

Editorial

The impact of the growth of day surgery on inpatient practice needs to be more actively considered than it has been to date by the medical profession and by healthcare planners. Clearly, a move to 60% of all cold surgery to day care will have a dramatic effect on the number of inpatient beds required to service a particular population. This downward pressure on the number of beds will be further accelerated by the reduction in the average length of inpatient stay that is also occurring. For example, in the general surgical department of my own hospital, which serves a population of about 222 000, the average length of inpatient stay in 1978 was 7.7 days, 4754 patients were operated on and 61 of these were dealt with on a day basis. The inpatient work was carried out in 140 inpatient beds. The surgical day unit at Kingston Hospital opened at the end of 1978. Its activity has grown steadily. By 1992 the surgical department had reduced its inpatient beds to 50, a total of 6734 surgical patients were treated and 69% of the cold work was undertaken on a day basis. Despite the increased complexity of the remaining inpatients the average length of inpatient stay fell to 5.3 days. This decrease has come about not only because of improvements in surgical techniques and management, but also because of a change in attitude towards the appropriate time of discharge resulting from experience of what can be achieved on a day basis.

There is no doubt that the trend to day care and the reduction of inpatient stay will continue. A point will be reached where the remaining inpatient facilities will be below the critical size necessary to provide flexibility for emergency admissions, specialized care and an income to support 24-hour nursing, medical and central services. As a consequence, inpatient units will need to be reduced in number and serve a larger population base.

This move to centralize inpatient care should not be accompanied by a similar move for day surgery. Freestanding day units in place of closed inpatient facilities could provide the majority of cold surgery close to where the patients live. However, in the future such units should not be confined to day surgery. They could also provide one or more of the following services: investigation facilities, day medical care, chemotherapy, hotel care, physiotherapy, etc. and might be placed on the same site as a primary care unit or a graduated care of the elderly facility. Thus, they would not be surgical day units but rather day hospitals. Such facilities have been termed intermediate care units or advanced urban or rural health care centres.

Such changes are inevitable, yet many managers and doctors are still planning and building new inpatient facilities or protecting existing ones which are redundant to need. Unless the health professionals change their thinking it will be impossible to convince the general public that a reduction in inpatient facilities is in their best interests both from the point of view of the quality of care and the most effective use of their health care taxes.

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Comment

Clinical indicators for quality assurance in ambulatory surgery

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Standards of day surgery services should be as high as traditional overnight-stay hospital services. Accreditation has been developed in some countries as a mechanism for quality assurance. Accreditation systems should centre on outcome rather than structure and process. In 1993 the National Day Surgery Committee of Australia prepared a list of clinical indicators for quality assurance in ambulatory surgery. These indicators have been briefly discussed. It would be ideal if a list of clinical indicators for ambulatory surgery, with worldwide support, could be prepared for universal application.

Key words: Clinical indicators, quality assurance, universal

The concept of ambulatory (day) surgery is now widely established throughout the world and, although it has been developed much more extensively in some countries than in others, it seems that organized, high standard ambulatory surgery is almost non-existent in some countries.

It is essential that the quality of healthcare in ambulatory surgery centres should be the same as that provided in traditional overnight-bed hospitals. There is, in fact, a body of opinion that the quality of healthcare may be higher in ambulatory surgery than in overnight-stay hospital surgery. An important element in the establishment and expansion of ambulatory surgery is the development of appropriate standards for the assurance of high-quality healthcare in these centres.

The design, structure, equipment and safety standards in ambulatory surgery centres are an essential part of the licensing of these centres, which is a responsibility of appropriate Government authorities (health department) and should be separate from any accreditation system. Some countries have introduced accreditation as a mechanism for the assurance of high-quality healthcare in these centres; although it seems that the present system of accreditation in these countries (e.g. USA and Australia) is excessively time consuming and expensive, with overemphasis on structure and process rather than quality of outcome.

During 1993 the National Day Surgery Committee of Australia carried out an intensive study of clinical indicators for quality assurance in ambulatory surgery centres and it would be ideal if some similar system could be developed for universal application. As a most important principle, any such system of clinical indicators should apply to all ambulatory surgery centres whether they be freestanding or within private or public hospitals. The clinical indicators identified by the National Day Surgery Committee are as follows, with some brief comments on their implications:

Cancellation on the day of surgery

This could be a decision by the patient for a very good reason, however it may be an indication of failure of the centre to provide appropriate instructions (e.g. medications), failure of the patient to understand the instructions (e.g. language difficulties) or a general lack of motivation and determination by the patient to have the operation.

Cancellation on the day of surgery may also occur when the patient is found to be unfit for anaesthesia following arrival at the centre. This may be due to an unrecognized concurrent medical problem, failure of the patient to carry out appropriate instructions concerning an unrelated condition or the development of an intercurrent illness immediately prior to the operation (e.g. upper respiratory tract infection, gastroenteritis).

In summary, there are a number of reasons for the cancellation of an operation on its planned day and some of these are unavoidable. Nevertheless, both the treating surgeon and the management of the ambulatory surgery centre should develop a simple, precise admission system

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to assist patients and minimize cancellation on the day of operation. In this context, the treating surgeon has an important role in the selection of appropriate patients for ambulatory surgery, with regard to both the procedure and the patient's fitness for anaesthesia.

Return to theatre

This indicator has universal application to both overnight-stay surgery as well as ambulatory surgery and would reflect the development of complications related to surgical technique, or the failure to detect co-existing, but possibly unrelated, pathology which would have an immediate adverse affect on the operation (e.g. a bleeding diathesis). The latter should be detected by the treating surgeon before the operation. There will always be the occasional unexpected operative complication but this should be a rare occurrence and emphasizes the importance of acquiring a surgical technique appropriate for ambulatory surgery. Ambulatory surgery requires a high level of surgical practice and skill, and the appropriate training of surgeons cannot be overemphasized.

Unplanned overnight admissions

It is accepted that a very small number of ambulatory surgery patients will require transfer for overnight(s) stay in hospital and the majority of these will be due to a major surgical or anaesthetic complication, requiring further surgery or ongoing postoperative management (intensive care). A significantly increased number of unplanned overnight admissions might be an indicator of inappropriate ambulatory surgery practice. The reasons are multifactorial and include unsatisfactory selection of patients by the surgeon (e.g. major operation and/or inexperienced surgeon), delayed recovery from the anaesthetic (the result of a variety of circumstances including high anaesthetic risk patients and/or inexperienced anaesthetist) and failure of the centre's management (accepting elderly patients with or without physical/medical infirmities and/or unsatisfactory home care back-up).

Delayed discharge

This indicator applies specifically to ambulatory surgery. For administrative purposes it can be defined as a period of more than six hours from the time of leaving the operating theatre and may be an indicator of unsuitable choice of procedure, unsuitable anaesthetic and/or inappropriate choice of patient. Since 'street fitness' after many procedures may be reached in as little as one hour or be considerably longer for other procedures, delayed discharge relates to the anticipated recovery time for each patient and procedure. It is essential to ensure a rapid recovery from the anaesthetic so that patients are

fit for discharge in an acceptable period of time from the operation. Any significant number of delayed discharges would seriously affect the throughput of patients in ambulatory surgery centres. The training of anaesthetists to develop appropriate anaesthetic techniques for ambulatory surgery is essential.

Three other clinical indicators were also considered but rejected as being impracticable or unsatisfactory for application to ambulatory surgery and those are as follows:

Infection requiring antibiotics. Notwithstanding that this is a classical indicator which is widely used as an important overnight(s)-stay hospital indicator, it was considered that collection of accurate data would be too difficult and time consuming as the patient will be at home and a number of alternative follow-up routes would be necessary – surgeons' rooms, outpatient clinics, casualty departments, general practitioners' rooms etc. In practice, most surgeons would inform the ambulatory surgery centre if there was an unusually high incidence of unanticipated wound infections. In summary, it was considered that collection of accurate and reliable data would be onerous and unreliable.

Postoperative deaths. It is highly unlikely that a patient would die in an ambulatory surgery centre. In most instances, postoperative death would occur at a later stage after transfer to a hospital intensive care unit or emergency department. Ambulatory surgery centres would be well aware of such an outcome, however the frequency should be so low as to preclude it as a practical clinical indicator.

Planned overnight admissions. This was considered to be incompatible with the concept of ambulatory surgery and should not be included.

The above-mentioned recommended clinical indicators are easy to identify and neither time consuming nor financially onerous. Furthermore, they would appear to be particularly appropriate to assess the quality of service and outcome of ambulatory surgery, having regard to the dominant principle of providing high quality, safe health care to patients.

These clinical indicators have not been introduced into Australia as yet, however they are under consideration by the organization responsible for accreditation (the Australian Council on Health Care Standards). It is not suggested that this is necessarily a complete or final list and other ambulatory surgery organizations may care to examine and identify appropriate indicators with the ultimate aim of producing an acceptable list of clinical indicators for universal application.

Review

Recent advances in ambulatory anaesthesia

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Outpatient surgery is no longer restricted to young, healthy patients having brief, minor procedures. Even high-risk patients may be acceptable candidates for ambulatory surgery if their systemic diseases are well controlled preoperatively. The development of new short-acting anaesthetics with fewer unpleasant side effects, innovations in pain management, and technological advances have all contributed to the dramatic growth of ambulatory surgery. Moreover, recent liberalization of fasting instructions for clear liquids and advances in antiemetic therapy have helped eliminate, or at least attenuate, some of the more unpleasant aspects of the anaesthetic-surgical experience. This paper highlights current practice in preoperative preparation, selection of anaesthetic techniques and agents, prevention and therapy of nausea and vomiting, and management of problems that present in the postanesthesia care unit (PACU).

Key words: Ambulatory surgery, patient selection, procedure selection, anaesthetic technique, fasting guidelines, antiemetic prophylaxis, preemptive analgesia, postoperative complications

Although the practice of outpatient surgery dates back to the early 20th century^{1,2}, as recently as 1980 ambulatory surgery accounted for only 16% of total operations performed in the United States. In the past 15 years, however, explosive growth has occurred, outpatient surgeries having increased from 3 million in 1980 to 11 million in 1990. Indeed, almost 60% of elective surgery in the United States is currently performed on an outpatient basis. The expansion, while impressive, of ambulatory surgery in Europe has not been as dramatic. In the United Kingdom, for example, ambulatory surgery accounts for approximately 20% of all operations.

Another significant development in the last decade has been the increasing popularity of freestanding ambulatory surgery centres (FASCs). Because FASCs are physically separate from the hospital with its associated support services, the types of operations that can be performed in FASCs are somewhat limited. Nonetheless, almost 20% of all outpatient surgery in the United States is currently performed in such centres³.

The stimuli for such exponential growth in day-care surgery are multiple and include cost containment, the

development of new short-acting anaesthetics with fewer unpleasant side effects, innovations in pain management, and technological advances. Clearly, the use of laser and endoscopy has dramatically affected how surgery is performed; the duration of postoperative recovery has been markedly truncated, and the quality of recovery has been rendered considerably more benign.

This paper will highlight four important areas of current concern in the subspecialty of outpatient anaesthesia: preoperative preparation; selection of techniques and agents; prevention and treatment of nausea and vomiting; and postanesthesia care unit (PACU) management.

Preoperative preparation

Screening, case selection, patient selection and testing

The era has passed when ambulatory surgery was reserved for American Society of Anesthesiologists (ASA) physical status I or II patients undergoing minor or superficial procedures of extremely brief duration. Medically stable physical status III, and occasionally even physical status IV, patients are candidates for outpatient surgery if their operative procedure is associated with both limited physiologic trespass and an uncomplicated recovery, and they reside in reasonable proximity to medical care. (In general, regardless of the patient's medical condition, appropriate ambulatory surgical procedures involve minimal blood loss or fluid shifts, produce only mild to moderate postoperative pain that

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can be adequately controlled by oral analgesics, and do not require invasive or prolonged monitoring.)

As the complexity of outpatient procedures and patients increases, screening patients has become essential to identify high-risk or inappropriate patients, to reduce inefficient, last-minute cancellations, and to minimize costly unanticipated postoperative hospital admission. Communication among patients, anaesthesiologists, surgeons, primary care physicians, and physician extenders is critical to the success of accomplishing these objectives.

Methods of preoperative screening include: health questionnaires, telephone interviews, presurgical facility visits, or a combination of these methods. Each institution must decide which approach best meets its needs. However, presurgical facility or clinic visits are becoming increasingly popular, perhaps because they provide 'one-stop shopping' for the patient. In this setting patients can confer with the anaesthesiologist, discuss postoperative pain management, undergo laboratory testing, and meet with the nursing staff to receive perioperative education. Clearly, most busy ambulatory surgery units will want to select some form of preoperative screening prior to the day of surgery to obtain the requisite medical, administrative, and financial information.

The patient's history and the findings from physical examination should determine which laboratory tests should be ordered. The ambulatory unit is not the place to screen for asymptomatic disease. Indeed, one decade ago Blue Cross/Blue Shield estimated that \$30 billion is spent on preoperative testing and evaluation in the United States. This insurance conglomerate claimed, moreover, that up to \$18 billion could be saved annually if only appropriate tests were performed⁴. In addition, unnecessary testing may increase potential malpractice exposure. False positive laboratory tests, for example, lead to augmented patient anxiety, increased operating room delays and other costs, and may result in invasive diagnostic tests and therapies that can actually injure patients. A recent retrospective study⁵ of 325 patients having nonselective preadmission testing prior to ambulatory surgery disclosed that at least one laboratory abnormality was noted in 84% of patients. Ninety-six per cent of the abnormal results were ignored by the attending physicians. It appeared that only 1% of patients potentially benefited from extensive testing. The authors concluded, therefore, that laboratory testing should be done selectively.

Clearly, medical staff and state regulations about preoperative testing must be fulfilled. However, as a routine in asymptomatic patients, only a haemoglobin or haematocrit is recommended in women under age 50. (Indeed, some centres will require no mandated tests for young, healthy patients). An electrocardiogram (ECG) is suggested for men >45 yr and for women >50 yr. A pregnancy test may be useful in women of childbearing age who are uncertain as to whether or not they might be pregnant⁶. In symptomatic patients, more extensive testing should be ordered, consistent with the patient's history and physical findings.

Table 1. Inappropriate outpatients

Psychosocial problems
Unwilling to participate
Unable to participate
Inadequate support network
Medical problems
Unstable disease
Acute substance abuse
Complex morbid obesity
High-risk former preterm infant

The inappropriate outpatient

As mentioned, ASA physical status III and IV patients may be candidates for ambulatory surgery if their systemic diseases are well controlled preoperatively and they are having relatively noninvasive procedures (e.g. cataract removal, carpal tunnel repair etc.). Indeed, in a prospective study, Natof discovered the incidence of perioperative complications in physical status III patients was not significantly different from patients without pre-existing disease⁷. Nonetheless, there are certain patients who are inappropriate candidates for outpatient surgery (Table 1). Exclusion categories may be psychosocial as well as medical. For example, anyone unable or unwilling to follow preoperative and postoperative instructions is unacceptable, as is an individual without a responsible adult to escort the patient home and help care for him or her postoperatively. Moreover, because of the possibility of acute untoward cardiovascular liability associated with anaesthesia in a patient who has recently abused illicit drugs, we preoperatively counsel these individuals and inform them that any signs of recent drug use will result in immediate cancellation on the day of surgery. We also encourage them to enrol in a rehabilitation programme.

Other inappropriate candidates include the medically unstable patient or the morbidly obese patient who has concomitant cardiorespiratory, hepatic, renal, vascular, or endocrine disease. Morbid obesity can be defined in a variety of ways, including a body mass index (BMI) >35. BMI is calculated as weight in kg divided by height in metres squared ($BMI = wt (kg)/ht (m^2)$). Alternatively, morbid obesity can also be defined as an actual body weight that is twice the ideal body weight for a given height and bone structure.

Age itself is not an exclusion criterion for the geriatric patient. More important than the actual chronological age is the physiological age and functional level of the patient. It is not at all uncommon to have nonagenarians on our outpatient surgery lists. Outcome studies have demonstrated minimal correlation between patient age and rate of perioperative complications^{8,9}. The ex-preterm infant, however, represents a high-risk group. These babies have a vulnerability to develop life-threatening apnoea, hypothermia and bradycardia as well as periodic breathing, perioperative aspiration, and laryngospasm. The age at which former preterm infants may be sufficiently mature for outpatient surgery varies, according to

Table 2. Premedication/preinduction options in children

Drug	Route	Dosage (mg kg ⁻¹)	Onset (min)	Comments
Midazolam	Intramuscular	0.1–0.2	<10	
Midazolam	Nasal	0.2	10	5 mg ml ⁻¹
Midazolam	Sublingual	0.2	10	Disguise bitter taste
Midazolam	Oral	0.5–1	15–20	Disguise bitter taste
Midazolam	Rectal	0.5–1	15–20	
Sufentanil	Nasal	0.002	10	Potential stiff chest
Fentanyl	Oral transmucosal fentanyl citrate	0.015–0.020	10–20	
Ketamine	Intramuscular	2–3; 'stun dose'	3	With atropine
Ketamine	Intramuscular	5–10; induction	3	With atropine
Ketamine	Oral	6–10	20	With atropine
Methohexital	Rectal	15–30	5–10	50–100 mg ml ⁻¹

From: Kallar SK, Everett LL. Controversies in ambulatory anesthesia: Premedication in adult and pediatric patients. *Anesthesiol Rev* 1992; **19**: 26–32, with permission.

the literature, from 44–60 weeks post-conception. Welborn and colleagues¹⁰ reported no postoperative apnoea or periodic breathing in babies without concomitant disease who were older than 44 weeks post-conception. Kurth and associates¹¹, however, documented cases of prolonged postanesthetic apnoea in former preterm infants whose postconceptual age was less than 55 weeks. Moreover, this potentially fatal complication occurred as late as 12 h following anaesthesia. Therefore, it seems prudent to admit patients less than 55 weeks postconceptual age so that they can be continuously monitored overnight for oxygen desaturation, apnoea, and bradycardia. The putative efficacy of intravenous (iv) caffeine to suppress postoperative apnoea in former preterm infants¹² does not mitigate this recommendation. In addition, fragile former preterm infants with a history of respiratory distress syndrome, bronchopulmonary dysplasia, ongoing apnoea, or postfeeding aspiration should be asymptomatic – regardless of postconceptual age – before being anaesthetized on an outpatient basis.

Many, if not most, anaesthesiologists at hospital-based ambulatory surgery facilities believe that malignant hyperthermia susceptibility (MHS) is not a contraindication to outpatient surgery, providing non-triggering agents are administered, and dantrolene is immediately available. Prophylactic use of dantrolene does not appear to be indicated¹³, and patients should be monitored postoperatively for 4–6 h. If their perioperative course is uncomplicated, MHS patients can be discharged home, following extensive and explicit instructions, provided they can be transported quickly to a medical facility should complications develop.

NPO instructions and aspiration prophylaxis

Several recent studies have demonstrated that gastric pH and volume are not affected deleteriously by allowing clear liquids up to 2–3 h before surgery^{14,15}. Therefore we permit our patients with normal gastrointestinal physiology by history to swallow unlimited amounts of clear liquids up to 3 h before surgery. 'Clear liquids' include water, coffee, tea or clear fruit juices such as apple juice or pulp-free orange juice. Moreover, because aspiration

is such a rare event in outpatient surgery¹⁶, we do not routinely administer either H₂ blockers or a combination of antacid and gastrokinetic agents to all our outpatients. If, however, the patient has a condition associated with an increased risk of aspiration (e.g., pregnancy, obesity, reflux, gastroparesis, etc.), it is our practice to administer ranitidine 150 mg orally the evening before and the morning of surgery, combined with metoclopramide 10 mg iv approximately 1 h prior to surgery. If logistical factors do not permit the administration of oral ranitidine, then we typically give iv metoclopramide 1 h preoperatively, followed by oral Bicitra 15 min prior to induction of anaesthesia.

Premedication

Often, pharmacologic premedication is not necessary for adults undergoing ambulatory surgery. The majority of adults do well with gentle reassurance coupled with a thorough explanation of what to expect perioperatively. An excessively anxious patient, however, may benefit from 2 or 3 mg of iv midazolam on arrival in the outpatient surgery unit, assuming that the patient is young, otherwise healthy, and can be appropriately monitored with pulse oximetry. With adults, preinduction medication is common. Short-acting benzodiazepines, such as midazolam, and/or short-acting opioids such as fentanyl 1–2 µg kg⁻¹ or alfentanil 6–10 µg kg⁻¹ iv prior to induction are highly effective in facilitating a smooth perianaesthetic course, without delaying awakening.

In children, premedication is often indicated, and a variety of premedication/preinduction options have been described by Kallar and Everett¹⁷ (Table 2).

Anaesthetic techniques and agents

A variety of anaesthetic techniques have been used successfully in the outpatient setting, and these include general anaesthesia, regional anaesthesia, and local infiltration anaesthesia with or without sedation, also known as monitored anaesthesia care (MAC). Proponents of general anaesthesia emphasize its controllability and the speed with which it can be induced. On the other

hand, partisans for regional anaesthesia underscore the postoperative analgesia and lack of emetic symptoms generally associated with its use. Clearly all techniques have advantages and disadvantages, and the selection of technique should be individualized. Factors influencing the decision include the medical history of the patient, surgical exigencies, and personal preferences of the patient, the surgeon, and the anaesthesiologist. To a certain extent, institutional factors will also affect the decision. For example, if adequate space (i.e. a separate block room with appropriate monitoring and resuscitation equipment) and support staff are unavailable, choice of regional blocks may need to be limited to those with a rapid onset time, such as Bier block and spinal for upper and lower extremity surgery respectively, rather than axillary and epidural blocks.

Regional anaesthesia

Upper extremity blocks

In most instances, intravenous regional anaesthesia (Bier block) with 40–50 ml of 0.5% lidocaine without epinephrine will provide adequate anaesthesia for hand and forearm surgery of less than 1 h duration. Although this block is easily and quickly executed, it typically affords somewhat less profound analgesia than axillary block and may require supplementation. Bupivacaine should not be used for Bier block because of the risk of fatal cardiotoxicity associated with excessively high blood levels¹⁸.

Axillary brachial plexus block provides excellent anaesthesia for a variety of hand and forearm procedures, with relatively few complications if toxic doses of local anaesthetics are avoided. Bourke and Furman¹⁹ recently reported the addition of morphine 0.1 mg kg⁻¹ to their local anaesthetic axillary block solution (0.55 ml kg⁻¹ of 1.5% lidocaine with epinephrine 1:200 000) provided enhanced postoperative analgesia without an increased frequency of side effects or major complications. The major disadvantage of axillary brachial plexus blockade is its relatively slow onset.

Interscalene blocks may be useful for outpatient shoulder arthroscopy and other minor shoulder procedures, but are somewhat less predictable for more distal procedures such as hand surgery. When performed carefully, complications of interscalene block are few. However, pneumothorax, intravascular injection, Horner's syndrome, recurrent laryngeal nerve block, subarachnoid injection, and epidural injection are all possible. Vertebral artery injection with subsequent reversible 'locked-in' syndrome has been reported following interscalene brachial plexus block²⁰. 'Locked-in' syndrome describes a state in which selective supranuclear motor deafferentation in the brain stem produces tetraplegia and paralysis of lower cranial nerves (causing aphonia) without obtunding consciousness. Vertical eye movements and blinking are the only voluntary movements the patient can perform. A recent study by Urmey et al.²¹ documented a 100% incidence of ipsilateral phrenic nerve blockade associated with inter-

scalene block. Although inconsequential in healthy patients, this hemidiaphragmatic paresis may lead to respiratory compromise in those with pre-existing pulmonary disease. Pregnant patients may also be vulnerable to respiratory compromise as evidenced by a recent case report of respiratory distress subsequent to supraclavicular block of the brachial plexus that produced unilateral diaphragmatic paralysis in a pregnant patient²². In addition, supraclavicular blocks are usually not recommended for outpatients because of the risk of pneumothorax.

Combinations of long-acting local anaesthetics and opioids or other analgesics have been used creatively to prolong postoperative analgesia. As long as the upper extremity is protected by a padded sling, there is no need to delay discharge of a competent patient until the effects of the upper extremity block dissipate.

Lower extremity blocks

For surgery of the pelvis or lower extremities, spinal anaesthesia is rapidly executed and effective. One of its major disadvantages is postdural puncture headache (PDPH). However, using the newer 'noncutting' needles, such as the Sprotte and Whitacre needles, the incidence of headache has been dramatically reduced (0–2% for the 25 gauge Whitacre; 0–8.2% for 22 or 24 gauge Sprotte needle)²³. Although these needles are considerably more expensive than Quincke tip needles, their use may be warranted, at least in young outpatients who are most vulnerable to PDPH (Table 3). Another concern is, of course, urinary retention. Therefore, the local anaesthetic administered should not unduly prolong recovery. Lidocaine (50–75 mg), for example, will typically provide adequate surgical anaesthesia for approximately 1½ h, whereas bupivacaine (12–15 mg) is generally reliable for operations lasting 2½ h or less. It is not unusual, however, for bupivacaine to produce urinary retention, especially in males older than 45 yr, for at least 6 h after completion of surgery. Therefore, the routine use of bupivacaine cannot be recommended for most ambulatory procedures. Rather, if a block recedes prior to completion of surgery, a brief mask anaesthetic can be administered, provided the patient has no risk factors for aspiration.

A major advantage of catheter epidural anaesthesia is the greater flexibility it affords in terms of duration of anaesthesia. However, epidural techniques require more time to achieve an adequate block than does spinal anaesthesia, and the incidence of inadvertent dural puncture with attempted epidural is in the 0.5–1% range. PDPH typically occurs in approximately 70–80% of such instances³¹, and an epidural blood patch is frequently indicated in this setting.

The '3 in 1' block (femoral, obturator, and lateral femoral cutaneous nerves can all be blocked using a single perivascular injection) has been employed for outpatient knee arthroscopy. However, simple infiltration of the portals with 1% lidocaine and instillation of 0.5% bupivacaine into the intra-articular space is also a highly

Table 3. Incidence of spinal headache after dural puncture

Study	Needle Size (gauge)					
	25 %	26 %	27 %	29 %	22 (Whitacre) %	24 (Sprotte) %
Flaaten, 1985 ²⁴	37 ^a					
Sarma, 1990 ²⁵	18 ^b	4.8 ^b				
Kang, 1992 ²⁶		11.9 ^c	1.8 ^c			
Dahl, 1990 ²⁷				2 ^d		
Snyder, 1989 ²⁸		25 ^e			4 ^e	
Sprotte, 1987 ²⁹						0.92
Mayer, 1992 ³⁰			2 ^e			2 ^e

^aAge range 26–46 yr; ^bAge range 18–87 yr; ^cAge < 40; ^dAge range 18–49 yr. ^eObstetrical patients. Reprinted with permission from Zarnsky R. Anesthesia for orthopedic surgery. In: McGoldrick KE ed. *Ambulatory Anesthesiology: A Problem-Oriented Approach*, Baltimore: Williams & Wilkins, in press.

Table 4. Properties of inhaled anaesthetics

Agent	Blood/gas partition coefficient	Vapour pressure (mmHg at 20°C)	MAC %	Stability
Nitrous oxide	0.46	39 000	105	Stable
Halothane	2.4	241	0.75	Stable
Enflurane	1.9	175	1.68	Stable
Isoflurane	1.4	238	1.15	Stable
Desflurane	0.42	673	6.0	Stable
Sevoflurane	0.6	162	1.71	Unstable

effective technique and simpler to execute. Moreover, femoral-sciatic blocks are of rather limited usefulness in outpatients because of slow onset and significant postoperative motor block that can impair ambulation.

Ankle blocks can be used for foot surgery, provided the surgeon can operate without a thigh tourniquet. Epinephrine should be omitted from the local anaesthetic solution because of the proximity of injection sites to vessels supplying the digits. Although Bier blocks have been described, using a thigh tourniquet, for surgery on the lower limb, large volumes (75–100 ml) of local anaesthetic are required. Thus, toxicity could occur in the event of inadvertent tourniquet deflation early in the operative course.

General anaesthesia

In addition to safety, the anaesthetist must be concerned with rapid return of preoperative levels of function that will permit discharge on the same day. Several recent additions to our anaesthetic armamentarium have favourable pharmacokinetic profiles that facilitate our objectives of safety, rapid recovery, and minimal side effects. These drugs include both inhalational and intravenous agents.

Inhalational agents

Isoflurane and enflurane traditionally have been used successfully in outpatient surgery. An exciting question for the future is how desflurane and sevoflurane will affect our anaesthetic practice, given their decreased

blood solubility and the associated prospect of more rapid emergence (Table 4).

Desflurane (I-653) is a fluorinated methyl-ethyl ether whose structure differs only slightly from isoflurane. Its low blood-gas partition coefficient (0.42) results in a rapid onset and recovery. Because of its pungent odour, however, desflurane produces varying degrees of airway irritation during induction. Although desflurane is less potent than the other volatile agents (e.g. MAC of 5–7% alone and MAC of 2–4% with fentanyl-thiopental-N₂O), it undergoes minimal (if any) metabolism, produces no unusual clinical toxicity, and is stable in the presence of soda lime. Similar to other volatile agents, desflurane appears to produce dose-related cardiovascular and respiratory depression. It has been suggested, however, that desflurane, unlike isoflurane, when combined with nitrous oxide may lead to an activation of beta-adrenergic activity as is seen with diethyl-ether³². Recently, Ebert and Muzi³³ also reported sympathetic hyperactivity during desflurane administration to healthy volunteers. The effects of desflurane on the cardiac response to catecholamines³⁴ are similar to those seen with isoflurane. Desflurane is an extremely volatile agent with a boiling point of 23°C. Because the concentration of gas within the vaporizer is exquisitely temperature-dependent, a specialized vaporizer is necessary.

Sevoflurane is a methyl-isopropyl ether whose solubility in blood approaches that of nitrous oxide. Induction of anaesthesia with sevoflurane is achieved rapidly and smoothly; coughing and breath holding are not the problems they are with isoflurane and desflurane. The MAC of sevoflurane in humans is 1.71% without nitrous

oxide and 0.66% with 65% nitrous oxide³⁵. Sevoflurane appears to cause somewhat less haemodynamic perturbation than isoflurane in terms of blood pressure reduction. Heart rate appears to decrease rather than increase³⁶, and the arrhythmogenic dose of epinephrine exceeds that associated with isoflurane³⁷.

Unfortunately, sevoflurane appears to be unstable under both *in vivo* and *in vitro* conditions. The *in vitro* degradation of sevoflurane by soda lime does not appear to produce toxic metabolites³⁸. Although *in vivo* degradation is enhanced by hepatic enzyme induction, studies in enzyme-induced rats, with or without concomitant hypoxia, have been unable to document hepatic or renal injury³⁹⁻⁴¹. Typical plasma fluoride levels after sevoflurane administration to outpatients are in the range of 15–30 μM , considerably below the level associated with nephrotoxicity. The incidence of postoperative nausea and vomiting after sevoflurane is similar to that encountered with the other inhaled agents, including desflurane.

Intravenous agents

Propofol is an exciting drug from the alkyl-phenol family that has been formulated as an emulsion in an intralipid-type substance. Propofol can be used for induction of anaesthesia, maintenance of anaesthesia, or, in smaller doses, for conscious sedation. Important advantages associated with propofol as an induction agent include its rapid elimination and its lower incidence of such perioperative complications as nausea, vomiting, hiccoughing, and excitatory movement compared to thio-pental, etomidate, or methohexital. Disadvantages include pain on injection and the potential for significant cardiovascular depression when given rapidly to elderly or fragile patients. Injection pain can be minimized by using larger forearm or antecubital veins rather than small dorsal hand veins. Alternatively, 2 or 3 ml of 1% lidocaine can be administered prior to propofol. Haemodynamic changes can be obtunded by using reduced doses and injecting more slowly in elderly or debilitated patients.

A variety of infusion schemes and devices exist for delivering continuous drug infusions. These work best for drugs with relatively short half-lives such as propofol, midazolam, and alfentanil. Even following a loading dose, a rapid rate of infusion will be required initially to maintain a constant blood level because the process of distribution rapidly removes the drug from the circulation. As the distribution phase nears completion, the rate of infusion can be slowed to approximate drug clearance. Although considerable interpatient variability exists with regard to desirable infusion rates, a variable-rate infusion of propofol ranging from 50–150 $\mu\text{g kg}^{-1} \text{min}^{-1}$ in combination with 70% N_2O generally results in a smooth intraoperative course and rapid recovery for patients undergoing brief procedures. The concomitant use of an inhalation agent, an opioid, or a benzodiazepine can affect dose requirements for propofol and subsequent emergence time.

Although some studies suggest that propofol can sig-

nificantly decrease recovery time, and therefore be cost effective, more data are needed to compare propofol's recovery profile with traditional anaesthetic agents and techniques. The prolonged recovery reported after inhaled drugs may be due to the hangover effect of thio-pental⁴². In two recent studies where isoflurane anaesthesia was induced with propofol, recovery was as fast as with propofol alone in patients undergoing outpatient gynaecologic laparoscopies⁴³ and in patients undergoing arthroscopic procedures of the knee⁴⁴. Whether propofol actually possesses antiemetic properties also needs to be investigated further. One postulated mechanism is that propofol may increase prolactin levels and thus antagonize dopamine-2-(D_2) receptors⁴⁵.

Midazolam is a short-acting benzodiazepine that has strong amnestic properties. In 2–3 mg iv doses, midazolam is often used as part of a co-induction technique with propofol. The availability of flumazenil, a specific benzodiazepine antagonist, can promptly reverse any residual sedative or amnestic effects. Flumazenil should be given slowly iv in 0.2 mg incremental doses, up to a total dose of 0.8–1.0 mg.

Alfentanil, a less potent fentanyl derivative, has a more rapid onset and a shorter duration of action than either fentanyl or sufentanil. Alfentanil's limited ionization, reduced lipid solubility, small volume of distribution, and short elimination half-life (60–90 min) reduce its potential for accumulation in lipid storage sites. Its major disadvantages include its emetogenic properties and its potential for causing laryngeal and chest wall rigidity. Remifentanyl (an ultra-short-acting fentanyl derivative) is currently undergoing extensive clinical evaluation during both general anaesthesia and MAC in the outpatient setting.

The concept of pre-emptive analgesia is an important clinical issue. When administering general anaesthesia, it is important to appreciate the suggestion that iv analgesia or local anaesthetic infiltration or blocks given prior to the onset of surgical incision may be more efficacious than if administered after the onset of pain⁴⁶. Prophylactic treatment to prevent receptor activation locally and within the neuraxis may alter transmission of pain to reduce analgesic requirements. This phenomenon is known as neuroplasticity. In addition, a number of studies have suggested that pretreatment with rectal acetaminophen or nonsteroidal anti-inflammatory drugs⁴⁸ (NSAIDs) such as rectal ibuprofen⁴⁷, indomethacin or parenteral ketorolac⁴⁸ administered prior to surgery results in superior analgesia to that from similar drugs given later. Moreover, α_2 -agonists (e.g. clonidine, dexmedetomidine) can be administered iv for premedication to reduce both iv and inhaled anaesthetic requirements. These adjunctive drugs also appear to decrease postoperative analgesic requirements.

Mivacurium is a short-acting nondepolarizing bis-benzyl-isoquinolinium muscle relaxant that undergoes rapid hydrolysis by plasma cholinesterase. Owing to this extensive metabolic breakdown, mivacurium has a high clearance rate and brief elimination half-life. The ED_{95} dose of 0.08 mg kg^{-1} produces maximum blockade in approx-

imately 4 min with spontaneous recovery to 95% of control of the first twitch height in approximately 25 min. A dose of 0.2–0.25 mg kg⁻¹ for intubation shortens onset time to approximately 2 min; spontaneous recovery to 95% of control takes about 30 min⁴⁹. Intubation doses of mivacurium have approximately twice the duration of doses of succinylcholine and half those of vecuronium and atracurium. Ali and coworkers⁵⁰ have recommended continuous infusion of mivacurium when rapid spontaneous recovery from neuromuscular blockade at the termination of surgery is desirable. Continuous infusion should be initiated at a rate of 10 µg kg⁻¹ min⁻¹ and titrated to maintain 90–95% twitch suppression. Preliminary studies suggest that mivacurium may reduce the incidence of postoperative myalgias compared to succinylcholine, as well as nausea and vomiting, following outpatient procedures. Avoidance of reversal drugs such as neostigmine may also reduce the incidence of postoperative emesis. A potential disadvantage of mivacurium is its weak histamine-releasing properties that can be obtunded by administering bolus doses over 90 s and by avoiding overdoses.

Several new vecuronium derivatives are currently under active clinical investigation, including rocuronium (ORG 9426) that seems to have a more rapid onset than vecuronium. The investigational drugs ORG 7617 and 9616 have onset and recovery profiles that approach those of succinylcholine. However, concern has been expressed about acute haemodynamic changes associated with these investigational agents.

Monitored anaesthesia care (MAC)

A frequently performed service in the outpatient setting, MAC involves monitoring a surgical patient and may or may not involve administration of analgesics, sedatives, and other medication. In certain instances, MAC is an adjunct to local anaesthesia performed by the surgeon because the medical status of the patient is fragile.

Satisfactory sedation can typically be achieved with either propofol, midazolam, or barbiturates. A short-acting opioid may be indicated for analgesia. However, the co-administration of opioids increases the likelihood of somnolence and respiratory depression⁵¹.

The recently approved eutectic mixture of local anaesthetics (EMLA) has been an asset for certain procedures commonly performed with MAC. EMLA, for example, has been shown to provide surface analgesia for shock-wave and laser-induced pain. Therefore, this topical ointment is gaining popularity for lithotripsy, dermatologic, and certain other superficial outpatient procedures. It is important, however, to appreciate that EMLA has a slow onset and must be applied at least one hour prior to surgical stimulation.

Prevention of nausea and vomiting

When asked which postoperative symptoms they considered the worst, patients chose nausea and vomiting most commonly and were prepared to tolerate increased

pain, sedation or dysphoria to avoid this symptom⁵². In another survey, uncontrolled vomiting was responsible for almost 20% of unanticipated hospital admissions after ambulatory surgery⁵³. At a time when many other complications of anaesthesia have been minimized, perioperative nausea and vomiting (PONV) is still a problem in up to 70% of patients undergoing ambulatory surgery under general anaesthesia⁵⁴.

Avoidance of predisposing factors

Unfortunately many of the predisposing factors for PONV are outside the control of the anaesthesiologist. These factors include younger age, female gender, ASA physical status categories I and II, elective surgery and longer duration of anaesthesia⁵⁵. However, many factors related to anaesthetic technique have been shown to increase the incidence of PONV; these include the use of general anaesthesia as opposed to regional⁵⁶, the use of opioids, and, perhaps, the use of N₂O or neostigmine^{57–59}, an inexperienced anaesthesiologist⁶⁰, pain⁶¹, and early feeding⁶². No consistent differences have been shown between equi-analgesic doses of different opioids, although in an individual patient there may be important differences in the emetic effects of different opioids. Partial-agonist opioids increase the incidence of PONV⁶³. The use of propofol has a major beneficial effect on the incidence of PONV⁵⁸; it is possible that findings from studies in which propofol was not used may not be relevant to current practice in ambulatory surgery where propofol is used almost universally.

Prophylaxis

No currently available drugs act on the emetic centre, the final control centre for vomiting in the brain stem. Drug therapy aims to modify sensory input by acting on the chemoreceptor trigger zone where many of the afferent impulses to the emetic centre originate. Currently available anti-emetic agents act predominately on either dopaminergic, cholinergic, histaminic or 5-HT₃ receptors. Prochlorperazine, perphenazine, droperidol (dopamine antagonists), hyoscine (cholinergic antagonist), cyclizine, promethazine (histamine antagonists), and ondansetron (5-HT₃ antagonist) have all been shown convincingly to provide effective prophylaxis against PONV^{54,64}. Data are conflicting regarding the efficacy of another commonly used agent, metoclopramide, possibly because of its short duration of action⁶⁴.

Comparative studies of the efficacy of these agents are rare; a number of recent studies have confirmed the greater efficacy of droperidol compared to metoclopramide⁶⁴. Ondansetron 8 mg was found to be more effective than droperidol 1.25 mg in preventing PONV⁶⁵, but another study from the same author found ondansetron 4 mg to be less effective than droperidol 1.25 mg⁶⁶, with no difference between the groups in sedation or well-being scores. Further comparative studies are needed to determine the optimal agent and dose for prophylaxis of PONV.

These agents, with the exception of cyclizine and ondansetron, are associated with a significant incidence of side effects, particularly sedation (leading to delayed recovery from anaesthesia) and occasional extra-pyramidal reactions. Dysphoria is a particular problem with droperidol; 23% of patients who had received 1.25 mg of droperidol⁶⁷ complained of feelings of anxiety after surgery compared to none of the controls. Nevertheless the use of prophylactic anti-emetics may speed recovery by preventing PONV^{68,69}.

There are theoretical advantages in using agents which block different receptors in the chemoreceptor trigger zone and this is well recognized in cancer chemotherapy patients. Only one study has confirmed this for PONV; metoclopramide combined with droperidol gave more effective prophylaxis than droperidol alone⁷⁰. Novel approaches to the problem of PONV include the use of ephedrine⁷¹, of transdermal sustained-release hyoscine and of acupuncture⁷². To date there are few data on the efficacy of ephedrine; its cardiovascular effects and short duration of action are likely to limit its usefulness. Transdermal hyoscine seems to be moderately effective provided it is applied several hours before the end of surgery, and it has a low incidence of side effects⁶⁴. However, one study in children undergoing eye surgery reported that scopolamine was ineffective and produced an unacceptably high incidence of behavioural side effects typical of belladonna alkaloids, including hallucinations and extreme agitation⁷³. Studies of the efficacy of acupuncture in preventing PONV have had conflicting results and its place in ambulatory practice is uncertain.

The decision to use prophylactic anti-emetics must be individualized for each patient. The incidence of PONV varies from less than 10% in patients undergoing minor procedures under propofol anaesthesia^{74,75} to 71% in female patients undergoing laparoscopy under thiopentone/N₂O/volatile agent anaesthesia⁵⁴. Few data are available on whether prophylactic anti-emetics are beneficial after the use of propofol; Watcha et al. showed that droperidol decreased the incidence of vomiting from 60 to 43% after propofol/N₂O anaesthesia for strabismus surgery (failing to achieve statistical significance)⁷⁶. The side-effects of anti-emetics are a particular concern in ambulatory care patients. The individual anaesthesiologist must decide whether to use prophylactic anti-emetics routinely or to reserve them for patients at high risk of PONV.

To summarize our approach to a patient at high-risk of PONV after ambulatory surgery, we use regional anaesthesia if possible. If general anaesthesia is necessary, we use propofol as the induction agent and maintain anaesthesia with a volatile agent or propofol without N₂O. We supplement anaesthesia with small doses of fentanyl (1–2 µg kg⁻¹) and provide additional intraoperative and postoperative analgesia by NSAIDs or regional block if appropriate. We use droperidol 20 µg kg⁻¹ as prophylaxis, a dose which decreases PONV without prolonging recovery⁶⁸. We use parenteral opioids for postoperative analgesia only when absolutely necessary.

We delay ambulation and do not insist on intake of oral fluids as a requirement for discharge.

Treatment

Fewer studies have looked at the treatment of established PONV but the available evidence confirms that agents which provide effective prophylaxis against PONV are also effective in its treatment. Ondansetron, prochlorperazine, droperidol and cyclizine have been shown to be more effective than placebo in treating established PONV^{77–79}. With the exception of ondansetron all of these have the potential to cause sedation and delayed recovery, especially droperidol. An original approach to the problem of PONV was the use of sub-anaesthetic doses of propofol as treatment⁸⁰. While boluses of 10 mg propofol were effective in 81% of cases vs. 35% for placebo, the incidence of nausea or vomiting was similar in both groups 30 min later.

Our current practice is to use cyclizine or prochlorperazine as first choice anti-emetic and use ondansetron if this is not effective. The chief (and arguably only) disadvantage of ondansetron is its price (4 mg costs IR£9.68 or US\$17.00), but this amount is worthwhile if the patient can leave the hospital a number of hours earlier. Clearly, ondansetron is cheap when compared to the cost of overnight hospitalization.

Postanaesthesia care unit management

The aims of the recovery period after ambulatory surgery are to provide patient safety and comfort while minimizing costs. This requires rapid recovery without complications to allow early discharge and early return to work. The introduction of new drugs and anaesthetic techniques has revolutionized this area. Thus the rate of unanticipated hospital admission after ambulatory surgery, a key indicator of quality of care, has remained about 1% despite the increasing complexity of the procedures performed⁵³. The reason for admission in 40% of the cases in the study by Gold and colleagues⁵³ was surgical; representative problems included bleeding, perforated uterus, extensive surgery, etc. The causes of the remaining 60% could have been related to anaesthesia. The commonest findings were uncontrolled pain (18% of all admissions), intractable vomiting (17%), urinary retention (5%), postoperative somnolence (3%), aspiration pneumonia (3%), and suspected myocardial infarction (3%). Factors found to increase the likelihood of hospital admission were the administration of a general anaesthetic, site of surgery (laparoscopy or abdominal surgery), an operating room time > 1 h, the occurrence of emesis, an ASA physical status of 2 or greater, and living more than 1 h drive from the hospital.

Another key indicator of quality of anaesthesia is the time from the end of anaesthesia until discharge. Anaesthetic factors which influence recovery time include: (i) premedication with narcotics, benzodiazepines, vagolytics; (ii) the choice of anaesthetic agents (thiopentone vs. propofol, opiates vs. volatile agents⁸¹ etc.); (iii) the use of

anti-emetics e.g. droperidol⁸²; and (iv) the use of general vs. local anaesthesia⁸³. There has been interest in the use of specific antagonists to anaesthetic agents to speed recovery. Flumazenil shortened recovery time after midazolam sedation (65 vs. 87 min). However, this combination had no advantage over propofol for sedation^{84, 85}.

Pain control is a challenge in the ambulatory setting; potent parenteral narcotics cause sedation and PONV and are used only as a last resort. Using regional anaesthesia for surgery provides analgesia in the early post-operative period. Analgesia may be provided by regional bupivacaine or opiates^{86, 87}. Nonsteroidal anti-inflammatory agents (diclofenac in Europe and ketorolac in the United States) provide analgesia without emesis⁸⁸ and may be given rectally or parenterally. A variety of oral analgesics may be used once the patient can tolerate oral fluids. If pain is uncontrolled by these methods, our approach is to relieve pain with intravenous fentanyl in the hope that other methods of analgesia will have acted before fentanyl wears off.

Recovery after ambulatory surgery may be considered as occurring in three stages: (i) phase 1 – recumbent (patient requires bed); (ii) phase 2 – sitting (patient rests in supervised area), (iii) at home. Criteria are needed to decide when patients may progress between these stages. Formal psychomotor tests may be performed but these are unnecessarily complex, time consuming, and require training. Thus they are usually reserved for research applications.

Clinical criteria are adequate and easy to use without special training. Patients may be transferred to phase 2 recovery when they are: (i) fully awake and oriented and (ii) able to stand and walk⁸⁹. Criteria used to assess fitness for discharge home after general anaesthesia have been described by White⁹⁰. These comprise: (i) stable vital signs > 30 min; (ii) no new signs of symptoms postop; (iii) no bleeding; (iv) minimal nausea; (v) intact neural and circulatory function in operated limb; (vi) normal micturition (if a pelvic procedure was performed); (vii) oriented in person, time and space; (viii) no dizziness after > 10 min sitting; (ix) pain controlled on oral analgesics; and (x) accompanied by a responsible escort. If lower extremity regional anaesthesia was used, normal muscle strength, normal sensation and, after perispinal anaesthesia, ability to micturate must have returned. As mentioned in the section on PONV, ability to tolerate oral fluids is not now considered essential for discharge⁶². It is considered acceptable to have fitness for discharge decided by a nurse applying these criteria rather than requiring examination by a doctor⁹⁰.

Discharge criteria are important for clinical and medicolegal reasons and should be documented as having been fulfilled by the patient. Other medicolegal considerations include providing written instructions for the patient concerning acceptable activities and postoperative care and providing emergency contact numbers in the event of a problem.

Audit is vital to check a unit's performance and to maintain standards. Mortality should be virtually nonex-

istent. Other indicators of quality of ambulatory anaesthesia are the rate of complications (in recovery and as elicited on telephone follow-up 24 h after surgery), the duration of stay in the recovery ward and the rate of unanticipated hospital admission (see above). Telephone follow-up is important to detect problems which occur after patients go home.

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Review

Adverse outcomes in outpatient anesthesia

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Day surgery, with its lower hospital costs, is increasing rapidly. The major challenge facing outpatient anesthesia care is to give the perfect outpatient anesthetic so that our patients do not have any adverse outcomes. Assessment of risk in surgical outpatients has been extrapolated largely from experience with inpatients. Further studies of adverse outcomes in outpatient anesthesia are warranted.

Key words: Anesthesia: outpatients, adverse outcomes

Day surgery with its lower hospital costs, now accounts for 60–70% of surgery performed in North America. The major challenge facing outpatient anesthesia care is to maintain favourable patient outcomes. In order to provide optimal anesthesia and superb outcome, we must understand the adverse outcomes of outpatient anesthesia.

Outpatient mortality

In the past 30 years, the anesthetic-related death rate has been approximately 1–2 10 000⁻¹ inpatients receiving anesthesia¹. The overall death rate associated with outpatient surgical care has been substantially lower^{2–6}. A weakness in all of these studies is that they relied on voluntary retrospective reporting from different centres. Recently, the Federated Ambulatory Surgery Association data was updated to include 1.1 million ambulatory anesthetic cases. There were 17 deaths for an incidence of 0.15 10 000⁻¹ cases⁷. Therefore the mortality rate is lower in outpatient anesthesia.

Complications

A major complication is defined as an untoward response or abnormal condition having the potential for serious harm. A minor complication is defined as an

untoward response with minimal or no potential for serious harm⁸. Major complications include hemorrhage, infection, serious anesthetic complications, persistent nausea and vomiting and any medical problem that requires hospitalization. Minor complications include transient nausea and vomiting, weakness, headache, myalgia, sore throat and dizziness⁸.

Adverse outcomes: specific predictors

There are very few studies on complications after outpatient anesthesia. In a prospective study of 13 433 patients at a freestanding ambulatory surgical centre, 106 medical, surgical or anesthetic complications were identified in the patient population⁹.

In a study of 1553 outpatients, Meridy found that the surgical procedure and the extremes of age affected neither the duration of recovery nor the rate of complications¹⁰. The rate of intraoperative events was 50 1000⁻¹ anesthetics (5%). Significant swings in blood pressure were experienced by 1.6% of patients, 0.5% of patients were difficult to intubate and 1.3% of patients had respiratory-related events. The most common Postanesthesia Care Unit (PACU) event was nausea and vomiting, 7.3%. In the PACU, 0.3% of patients had considerable variation in blood pressure and 0.43% had a respiratory-related event¹¹.

Despite the rapid growth in ambulatory surgery, many traditional predictors of adverse anesthetic-related outcomes have not been examined critically in outpatients. Assessment of risk in surgical outpatients has been extrapolated largely from experience with inpatients¹². There is a need to do prospective outcome in outpatients.

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ASA physical status

Is American Society of Anesthesiologists (ASA) physical status a specific risk factor for outpatients? In a survey of complications among 112 000 adults, ASA physical status score was an independent predictor of intraoperative and major postoperative complications after controlling for age, gender, number of preoperative medical conditions, type of anesthesia and surgery¹³. However, there was no correlation between advanced ASA physical status and hospital admission^{9,14,15}.

Age

Is age a specific risk factor for outpatient anesthesia? Infants are at greater risk for anesthetic morbidity. Infants less than 1 year of age had a nine-fold higher risk of anesthetic morbidity than older children. At what point should infants be considered for outpatient surgery? Unfortunately, there is no available scientific data to assist the clinician on this issue. Each case must be decided based on the clinician's evaluation of the infant, the parents and the medical situation. Berry accepted full-term infants at 2 weeks¹⁶. Premature infants are not suitable for outpatient surgery as they are more prone to complications of apnoea and bradycardia than term infants¹⁷.

Are elderly patients at higher risk for outpatient anesthesia? Advanced age is independently associated with an increased likelihood of admission in ambulatory patients (odds ratio 2.6)¹⁴. In a survey of elderly patients undergoing outpatient cataract surgery with conscious sedation, the admission rate was 18%. The age of patients admitted to the hospital was significantly greater than those not requiring admission¹⁸. We will need more specific data on geriatric outpatients as increasing numbers of surgical procedures in the elderly are being done on an outpatient basis.

Preoperative medical conditions

Duncan et al. studied 6914 adult outpatients. The relationship between adverse events and preoperative factors were determined by using a multiple logistic regression that included age, sex, duration of the procedure, and the hospital care. Major morbid events were infrequent. Patients' preoperative disease was predictive of some intraoperative events relating to the same organ system, but not to events in the PACU. Patients with preoperative respiratory problems such as asthma or chronic obstructive pulmonary disease were at higher risk for intraoperative complications, especially lower respiratory events. Similarly, those with preoperative hypertensive diseases were more likely to have difficulties with blood pressure control¹¹. Patients judged obese, or inadequately fasted, were found to experience a greater rate of recovery problems as well as discomfort¹¹.

Persistent symptoms after outpatient anesthesia

The majority of patients can be discharged within 1–2 h after outpatient anesthesia (80%). About 96% of patients can be discharged within 3 h after outpatient anesthesia. We studied 500 patients prospectively in our outpatient unit. Four per cent of patients had persistent symptoms delaying discharge. Patients who underwent surgical procedures (laparoscopy, arthroscopy, general surgery) had a six-fold increased risk of developing persistent symptoms as compared to patients who underwent cataract extraction or dilatation and curettage (D&C)¹⁹. The group with persistent symptoms had significantly longer duration of anesthesia as compared to the group with no persistent symptoms (68.2 ± 6.0 min vs. 41.7 ± 1.3 min)¹⁹.

The persistent symptoms delaying discharge were due to persistent pain, nausea/vomiting, hypotension, and unsteady gait¹⁹. Patients with persistent symptoms and who were subsequently sent home reported a significantly higher incidence of nausea/vomiting, dizziness, drowsiness, hoarseness, sore throat and incisional pain than patients who did not manifest persistent symptoms¹⁹.

Delayed discharge after outpatient anesthesia

In our prospective study of 500 patients discharged after outpatient anesthesia, we found that 54% had delayed discharge²⁰. The majority of delays were due to the patient's escort not being immediately available (50%). Some delays were due to recurrent pain after home-readiness criteria was met²⁰. Thus, better pain management and ensuring the immediate availability of a companion would ensure a more cost-effective ambulatory surgical unit²⁰.

24-hour adverse outcomes

In the healthy patient, minor adverse outcomes after outpatient anesthesia can be disturbing as this will affect daily living function and work readiness. We have studied the 24-h adverse outcomes of 777 patients. Incisional pain, headache, drowsiness and dizziness were the most common complaints reported occurring in 26.5, 11.6, 11.5 and 9.7% of cases, respectively. The incidence of nausea/vomiting, fever and injection site pain was found to be 7.1, 5 and 2.1%, respectively²¹.

We found that at least one adverse outcome was 3.5 times greater after general anesthesia, 2.5 times greater after a non-gynecological procedure and 1.8 times greater if anesthesia exceeded 60 min. Age, gender and ASA class were not found to be statistically significant²². The relationship of a number of demographic variables to common day surgery adverse outcomes are shown in Table 1.

Table 1. Adverse outcomes related to demographic variables

Outcome event	Multiple logistic regression Factor	Odds ratio
1. At least 1 complication	General anesthesia	3.5 [†]
	Non-gyne procedure	2.5 [†]
2. Nausea & vomiting	Anes. duration > 60 min	1.8 [†]
	General anesthesia	4.4*
3. Pain, incision site	Anes. duration > 60 min	2.3*
	Non-gyne procedure	2.1*
4. Dizziness	Non-gyne procedure	4.4 [†]
	General anesthesia	3.7 [†]
5. Drowsiness	Anes. duration > 60 min	1.9*
	General anesthesia	13.2*
6. Fever	Anes. duration > 60 min	3.5 [†]
	Gender = female	2.7*
7. Bleeding	Age < 50	16.7 [†]
	Anes. duration > 60 min	2.6 [†]
6. Fever	Anes. duration > 60 min	2.2*
	Gyne procedure	3.4 [†]
7. Bleeding	Gyne procedure	3.4 [†]
	Anes. duration > 60 min	2.1*

* $P < 0.05$; [†] $P < 0.01$

Unanticipated hospital admission

Unexpected hospital admission following ambulatory surgery has been used as an index of outpatient morbidity and complications. The incidence of unanticipated admission rates varies between 0.1 and 5%^{10,23}. The Phoenix Surgicenter found that their admission rates increased from 0.2% overall to 0.6% for patients over the age of 64 yr²⁴, whereas Meridy retrospectively found no relationship between age, duration of anesthesia or PACU stay and the need for admission¹⁰. Patel and Hannallah reported an incidence of admission of 0.9%. One third of these admissions were for protracted vomiting²⁵. In a case control study among 9616 patients, factors identified to be associated with an increased likelihood of admission were general anesthesia, abdominal procedures, lengthy procedures, postoperative vomiting and age¹⁴. Thus hospital admission appears to be a function of the surgical procedure such as type of surgery, type of anesthesia and length of procedure. It may be related to age, but possibly not to ASA physical status.

Levy reported that unanticipated admission due to more extensive surgery than anticipated or surgical misadventure accounted for 63.2% of the admissions. Pre-existing medical diseases and perioperative complications accounted for 19.9%. Anesthesia-related reasons such as persistent nausea and vomiting, and prolonged somnolence accounted for 12.2%, and social reasons, 4.7% of unanticipated admissions²³.

Conclusion

The safe and expeditious conduct of outpatient surgical care can only succeed by careful selection of patients and surgical procedures, appropriate intraoperative and postoperative anesthetic care and prudent and timely discharge of patients. The challenge is to give the perfect

outpatient anesthetic so that our patients do not have any adverse outcomes.

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THE BRITISH ASSOCIATION OF DAY SURGERY
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Review

Outpatient tonsillectomy and adenoidectomy: avoiding complications

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Especially during the last decade, tonsillectomy and adenoidectomy (T&A) have been performed increasingly in outpatient surgery facilities. Although complications following T&A are infrequent, they can be serious and have a precipitous onset. Hemorrhage and acute airway obstruction are among the most feared sequelae, and certain patterns have emerged depicting the circumstances under which these complications are more likely to happen. Other postoperative problems include fever, recurrent emesis, and poor oral fluid intake. To avoid unanticipated postoperative admissions, patients should be carefully selected and then observed for a minimum of 6 h following surgery. An individual with a history of obstructive sleep apnea is an inappropriate candidate for outpatient T&A. In addition, children younger than 3 yr are more likely to require postoperative hospitalization owing to such problems as respiratory distress and dehydration than older children.

Key words: Outpatient, ambulatory, tonsillectomy and adenoidectomy, complications

Introduction

With each passing year, the list of surgical operations designated as 'outpatient' continues to grow. These mandated decisions by insurers tend, not surprisingly, to emphasize a rigid, procedure-oriented approach rather than to consider the extenuating or modifying aspects of an individual patient's medical condition. Especially during the last decade, tonsillectomy and adenoidectomy (T&A) have been performed increasingly in the outpatient arena, owing in no small part to economic pressures. Indeed, by the mid 1980s, 10 states mandated outpatient surgery for tonsillectomy, although medical exemptions to this policy were available in every state.

Fortunately, complications following T&A are infrequent. Nonetheless, they tend to be serious and have a precipitous onset. Hemorrhage and acute airway obstruction are among the most dreaded sequelae, and certain patterns have emerged describing the settings in which these complications are more likely to occur. Other postoperative problems include fever, recurrent emesis, and poor oral fluid intake (Table 1). This brief overview will present some salient features concerning patient selection and clinical management, including

Table 1. Percentage of complications following T&A

Complication	1st 6 postop. hrs	6–24 postop. hrs
Significant hemorrhage	0.7	0.4
Fever	0.7	0.7
Protracted emesis	0.7	0.6
Total	2.1	1.7

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duration of postoperative observation, that are designed to enhance the perioperative course of children undergoing T&A.

Postoperative hemorrhage

Tonsillectomy, with or without adenoidectomy, is one of the most frequently performed procedures in the United States, accounting for approximately 340 000 operations annually¹. One of the most serious complications of T&A is hemorrhage, which may lead to compromise of the airway and cardiovascular collapse. The documented incidence of hemorrhage ranges from 0.006% in a review by Chaing² to 8.1% as reported by Kerr³. To a certain extent, inconsistencies in data collection account for some of the variations noted. Allen⁴, for example, reported only those cases (0.1%) that were returned to

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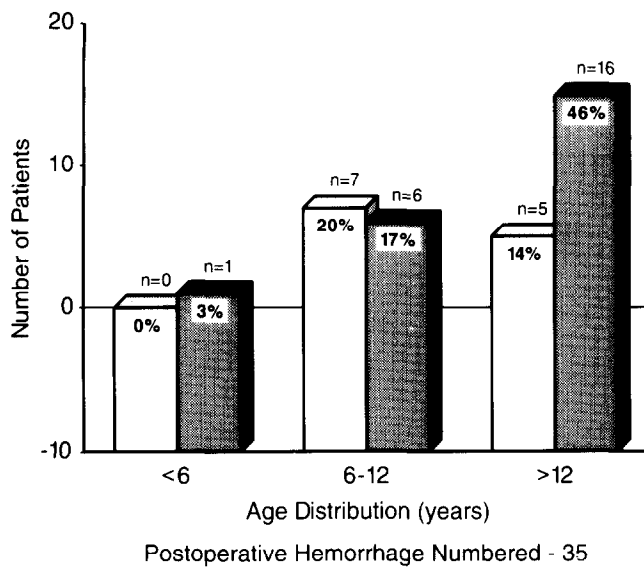


Figure 1. Distribution of postoperative hemorrhage by age. □ Requiring surgery (cautery under anesthesia; ■ handled without surgery. Reprinted with permission from Haberman RS, Shattuck TG, Dion NM. Is outpatient suction cautery tonsillectomy safe in a community hospital setting? *Laryngoscope* 1990; **100**: 511-15.

the operating room for control of bleeding, whereas Kerr included patients whose hemorrhage was controlled by such local means as clot removal and gargles. Interestingly, there appears to be no clear relationship between bleeding complications and the surgical technique chosen for removal of tonsils and adenoids.

Hemorrhage following tonsillectomy may be either primary (occurring in the first 24 h after surgery) or secondary (bleeding occurring after 24 h). Crysdale and Russel² reported an incidence of primary hemorrhage of 2.15% (76% of the hemorrhages occurred in the first 6 h following surgery). Of these patients experiencing primary hemorrhage, only 3% (or 0.06% of all the patients) required a second general anesthetic for hemostasis. Patients under 4 yr in this study had a lower relative frequency of bleeding; however, the incidence of fever, inadequate oral intake, and airway distress was higher in this age group.

Haberman and others⁶, reporting on suction cautery tonsillectomy in a community hospital setting, documented that primary hemorrhage was rare (0.6%). Consistent with Crysdale's data, Haberman⁶ also observed a lower incidence of postoperative hemorrhage in children less than 6 yr (Figure 1). Secondary hemorrhage was much more frequent with an incidence of 6.4% and occurred most commonly on the sixth postoperative day. Their postoperative bleed rate requiring surgical intervention was 2.4%⁶, similar to others. Lee⁷ reported 3000 T&As performed over a 4-yr period, with a primary hemorrhage rate of 0.7% and a readmission rate for secondary hemorrhage of 1.5%. Carithers and colleagues⁸ reported an incidence of primary tonsillar hemorrhage of 1.2%, with 41% of bleeding episodes occurring within the first 4 h (Figure 2). The incidence of primary



Figure 2. Incidence of primary tonsillar hemorrhage occurring within 24 h postoperatively. Reprinted with permission from Carithers JS, Gebhart DE, Williams JA. Postoperative risk of pediatric tonsillectomy. *Laryngoscope* 1987; **97**: 422-9.

adenoidal hemorrhage was 3.2%; 95% of the episodes occurred in the first 4 h. Neither group of patients with primary bleeding required reoperation for hemostasis. Secondary hemorrhage of either the tonsillar fossae or adenoid bed occurred in 1.6% of patients.

In a prospective study published in 1990, Guida and Mattucci⁹ reported an overall complication rate of 3.8% within the first 24 postoperative hours. These investigators had a 1.1% incidence of primary tonsillar hemorrhage, with 63% of bleeding occurring in the first 6 h. These and other studies have led to the recommendation that outpatient T&A surgery should be followed by at least 6 h of postoperative observation before discharge. Indeed, Carithers⁸ suggests keeping T&A patients at least 8 h and possibly 10 h after surgery to minimize the risk of complications after discharge.

Patient selection

Areas of special concern in patient selection for outpatient T&A are a history of obstructive sleep apnea (OSA) and age under 3 yr. Indeed, the overwhelming consensus is that patients with OSA should be admitted overnight for careful postoperative monitoring. The disposition of patients less than 3 yr is more controversial.

OSA should be suspected in children with adenotonsillar hypertrophy who exhibit habitual snoring, restless sleep, and other typical symptoms such as difficulty in swallowing that impairs nutrition and growth, and daytime drowsiness. The diagnosis of sleep apnea syndrome is made with polysomnography which graphically records respiratory activity during natural sleep. The two most frequent sites of obstruction during sleep are at the soft palate and base of the tongue¹⁰. Occasionally, extreme lymphoid hyperplasia causes upper airway

obstruction resulting in hypoxemia and hypercarbia and, eventually, pulmonary hypertension and cor pulmonale. Patients with cor pulmonale have ECG and echocardiographic evidence of right ventricular hypertrophy, and approximately one-third have chest radiographs consistent with cardiomegaly¹¹. In many cases, digitalization and surgical removal of the tonsils and adenoids can reverse these progressive cardiovascular changes¹². Children with trisomy 21 are particularly vulnerable to severe upper airway obstruction from lymphoid hyperplasia, as are those with mucopolysaccharidoses. Children with craniofacial abnormalities, especially those associated with midface hypoplasia, are also at increased risk¹³.

Nearly half of patients with OSA have neurological dysfunction. Brainstem regions controlling upper airway musculature may be affected, resulting in occlusion of the oropharynx when the collapsing force of negative inspiratory pressure exceeds the dilating force of pharyngeal muscular contraction. Objectives of surgical treatment include relief of airway obstruction and increasing the cross-sectional area of the pharynx¹⁴. In some patients with sleep apnea, however, other factors predispose them to the development of cor pulmonale, and they will remain insensitive to hypercarbia despite hypoxemia even after surgical relief of airway obstruction. These patients will continue to have persistent hypercarbia on a central basis. This situation may eventually deteriorate to a respiratory failure, possibly owing to a hyperreactive pulmonary vascular bed¹⁵.

Postoperative airway compromise has been reported as a complication following T&A but happens infrequently in the general pediatric population. The risk ranges from 0–1.3% in a large series of pediatric patients undergoing adenotonsillectomy for a variety of indications^{5,8,16}. However, in their 1992 study of respiratory compromise after adenotonsillectomy in children with OSA, McColley and colleagues¹³ reported a 23% incidence of severe respiratory compromise, defined as intermittent or continuous oxygen saturation of 70% or less, and/or hypercapnia, requiring intervention. Moreover, the incidence of respiratory compromise in children with OSA below 3 yr of age was 52% in their series.

Children with OSA may be at risk for postoperative respiratory compromise for several reasons. Anesthetic agents, including inhalational anesthetics and narcotics, lead to upper airway collapse by decreasing the activity of pharyngeal dilator muscles¹⁷. This occurs even with subanesthetic doses¹⁸ and, therefore, may persist once other effects of anesthesia have abated. Pulmonary edema may complicate adenotonsillectomy¹⁹, possibly through the mechanism that produces pulmonary edema following relief of acute upper airway obstruction²⁰. In addition, children with OSA may have impaired ventilatory responses to carbon dioxide, and the cardiopulmonary sequelae of OSA may render these children more vulnerable to postoperative complications. McColley and colleagues¹³ emphasize that children with OSA are at risk for respiratory compromise following adenotonsillectomy. Young age (less than 3 yr) and severe sleep-related upper airway obstruction (i.e., an obstructive

event index $> 10 \text{ h}^{-1}$ of sleep during polysomnography) significantly increase this risk. Therefore, in-hospital postoperative monitoring for children undergoing adenotonsillectomy for OSA is clearly indicated.

The literature regarding tonsillectomy in young children is conflicting. Reiner and colleagues²¹ reviewed 1000 patients undergoing tonsillectomy or adenoidectomy and concluded that these procedures can be performed safely as outpatients regardless of age or indication. Their study, however, did include patients in whom only adenoidectomies were performed, and this procedure has less potential for complications than the combined procedure or tonsillectomy alone. In contrast, Carithers and associates⁸ reported that patients less than 3 yr were at higher risk for immediate postoperative complications, including emesis and poor oral intake, leading to dehydration. Crysdale and Russel⁵ noted a higher incidence of fever, inadequate oral intake, and airway distress in patients under 4 yr, while Shott and colleagues²² believed that children less than 3 yr were inappropriate candidates for outpatient adenotonsillectomy because of potential airway complications. A 1992 publication by Tom and colleagues²³ retrospectively studied the records of 223 children, 36 months and younger, who underwent tonsillectomy. Although there were no mortalities and no cases of primary postoperative hemorrhage, 60.1% of children required more than routine postoperative care and benefitted from hospitalization; 51% of patients developed airway problems, and 14.8% of those youngsters with respiratory complications were admitted to an Intensive Care Unit. Tom's group concluded: "Although a recommendation based solely on age may be criticized, a planned hospitalization for children under 3 years undergoing tonsillectomy is recommended. After a period of assessment, the surgeon and family may decide to manage the child as an outpatient."²³

Conclusions

The decision to perform T&A as an outpatient procedure is a matter of professional judgment for the operating surgeon and the anesthesiologist. To assist with this decision the following observations and recommendations⁹ are offered:

1. There must be meticulous attention to patient selection, and patients with certain conditions are inappropriate candidates. Disorders such as coagulopathies, immunosuppression, and OSA syndrome are contraindications to outpatient tonsil and adenoid surgery. Moreover, children younger than 3 yr are more apt to require postoperative hospitalization because of such complications as respiratory distress and dehydration than are older children.
2. In the pediatric patient, evaluation of the family's social situation and knowledge of the distance from home to surgical facility are extremely important. Preoperative parental education and detailed instruction will help ensure patient postoperative safety.

3. Meticulous attention to intraoperative hemostasis is essential.
4. Recovery room observation by skilled personnel for a minimum of 6 hr should help minimize complications following discharge.

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Original Papers

Invaginated axial stripping and stab avulsion (hook) phlebectomy: a definitive outpatient procedure for primary varicose veins

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The classical high ligation and ankle-to-groin intraluminal saphenous vein stripping requires hospitalization, general anaesthesia, long convalescence, loss of income, unacceptable scarring and possible permanent nerve injury. This report describes the technique of invaginated axial stripping in conjunction with tributary stab avulsion (hook) phlebectomy. Using femoral block anaesthesia with supplemented local infiltration, the varicose tributaries are avulsed, through multiple stab incisions only 1.5–3 mm long, with specially designed hooks. This is performed in an ambulatory (office) setting, making varicose vein surgery a minimally-invasive procedure. Two hundred and fifteen patients with 261 involved limbs were operated on during a two-year period. Postoperative pain and complications were minimal. All patients immediately resumed normal daily activities. Cosmesis was excellent. There have been no recurrences in up to 3 years follow up. This procedure adheres to strict haemodynamic principles. Elimination of hospitalization, reduced postoperative morbidity, immediate ambulation, minimal nerve damage, excellent cosmesis and finally, obvious cost efficiency should make this form of varicose vein surgery appealing to surgeons and patients alike by making the future surgical care for varicose veins available today.

Key words: Varicose vein surgery, stab avulsion phlebectomy, vein stripping, outpatient surgery, femoral block anaesthesia

Varicose veins are a common and progressive disease, which, if untreated, often leads to discomfort and pain, as well as to thrombophlebitic, inflammatory, and stasis complications, including chronic venous ulceration. Because the valvular incompetence and the resultant reflux, which is responsible for the ambulatory venous hypertension¹, are confined to the superficial system, primary varicose veins should be, theoretically, easy to treat.

Since venous competency cannot be restored, varicose veins must be ligated and removed. The classical internal stripping, regardless of the stripper type used, ends with the vein wrapped together as a thick plug on the stripper's hard 'acorn' shaped head, traumatizing the surrounding tissues. It leaves behind a large tunnel in which blood accumulates. This causes postoperative pain and the subsequent convalescence is prolonged. This thick

tissue plug can cause damage to the adjacent lymphatics and nerves. Removal of the tributary varicosities requires separate and generous incisions which may also produce unacceptable scarring. Since this is usually performed under general anaesthesia in a hospital setting, this classical approach is also expensive. Coupled with the emphasis on maximal preservation of the main saphenous trunk as possible future vascular graft material, the 'routine' and 'blind' ankle-to-groin stripping becomes 'overkill' in most cases.

The purpose of this article is to present a haemodynamically correct surgical protocol for treatment of primary varicose veins as an alternative to routine and blind stripping. It calls for the ligation of the most proximal source of reflux, such as sapheno-femoral or sapheno-popliteal junctions, only when there is demonstrated incompetence. The report describes the technique of the limited (knee-to-groin, rather than ankle-to-groin) and less traumatic invaginated form of axial stripping, in conjunction with tributary hook (stab avulsion) phlebextraction. It is a more detailed protocol than the one previously described². Using the paravascular technique of lumbar plexus anaesthesia, the 3-in-1 femoral block

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with supplemented local infiltration and performed in an ambulatory (office) setting, the method has placed varicose vein surgery in the realms of minimally-invasive procedures.

Patients and methods

Two hundred and fifteen patients with primary varicose veins with a total of 261 limbs were seen in a private phlebological practice between May 1990 and May 1992. All patients were evaluated by physical examination and non-invasive continuous wave (cw) Doppler ultrasound venous studies. Of these patients 187 (87%) were female and 28 (13%) were male; 146 (68%) were less than 50 years old, 69 (32%) were 50 years or older; 169 (79%) had unilateral and 46 (21%) bilateral involvement; 122 (47%) were right, and 139 (53%) were left legs for a total of 261 involved limbs.

Three major groups of varicosities were identified:

Group I. 180 (69%) legs had varicose veins in the territorial distribution of the long saphenous vein. A sapheno-femoral junctional (SFJ) escape was found in 124 (69%) limbs. It was associated with concomitant saphenous trunk incompetence exhibiting various degrees of reflux in only 90 limbs. In 34 limbs the main saphenous trunk was found normal and competent with varicosities limited to the medial and lateral accessory veins. Non-junctional escape points were detected in the remaining 56 (31%) limbs; no escapes could be detected in 21, a mid-thigh perforator (MTP) escape was found in 13, and pelvic escapes (belonging to the territorial distribution of the internal iliac vein) were detected in 22 limbs.

Group II. 29 (11%) legs had short saphenous varicosities and sapheno-popliteal junction (SPJ) incompetence was found in all of them.

Group III. 52 (20%) legs had nonsaphenous varicosities. The varicose veins were mainly limited to the lateral thigh venous system.

Preoperative assessment

A careful preoperative examination was mandatory in order to tailor the procedure appropriately to the haemodynamic pathology of each patient. The clinical examination alone (observation, percussion wave, Trendelenburg test, etc.) may not accurately identify all the components of the regurgitant circuit³. Therefore, a cw bidirectional Doppler ultrasound examination (Parks Vascular Mini-Lab III, model 1059, Aloha, OR), performed with the patient standing, is mandatory in all cases to detect venous flow, pathway of incompetence and the most proximal escape point accurately. Duplex imaging (Biosound Phase 2, Biosound, Indianapolis, IN) was only used in cases in which it was believed that the clinical and Doppler examination failed to provide the required information. It was also used for mapping the long saphenous vein in cases where stripping was contemplated. The detailed clinical and noninvasive examination protocol has been published elsewhere^{2,4}.

The technique

Special instrumentation

The operation is designed to be performed in an ambulatory or office setting, to cause minimal trauma, little or no convalescence, and result in maximal cosmesis. Specially devised hooks in different sizes have been introduced by different practitioners such as Muller*, Oesch†, Varady‡ and Villavicencio§. These hooks permit removal (avulsion) of varicosities via minute incisions, not longer than 1.5–3 mm, which do not require sutures. The surgical tray should also have the 'mini strippers' introduced by Varady and Villavicencio, the Varady phlebodissector(s), straight and curved baby Kochers or Halsted's to assist in grasping the veins, and regular mosquito forceps.

Preoperative marking

With the patient standing in a warm room all veins are marked with an indelible marker. A successful procedure demands precise and accurate marking, therefore the operating surgeon should do it in person. The most proximal escape point is revalidated with Doppler ultrasound and marked too. If stripping is contemplated, duplex mapping of the long saphenous vein is helpful to mark the entry sites of its tributaries precisely.

Loco-regional anaesthesia

After the leg is cleansed and draped, local anaesthesia is obtained using either lidocaine HCL (Xylocaine) 1% of bupivacaine HCL (Marcaine) 0.25%. In the event that stripping of any length of the long saphenous trunk is required, the paravascular technique of lumbar plexus anaesthesia, or the 3-in-1 block introduced by Winnie⁵ is performed. This requires 20–40 ml of Xylocaine 1% delivered via a 22 gauge, 1½ inch long needle. Mepivacaine (Carbocaine) 1% which has less systemic toxicity is also an excellent anaesthetic choice.

This is a modification and refinement of the standard femoral block anaesthesia and has been successfully used in varicose vein surgery, including stripping^{6,7}. When successful, this technique will ensure complete anaesthesia of not only the territorial distribution of the femoral (and saphenous), but obturator and lateral femurocutaneous nerves as well, resulting in skin anaesthesia of the entire antero-medial aspect of the limb down to the ankle. However, should ligation of the sapheno-femoral junction be necessary, this form of nerve block will not provide anaesthesia of the groin area, which should be separately infiltrated. In case stripping/removal (proxi-

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mal third being usually sufficient) of the short saphenous vein is necessary, simple local infiltration of the vein's track will be sufficient. Ligation of both junctions, as well as avulsion of the tributaries is done with simple local infiltrative anaesthesia.

The customary anaesthetic used is lidocaine HCL (Xylocaine) 1% and it is delivered through a 22 gauge spinal needle. In order to avoid possible systemic toxicity and dose and volume limitations, dilution (in normal saline) of the commercially available 1%, to 0.5% and even 0.25%, should be done. The pH of Xylocaine is acidic, which is a source of patient discomfort. Therefore, 5 ml of 8.4% sodium bicarbonate is added to the original 50 ml to minimize pain. Bupivacaine HCL (Marcaine) 0.25%, a long acting agent, is another excellent choice for anaesthesia for the ligation of the junctions as well as for avulsion of the varicose tributaries. Dilution of the commercially available 0.25% solution to 0.125% can be used without diminished efficiency. Sodium bicarbonate will precipitate with Marcaine and should be avoided. Marcaine should not be used for regional (femoral 3-in-1) block anaesthesia due to possible transient quadriceps motor paresis, and inability to ambulate for 4–8 h. The addition of epinephrine, especially to Xylocaine, could result in delayed reabsorption, lower chances of systemic toxicity, and provide a longer lasting anaesthesia with a reduced anaesthetic volume. However, due to the possible secondary effects of epinephrine such as palpitations, chest discomfort, etc. its use in our office setting was omitted. Patients drive to and from the office, therefore premedication is not routinely administered. Anxious patients can be premedicated with 5–7.5 mg of per os diazepam (Valium). All patients ambulate immediately and leave the office 15–20 min after the procedure. Patients receiving premedication are, however, forbidden to drive themselves after the surgery. Due to dose limitation of the local anaesthetic, a bilateral case is never operated on in the same session.

Division of the proximal escape point – the high ligation

When incompetence is detected, a flush ligation of the saphenous vein at the junction(s) is the sine qua non of successful varicose vein surgery. Failure to perform the juxtafemoral or juxtapopliteal ligation properly, or failure to identify, divide and ligate the existing tributaries properly was found to be responsible for causing recurrent varicosities in more than 70% of cases⁸. A detailed description of the techniques of both junction ligation has been previously published².

Invaginated axial stripping

Blind ankle-to-groin stripping of cases of long saphenous varicose veins is rarely necessary. In most of our cases, short groin-to-(below)-knee stripping was all that was haemodynamically necessary. This is in concordance with other reports^{9–11}. We perform the invaginated stripping using the flexible mini vein stripper of Varady. It has three interchangeable heads, all smaller than the

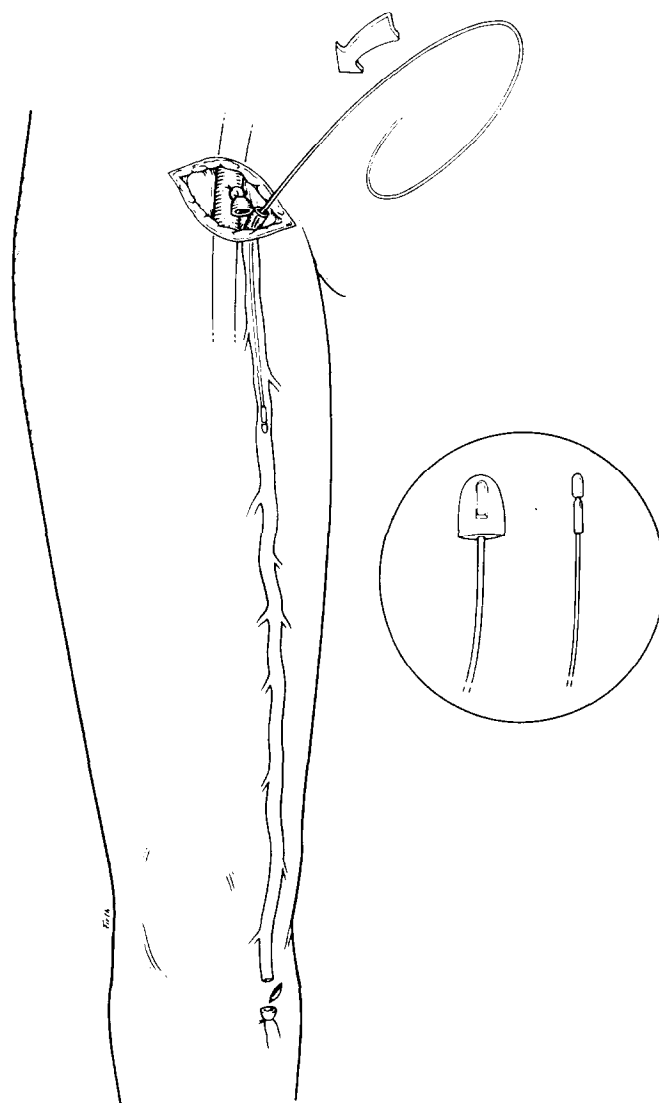


Figure 1. The Varady intraluminal mini vein stripper. Insert: its relation to the Codman disposable stripper head.

saphenous vein lumen. The instrument is always passed in a retrograde (from above downward) fashion (Figure 1) through the already transected juxtafemoral end of the long saphenous vein and is removed, just beneath the knee, through a 2–4 mm stab incision (tip of an 11 blade) with the help of the phlebextractor hooks previously described. Placement of this below-knee incision is guided by the previously marked vein as well as by palpation of the intraluminal stripper through the skin. With the stripper protruding from the lumen the distal end of the vein is tied to the stripper's small head with a $\frac{1}{8}$ in silk (umbilical) tape. The tape should be twice as long as the vein segment to be stripped. For cosmetic reasons, the saphenous trunk is normally stripped and removed through the already existing groin incision (Figure 2). If the stripper cannot be passed from above downward, the vein is exposed in the same place and the same way. The stripper is then passed in an orthograde (from below upward) fashion.

Tearing of the vein is minimized by avulsing and dis-

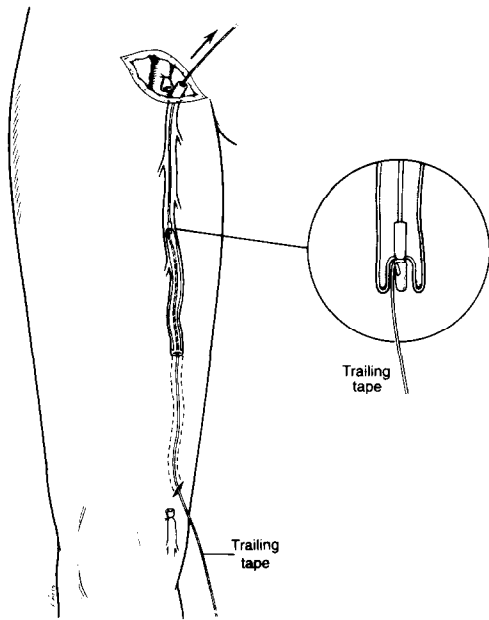


Figure 2. Invaginated knee-to-groin stripping. Insert: the trailing tape tied to the distal end of the vein.

connecting joining tributaries which anchor the saphenous trunk. In addition to the judicious preoperative duplex mapping, a continuous and gentle traction on the stripper, emerging with the vein turned inside out through the groin incision, will reveal their exact location by causing puckering of the skin above each tributary. To be effective, the tributary avulsion or disconnection should be done as close as possible to the vein trunk, using the same phlebextraction hooks and minimal incisions.

The moment the vein, turned inside out, becomes visible in the groin incision the traction on the stripper is exchanged for direct traction on the vein trunk itself, using two small grasping forceps. If, in spite of all these precautions the vein has torn, the stripper is removed in its entirety through the groin incision. The upper end of the exteriorized tape, localized in the vein's lumen, is tied into a knot, while the juxtafemoral end of the vein is firmly attached to it with the help of a second long 'trailing' tape. By pulling on the tape protruding from the below-knee skin opening, stripping of the retained segment is completed (Figure 3). However, for better cosmesis, the trailing tape will enable the delivery of this vein segment in an orthograde fashion through the still open groin incision as described by Conrad¹². In case technical difficulties preclude axial stripping, the previously mapped and marked saphenous trunk can be avulsed in segments using the hook phlebextraction technique that will be described below. The invaginated ankle-to-groin stripping should not be done in one single step. The above described technique should be repeated in those cases where stripping of the infrapopliteal segment of the long saphenous vein is required. For similar

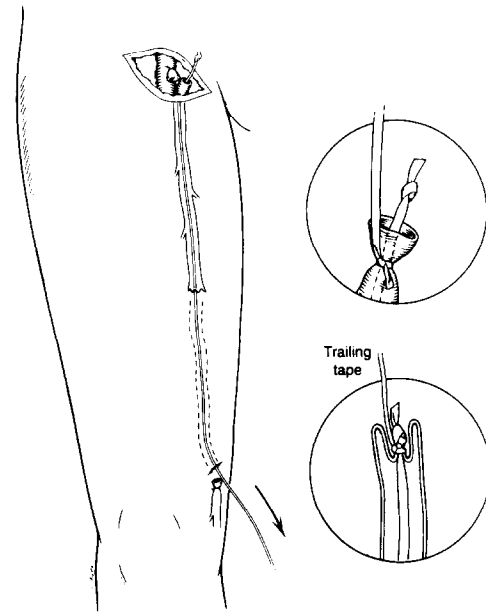


Figure 3. The torn long saphenous vein trunk is removed with the intraluminal trailing tape. Inserts: the attachment of the two tapes to the upper end of the vein.

reasons, the ankle incision, rather than the below-knee skin opening, is used for the delivery of the stripped segment. A detailed, but somewhat different variation of the technique, using a nylon thread instead of silk tape was recently published¹³.

Stripping the entire length of the short saphenous vein trunk is rarely necessary. In most cases the removal of the proximal refluxive third will be sufficient. This can be accomplished by a limited stripping following the guidelines previously described for the long saphenous vein. Occasionally, avulsion of the short saphenous vein trunk through the incision used for the ligation of the SPJ, is possible as well. With patient in a prone position, maximal flexion of the knee (90°), is however necessary for removal of short saphenous vein segments 10 cm or longer.

Stab avulsion tributary phlebectomy

Due to their superficial location, i.e. just below the skin and above the membranous fascia, tributary varicose veins are easily amenable to avulsion by hook phlebextraction. With an 11 blade tip held in a Kelly or a mosquito forceps, or even with an 18 or 16 gauge needle, a small 1–3 mm long stab (puncture) wound is made along the border of the previously marked varicosities, making sure that the dermis is split as well (Figure 4). Due to the small openings, no special effort is made to stay in the Langer's lines. Whenever possible, however, the skin incisions should be made along the longitudinal axis of the leg. The exception is the area surrounding the knee where the stab wound should be placed transversally parallel to Langer's lines.

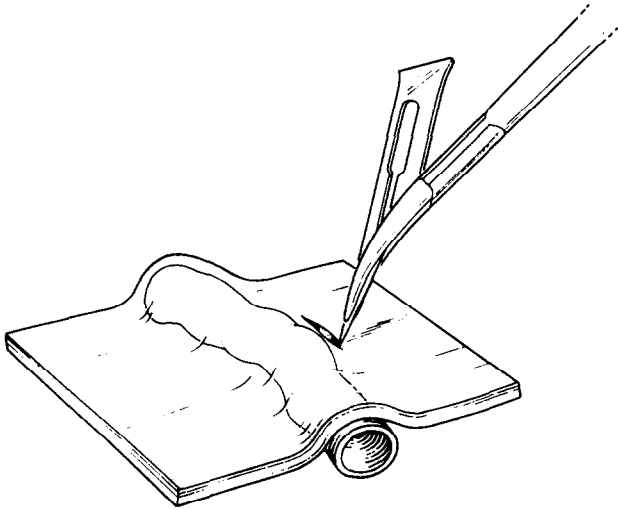


Figure 4. The preferred mode of holding the tip of the 11 blade with a small mosquito forceps.

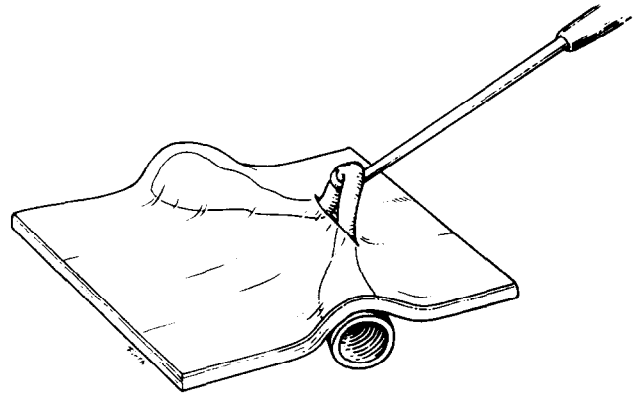


Figure 6. The varicose vein loop is exteriorized.

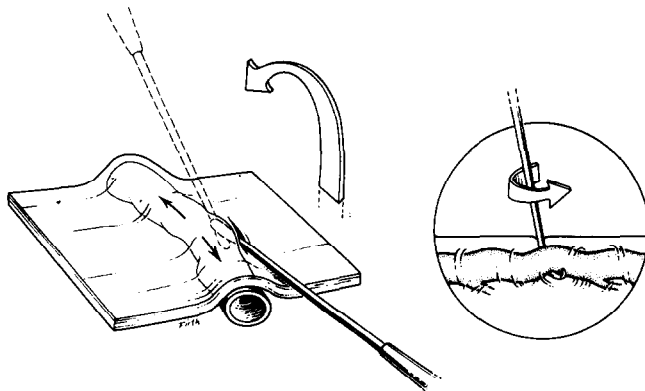


Figure 5. The Varady phlebodissector introduced through the stab wound is freeing the varicosity from the subcutaneous tissue along its longitudinal axis. Insert: the introduced hook is engaging the varicosity.

The Varady phlebodissector is introduced through the skin openings and pushed up and down along the longitudinal axis of the varicosity. With gentle forward and rotating movements, the varicosity is freed from its attachments to the subcutaneous tissues. With the help of the existing hooks which are introduced into the skin openings, the varicosities are engaged (hooked) and teased to the surface of the skin (Figure 5). Concomitant gentle counter traction of the skin by the thumb of the non-dominant hand will facilitate exteriorization of the varicosity (Figure 6). Occasionally, the hook will only engage the adventitia, making it difficult to deliver the varicosity. In such cases the skin opening should be

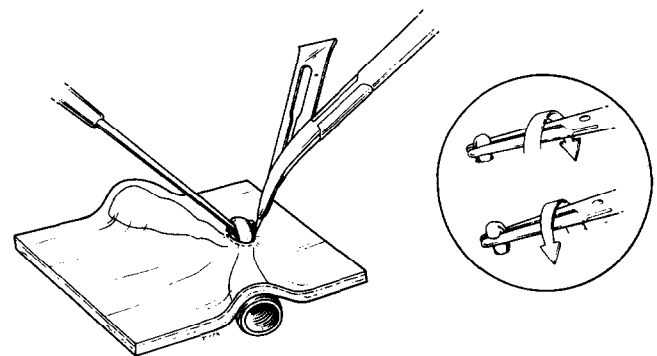


Figure 7. When difficulty is encountered in delivering the vein, the skin opening is enlarged. Insert: grasping the varicosity with a mosquito or Kocher forceps. The 'to and fro' twisting movements will facilitate the delivery of the vein.

slightly enlarged and the vein grasped with a forceps. To and fro forceful twisting movements, by pronation and supination of the wrist holding the forceps, will help exteriorize the vein (Figure 7). The two limbs of the exteriorized vein loop are separated and individually grasped with two small mosquito or baby Kocher clamps, and transected with a Metzenbaum scissor (Figure 8). With the varicosity in slight traction, the phlebodissector can be reintroduced into the skin opening to further dissect the vein away from its subcutaneous attachments. Gentle pulling on each limb separately, or rotatory and/or to and fro rocking movements, or even twisting the vein on the grasping forceps, will further exteriorize additional lengths of varicosities, which are avulsed. In case of small diameter and/or fragile veins, avulsion of both limbs should be done concomitantly (Figure 9). Using both these movements, it is possible to remove (avulse) up to 5–6 cm and even

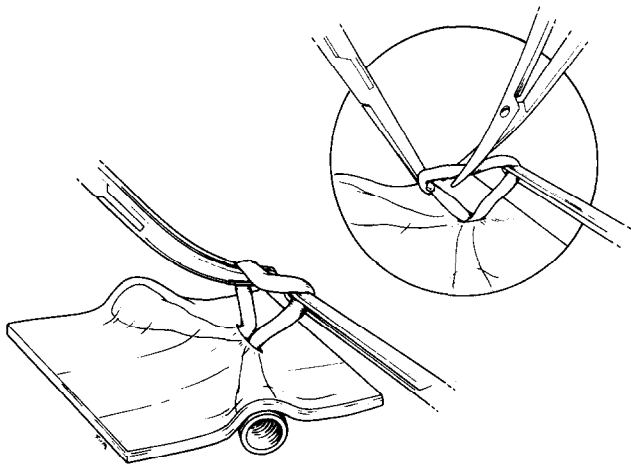


Figure 8. The two limbs of the varicose loop are individually grasped. Insert: the varicose loop is transected with a Metzenbaum scissor.

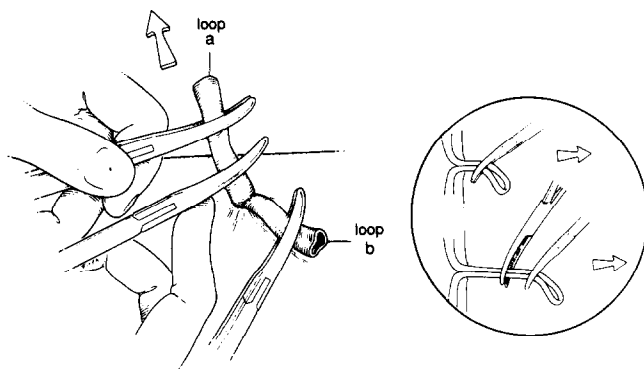


Figure 9. Preferably each limb is separately avulsed. Insert: In case of small diameter and fragile veins the avulsion is done by simultaneously pulling on both limbs of the loop. No ligatures are needed.

longer segments of vein through each stab wound. Ligation of the vein ends is not necessary.

The procedure is repeated as often as needed (20–40 times), until all the marked tributary varicosities of the limb are removed. To facilitate locating the varicosities, in addition to the preoperative markings, slight traction applied on the forceps while pulling on the vein, will enable one to palpate the varicosity 1–2 in below or above the stab wound. This taut cord-like palpatory finding is an excellent guide for placing the next stab wound and should override the preoperative marking of the veins in case the two do not coincide.

In case the veins are tightly anchored and cannot easily be teased out, one should alternate the different types and sizes of hooks. Personal experience will lead one to favour one type or another. In our hands, for the more

superficially located veins the Oesch hook proved to be the best, while for deep-situated varicosities and especially the saphenous trunks, the Muller hook seemed to be better. Right-handed surgeons should use right-handed hooks. A right-handed Oesch hook, used in the left hand in a 'back-hand' fashion, can be beneficial when the hook, held in the right hand, missed the marked vein. Bleeding is usually minimal and slight finger pressure, for a few seconds, will easily control any heavier oozing. The stretching of the vein wall, and particularly the intima, results in an excellent haemostatic plug. Elevation of the limb during the procedure is not required.

Stab evulsion truncal saphenectomy

In the majority of cases the incompetent saphenous trunk is removed via the previously described invaginated stripping. Occasionally this is impossible and the saphenous vein trunk itself is removed by the stab avulsion technique previously described for the tributary varicosities. In the thigh, the long saphenous vein trunk is situated deeper, i.e. beneath the membranous fascia, therefore, engaging the vein with the hooks may be difficult, especially in overweight patients. Careful preoperative marking, occasionally supplemented with duplex mapping of the vein will facilitate this stage of the operation. Following the juxtafemoral flush ligation and with the operative wound still open, the ipsilateral hip is flexed, abducted, and the knee flexed and outwardly rotated. Moderate traction is applied to the distal stump of the long saphenous vein. In thin patients, the thigh segment of the vein is now easily palpated, or visible, as a taut cord, causing puckering of the skin. A stab wound is made along the border of the palpated vein and with the aid of the biggest size Muller or Oesch, or the smallest Villavicencio hook, the vein is engaged, exteriorized, and transected. It is often possible to remove 7–10 cm segments of vein. This manoeuvre is repeated until the desired length of the saphenous trunk is avulsed. If the vein cannot be hooked despite traction, the flexible mini-stripper, a J-wire or an 8F baby feeding tube is inserted in the upper end of the divided long saphenous vein. This will facilitate palpation of the vein and permit it to be readily engaged by the phlebextraction hooks. Likewise, no ligatures are necessary on the evulsed vein ends.

The avulsion of the infrapopliteal segment of the long saphenous vein trunk may be more difficult than the thigh segment because of possible attachments to the deep pretibial fascia.

Dressing and postoperative care

The skin is cleaned, dried and the stab wounds closed with narrow steristrips. This is then covered with Tegaderm sheeting. Direct pressure with cotton balls, taped to the Tegaderm, over the stab wounds is used to control possible bleeding. The balls are applied on top of the Tegaderm sheet and secured with hypoallergenic tape. The entire leg is placed in a groin level, with waist attachment, 30–40 mmHg gradient elastic stocking. An extra

outer layer of Coban self-adhering wrap dressing (3M) is applied over the stocking to promote a tighter haemostatic compression. The patient removes this layer before bedtime, however the rest of the dressing is kept undisturbed until the next day. The leg is rechecked after 24 h when the haemostatic cotton balls are removed. The skin dressing and the stocking are kept on the leg for one week only. The first night the patient sleeps with the entire external dressing, thereafter, the stocking is used only during the day.

If the incisions are small, the scars will be almost invisible after 3–4 months. With patients that are known to develop keloids, the stab wounds should be kept as small as possible. In our experience, topical application of a combination of equal parts (5.0 gm) of hydroquinone (Solaquin Forte) 4% gel with clobetasol propionate (Temovate) 0.05% cream and tretinoin (Retin-A) 0.1% cream, might be beneficial in minimizing keloid formation and occasional hyperpigmentation. It is applied twice daily for 2–3 months.

After care

Patients leave the office 15–20 min after the procedure. Post-surgical discomfort is usually minimal and 1–2 tablets of 200 mg ibuprofen (Advil, Motrin) suffices for pain control in the evening after surgery. No leave of absence from work is necessary. All patients are permitted to resume normal daily activities, including returning to work, on the same day of the surgery. Patients are permitted to resume all sporting activities as well, except weight lifting, on the first post operative day. Showering is permitted 24 h after surgery with proper leg coverage. Obligatory follow-up visits are at 1 week, 2–3 weeks and 2–3 months after surgery.

Complications

Transient neurologic complications from the loco-regional anaesthesia can occur. Motor fibres of superficial mixed nerves (femoral, peroneal) may be affected, especially when higher concentrations of anaesthetic are used. After femoral block anaesthesia, the tone and strength of the ipsilateral quadriceps muscle should be checked before the patient is asked to stand up. Nerve palsies are invariably transient, clearing within several hours. Permanent nerve damage can occur only if a nerve is inadvertently hooked and avulsed.

Bleeding from the wound sites might occur. This is likely to manifest itself immediately following surgery when the patient stands up. As a precaution, patients are asked to walk in the office 10–15 min after surgery and are re-examined before leaving. If bleeding does occur, it can be readily controlled by additional pressure with reinforcement of the pressure dressing.

A phlebotic reaction may occur days or weeks after surgery and is due to a retained and clotted vein that was partially avulsed or missed. Incision and drainage of a fresh clot, local compression, ambulation and po 800–

1200 mg ibuprofen (Motrin) qd for 3–5 days, will resolve the symptoms.

Lymphatic accumulations (lymphocele) or fistulas, wound infection, hypertrophic scarring, have been reported.

Relative contraindications

Veins encased in dense fibrotic tissue or previous scar may be difficult to avulse. These include varicose veins in the gaiter or ankle area with liposclerotic skin, post sclerotherapy veins, post surgery residual veins, post phlebotic veins, as well as prepatellar and pretibial veins that may be closely attached to the fascia. In these cases, compressive sclerotherapy may be indicated.

Results

All 261 varicose limbs were operated on in an office setting and under loco-regional anaesthesia as described. The 209 limbs with (long and short) saphenous vein varicosities, 166 (80%) limbs with a clearly detectable proximal escape (124 incompetent SFJ, 29 incompetent SPJ and 13 incompetent MTP), were all divided and ligated and existing tributaries were properly identified and disconnected.

Of 180 limbs with long saphenous varicosities, removal (saphenectomy) of the incompetent saphenous trunk by stripping (or stab avulsion) was required in only 71 (40%) limbs: 52 of 124 limbs displaying SFJ incompetence, all 13 with MTP incompetence, 4 of 22 with pelvic escapes and 2 of 21 with ill-defined escapes. Of 71 limbs that required axial saphenectomy, 10 (6%) were total (ankle-to-groin) while 61 (34%) were limited (groin-to-knee). Of 29 limbs with short saphenous varicose veins, complete saphenectomy was mandated in one limb only; in the remaining 28, removal of the incompetent proximal third was sufficient to control the high pressure backflow properly. The total number of saphenectomies was therefore mandatory in only 100 (48%) of 209 limbs with saphenous varicosities; 89 (43%) were limited and 11 (5%) were complete saphenectomies. Stab evulsion tributary phlebectomy was performed in all 261 (180 long saphenous, 29 short saphenous and 52 non saphenous) varicose limbs.

Forty (15%) limbs were followed between 2 and 3 years, 137 (53%) between 1 and 2 years and 84 (32%) limbs were followed up to 1 year.

Neurologic complications were detected in six patients. Five developed transient nerve palsies as a result of the loco-regional anaesthesia. In two patients the peroneal nerve adjacent to the fibular head was inadvertently anaesthetized and in three patients quadriceps palsy occurred after a femoral 3-in-1 block. All symptoms resolved within a few hours. The only patient that underwent complete removal (hook phlebectomy) of the short saphenous trunk was left with a limited sensory deficit in the territorial distribution of the sural nerve.

Three patients had immediate bleeding from wound sites when they stood up from the operating table. Bleed-

ing was promptly controlled by pressure reinforcement of the external dressing. In one case of delayed bleeding, manifested by bleeding from the groin incision, wound exploration disclosed a slipped ligature from the distal end of the long saphenous vein.

Localized superficial phlebitis occurred in six patients, 1–2 weeks following surgery, and presumably caused by a clotted vein segment left in situ. The reaction resolved within 5–7 days following therapy with ibuprofen (Motrin) 800–1200 mg day⁻¹, compression, and continued ambulation. Nine patients had residual varicose veins which were obvious 1–2 weeks following surgery. Five patients with larger varicose segments had avulsion under local anaesthesia when they were detected. Three patients with smaller residual varicosities were treated by compressive sclerotherapy, with total obliteration.

Two patients developed pretibial small lymphatic collection or lymphocele. They were treated with needle aspiration, sclerotherapy (sodium tetradecyl sulfate – Sotradecol 1%) and local compression resulting in total reabsorption in 2–3 weeks. Prophylactic antibiotics were not used, and there were no wound infections. No deep phlebitis or pulmonary emboli was encountered. As of yet there have been no recurrent varicose veins identified.

Discussion

Since the beginning of the century, stripping of the long (and short) saphenous vein has been widely used in the surgical management of primary varicose veins. Keller¹⁴, Babcock¹⁵ and Mayo¹⁶ are among the early pioneers. The techniques used subsequently can be summarized by the following four steps: (a) division of the saphenous vein and ligation of the junction(s); (b) stripping (internal) of the entire saphenous vein; (c) excision and ligation of the varicose tributaries and (d) division and ligation of all incompetent perforators.

Unfortunately, the rationale for this procedure, even today, is based on the assumption that all varicose vein patients have a junctional valve escape, i.e. sapheno-femoral (SFJ) or sapheno-popliteal (SPJ) incompetence, and that the entire saphenous vein trunk is incompetent. This makes high ligation and routine ankle-to-groin (or to the popliteal fossa) stripping mandatory for all forms of truncal varicosities. However, the recently accumulated haemodynamic and topographic data on varicose veins clearly contradict most of these assumptions^{2,4,10,17}.

Bjoridal¹ clearly demonstrated that haemodynamically significant distal perforator systolic (deep-to-superficial) outflow is nonexistent in uncomplicated primary varicose veins, making the search and the wholesale ligation of perforators a futile surgical exercise in varicose vein surgery. Moreover, the distal ankle perforators connect with the posterior arch vein, which is a tributary, rather than with the infrapopliteal segment of the main saphenous vein. Avulsion of the varicose tributaries in the calf will, therefore, automatically disconnect any outflowing distal perforator. Additionally, the infrapopliteal segment of the saphenous vein, in many instances, was not found to be involved in the variceal process¹⁸.

This relatively new topographic and haemodynamic data, coupled with the quests for maximal preservation of the main saphenous trunk as possible vascular graft material, make the classical routine and blind ankle-to-groin stripping 'overkill'. The limited groin-to-knee stripping that we usually perform is haemodynamically satisfactory in most forms of primary varicose disease^{9–11}. The detailed haemodynamic principles of surgical care for primary varicose veins have been the subject of previous communications^{2,4,19}.

The principles of stab avulsion were independently introduced by Muller^{20,21} and Rivlin⁹. Muller coined the term 'phlebectomie ambulatoire' or ambulatory phlebectomy and Rivlin named the procedure 'multiple cosmetic phlebectomy'. Both used small existing or makeshift instruments to grab and avulse the varicosities through small skin openings. While Muller was the first to introduce his modified crochet hooks that facilitated the removal of the varicosities through even smaller (1.5–3 mm) incisions, it was Rivlin, in 1975, who reported an excellent 10 year recurrence rate of 7% in 1993 operated varicose limbs. Oesch^{22,23} ('mini-incision phlebectomy') and Varady^{24,25} ('micro-surgical varicectomy or phlebextraction'), designed different hooks. The term 'stab avulsion venectomy' was coined by Large^{26,27} in 1985. Thus the 'ambulatory stab avulsion phlebectomy' is a combination of already existing terminology that seems to us to correctly reflect the true character of the procedure.

In the face of recently published evidence that sclerotherapy, in any of its forms, is not a definitive therapeutic alternative for truncal varicose veins due to the high recurrence rates^{28–31}, surgery remains the treatment of choice for primary varicose veins. The invaginated form of stripping in conjunction with tributary stab avulsion (hook) phlebextraction does not necessitate any haemodynamic compromise¹⁹. On the contrary, it is a haemodynamically correct procedure, provided the preoperative examination is judiciously executed. Using loco-regional (femoral 3-in-1 block) anaesthesia and performed in an ambulatory (office) setting, the method has placed varicose vein surgery in the realms of minimally-invasive procedures.

Elimination of hospitalization, reduced postoperative morbidity, immediate ambulation, lack of nerve damage, excellent cosmesis and finally, obvious cost efficiency should make this unique form of varicose vein surgery appealing to surgeons and patients alike.

Summary

The surgical management of primary varicose veins is evolving. Recovery time, cost efficiency, level of trauma, recurrence rate and cosmesis are critical determinants. The classical and conventional high ligation and blind ankle-to-groin stripping are associated with hospitalization and general anaesthesia, long convalescence, loss of income, unacceptable scarring and possible permanent nerve injury to the long saphenous or sural nerve.

The selective high ligation and invaginated axial stripping performed in conjunction with tributary stab avul-

sion (hook) phlebectomy is a haemodynamically sound procedure provided it is preceded by an accurate Doppler ultrasound mapping of the existing regurgitant circuit. Postoperative pain and complication rate is minimal. Convalescence is eliminated and all patients are capable of immediately resuming normal daily activities. Cosmesis is excellent and nerve damage is eliminated. Performed in an ambulatory (office) setting and under loco-regional anaesthesia the cost efficiency of the approach is obvious. It is our belief that stab avulsion (hook) phlebectomy is a major advance in varicose vein surgery and it will rightfully become standard of care.

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Urology day care surgery: a patient satisfaction survey

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One hundred and ninety-five urology patients were given questionnaires to assess the quality of day care surgery – 96 responded. Analysis shows overall satisfaction with the day care urology service. Seventy-five per cent of patients would recommend a friend to have a similar procedure in the Day Surgery Unit (DSU). However, the survey has revealed that the quality of preoperative information needs improvement. A significant proportion of patients found car parking facilities on site inadequate. Primary care services were used by a fair number of patients. Each year more urology patients are treated through day care. This rise in number is anticipated to continue, particularly in the light of the changing NHS. However, the powers concerned must not forget that patients should have an opportunity to comment on the quality of service, and this paper highlights this aspect significantly.

Key words: Urology, day care

Introduction

Day care surgery is being utilized more frequently than ever before in urology. Although it is undoubtedly cost-effective, we must consider the patient's viewpoint in order to assess the quality of service. We therefore surveyed a group of patients selected randomly.

Method

During the period August to December 1992, 195 patients were asked to complete a questionnaire. This was handed to them with a stamped, addressed envelope at the time of discharge from the Day Surgery Unit (DSU). Each was asked to return the completed questionnaire within 3 weeks. The age distribution of patients responding to the questionnaire is shown in Figure 1.

All patients were referred to the DSU after initial assessment by the surgeon. General practitioners were notified. No initial investigations were done unless it was felt necessary. When patients arrived at the DSU, a nurse assessed them, and a questionnaire (relating to medical history) was completed by the patient. If required, an anaesthetist would also assess the patient. After under-

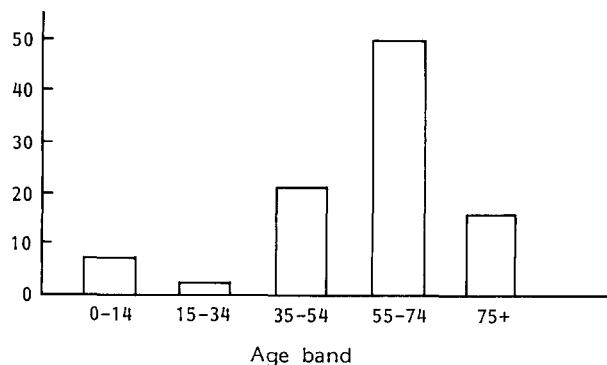


Figure 1. Age distribution of patients responding to questionnaire.

going surgery, patients were recovered and then discharged with appropriate instructions, and support services arranged where necessary.

A wide range of procedures, all under general anaesthetic, were performed on the 195 respondents. Paediatric operations included orchidopexy, circumcision, and herniotomy for congenital hydrocoele. Adult procedures included circumcision, vasectomy, excision of intrascrotal lumps, e.g. epididymal cysts, testicular biopsy, varicocelectomy, cystoscopies (including hydrodistension, perurethral diathermy, bladder biopsy, etc.), urethrotomy and urethral dilatation. It is noteworthy that the study was not extended to patients attending the flexible cystoscopy clinic.

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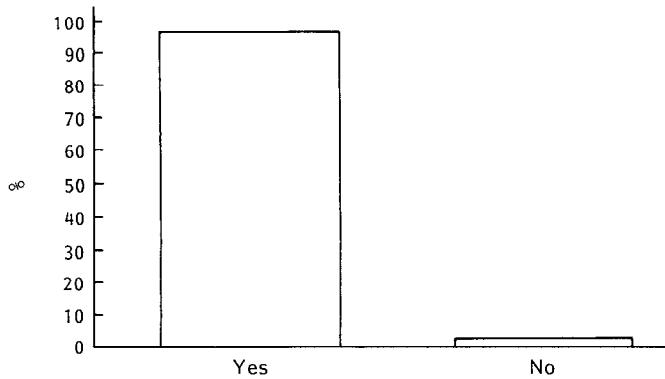


Figure 2. Was the written information received adequate?



Figure 3. Respondents' dissatisfaction with facilities.

Results

Preoperative information

Eighty-one per cent of the patients received a written explanation before coming to the DSU. Of the remainder, 76% received some form of explanation before coming to hospital. Eighty-nine per cent of patients found the information given was adequate or more. Therefore, a high percentage of patients received adequate information even before attending the DSU (see Figure 2). Significantly, however, 7% of patients found the information less than they would have wanted. Also, 8% of patients did not actually understand the explanations as much as they should have. Obviously there is room for improvement as far as communication is concerned.

It was shown that everyone involved in the DSU participated in the communication, and patients found the surgeon to be the most helpful person explaining the procedure.

Evaluation of environment (see Figure 3)

Twenty-eight per cent found car parking facilities inadequate. It must be remembered that a significant proportion of patients involved were elderly and infirm.

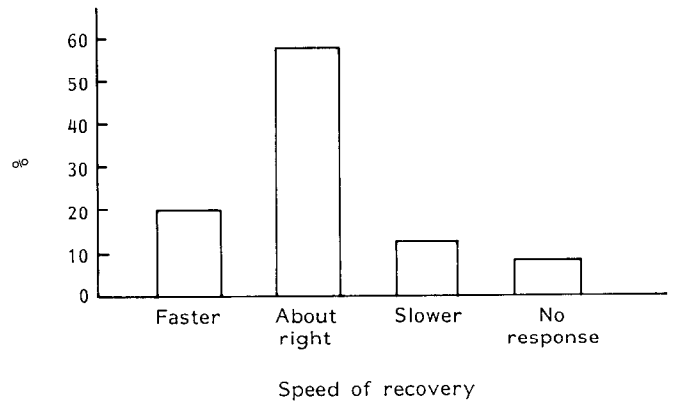


Figure 4. Respondents' perception of speed of recovery.

Obviously an operation under a general anaesthetic considerably compromises their physical ability in the immediate postoperative period; therefore, good car parking facilities close to the DSU are absolutely vital to carry out an efficient day care service.

Evaluation of recovery

Most patients did not require bed rest, although 11% were actually bed-bound for 1-3 days. The majority could do most daily activities from the first postoperative day. It is noteworthy that although 78% of patients perceived their speed of recovery to be 'about right' or 'faster', 13% thought recovery to be slower than anticipated (see Figure 4). This situation does leave scope for improvement. It is felt that better communication may improve matters, although the age range of the patients involved is responsible to some extent for their slow recovery.

Recommendation

Seventy-five per cent of patients would be prepared to recommend a friend to have a similar procedure in the DSU. Eleven per cent would advise having the procedure done as an inpatient, and a further 9% were not sure (see Figure 5).

Use of support services

A wide variety of support services were available after discharge from the DSU (see Figure 6).

District nurse: Thirty-four per cent of patients used the services of the District Nurse; the majority of which were routine general anaesthetic checks, in accordance with the Trust policy for postoperative care of DSU patients.

General practitioner: Thirty-two per cent of patients saw their GP after a DSU procedure. Having not had any feedback from our GPs, it is possibly fair to assume no major complication has resulted.

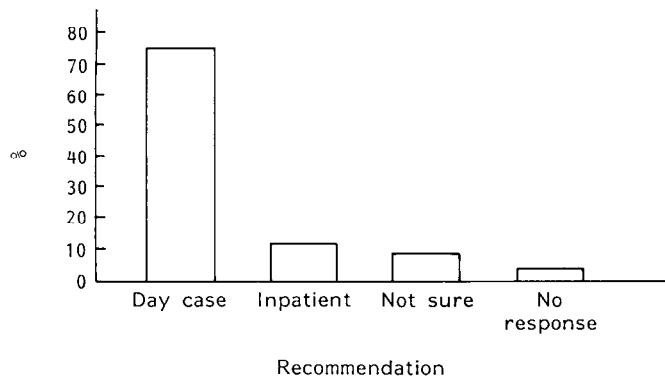


Figure 5. Type of admission respondents would recommend to a friend having a similar procedure.

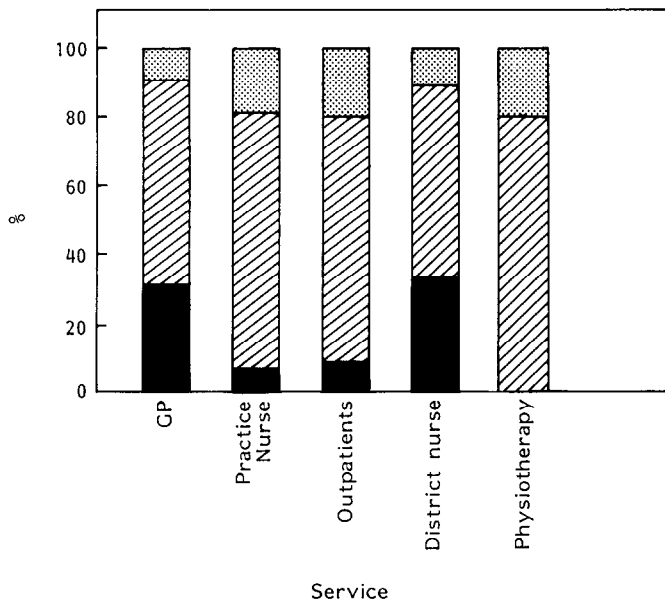


Figure 6. Services used after surgery. ■ No response; ▨ no; ■ yes.

Practice nurse: Seven per cent of patients sought help from their Practice Nurse.

Discussion

Undoubtedly urology day care surgery performed at this hospital, mostly under general anaesthesia, is being received favourably by most of the patients surveyed. This paper shows that communication between patients and the hospital has been quite satisfactory, although clearly there is scope for improvement. Better communication between the hospital, GPs and District Nurses will improve matters immensely. In addition, increasing the consultant profile and promoting dedicated nursing in the DSU will help towards improvement in communication.

Along with improvement in communication, support services such as those of the District Nurse and General Practitioner need to be enhanced and readily available. All these measures will lead towards better performance in day care surgery.

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Planning, building and operating a free-standing privately-owned day theatre complex: a nine year experience

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Building a privately-owned day surgery complex presents a unique challenge; how to marry the seemingly opposite requirements of high medical standards and reasonable profitability. Patient and doctor convenience are both served by locating the centre at the site of the surgeon's consulting rooms, as the patient may attend properly prepared, and have consultation and surgery disposed of on the same day. The ideal usage of such a complex is for high volume, rapid turnover cases, involving mainly healthy patients. Correction of planning mistakes can be ruinously expensive, and not only financially. Therefore the importance of critical analysis and thorough pre-planning cannot be over-emphasized. Safety is a key word. All protocols, whether they concern building, provision of equipment, surgical, anaesthetic or nursing practices, must have safety built in to their methodology. This specifically includes backup systems, and following that, simplicity, efficiency, and flexibility. It will be rewarded by significant savings in capital expenditure, time, running efficiency, job satisfaction and above all, patient satisfaction with the services provided.

Key words: Day surgery, building, planning

Introduction

The reason for building a privately-owned theatre must be determined with absolute clarity. The politicoeconomic climate must allow a reasonable return on the capital expended. i.e., no privately funded clinic can compete with a comprehensive state enterprise except in exceptional circumstances. If the day theatre complex is part of the consulting rooms, safety and efficiency are maximized.

Detailed below is the planning process and a nine year experience of running a privately-owned free-standing day theatre complex in a large Australian city encompassing almost 4000 cases.

Planning

Priorities

1. Patient safety;
2. Critical mass (patient numbers and turnover rate). This determines 3 & 4 below;

3. Building – cost effectiveness;
4. Operating costs (logistics of staffing). Servicing of capital costs, energy costs, disposables, cleaning and maintenance.

Every aspect of processes 1–4 above was thoroughly analysed prior to construction by the planning team, which consisted of two anaesthetists, surgeons from three different disciplines, a builder and a nurse theatre supervisor.

We attempted to have a 'backup' built into every system where possible. Patient safety was made non-negotiable, a decision being made at the outset that if it could not be adequately met because of expense, the project would not proceed. As the capital expenditure available was limited, critical mass also became important and priorities had to be laid down.

Prerequisites

1. Licensing from Department of Health authorities;
2. Building regulations from local authorities.

Depending on the county these regulations vary greatly. Indeed, in some states they may not even exist. In the latter instance it places a much greater responsibility on the surgeons involved. This is not all bad, as much

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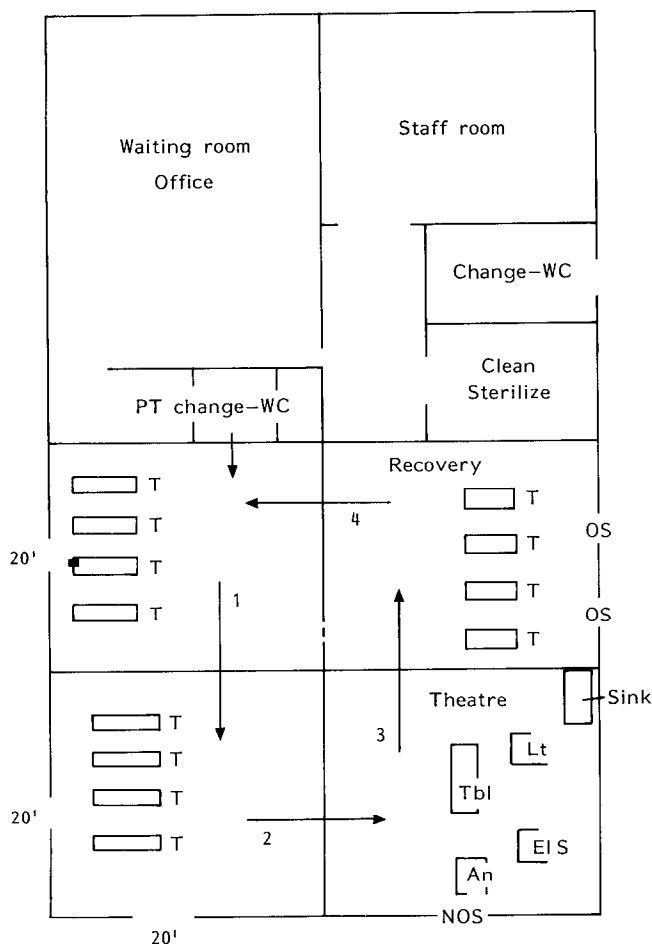


Figure 1. Actual floor plan of operating theatre complex. Arrows represent the patient flow from preanaesthetic room (1) to preanaesthetic room (2) to theatre (3) to recovery room (4), then back to preanaesthetic room (1). OS = oxygen/suction; An = anaesthetic machine; Tbl = operating table; Lt = operating light; NOS = wall-mounted nitrogen/oxygen/suction; T = patient trolley.

greater flexibility and operating efficiency can be achieved.

Capital costs

These were very carefully assessed, as they were fundamental to the viability of the unit.

Architecture

Figure 1 shows the actual plan of the theatre complex. A ground floor site is desirable in case a patient needs to be transferred to hospital. It would be efficient to have consulting rooms as part of the same complex. A ground floor complex allows elimination of an elevator – an expensive item. Optimal use of space is achieved by the circular flow pattern between the preanaesthetic rooms, theatre, and recovery room (see Figure 1). Floors were covered with heavy-duty linoleum with edges curled up to the walls. Doorways were 1200 cm wide, with double doors into the theatre, and a sliding door between the preanaesthetic rooms, and recovery and the anaesthetic

rooms, giving a space of 2400 cm, so that the patients could be properly supervised at all times by one nurse.

Fire control

Even in a ground floor situation attention must be paid to the logistics of what would occur in case of a fire and most especially, the rapid evacuation of patients and staff. A ground floor situation gives an extra degree of safety, but fire extinguishers and smoke alarms, and above all, evacuation drill, are minimal requirements.

Air conditioning

Air conditioning was provided, but only commercial units, one per room. Larger-than-normal units ensured rapid changes of air with minimal recirculation. Absolute filtered air conditioning is a very expensive item, which was not considered necessary in our experience. We have performed over 2000 laparoscopies without any infections whatsoever. More important, we felt, was the absolute exclusion of 'dirty' cases, i.e. no abscesses must ever be opened in such a day theatre.

Floor plan

The floor plan (see Figure 1) was found to be efficient, allowing for eight cases at a time. Provision of natural light in the theatre complex and preanaesthetic bays were found to be uplifting. We therefore chose to locate the sterilizing room behind the recovery room. Of course, it would have been more efficient to have the sterilizing room adjacent to the operating theatre.

Dimensions of rooms

The major rooms, preanaesthetic, theatre and recovery need to have minimum dimensions of 20 sq ft, ideally 24 × 24 ft. No dimensions are given for the other rooms; these can be varied according to requirements.

Flexibility may improve 'critical mass'

A day theatre complex lends itself to specific usage. However, as the capital cost is large, it is important to build in flexibility so that the centre may be used by other specialities, i.e., ideally it should cover orthopaedic, general surgery, plastic surgery, gynaecology and eye surgery.

The 'critical mass' is the minimum amount of turnover needed to achieve a break-even point financially. The ideal use for the purpose-built free-standing day theatre is to deal with cases which are relatively minor and which lend themselves to high turnover, e.g. in gynaecology: laparoscopy, curettage, hysteroscopy, colposcopy/biopsy/cautery of cervix; and in orthopaedic surgery – arthroscopy, back manipulations, epidurals, etc. In low turnover situations, many procedures can be done purely under local anaesthesia, such as hernial repairs and various vaginal repairs.

Patient safety and comfort

Backup anaesthetic and emergency equipment

Backup systems for suction and oxygen were considered a prime necessity, non-negotiable prerequisites, as was equipment to deal with any acute emergency, such as cardiovascular collapse. Large cylinders supplying piped O₂ and N₂O were set up in a special security cage outside the main part of the building. N₂O and O₂ were piped to the theatre, and O₂ to the recovery room. Double-headed gas-driven suction was supplied, giving six separate suction units in all. A cardioverter, ECG monitor. Boyle's anaesthetic machine, a separate double electric sucker unit, a bipolar diathermy unit and a tilting theatre table with a gynaecological collapsible bottom end were installed. No flammable anaesthetic agents were used. A simple 'scavenger system' was installed (exit of the out-flow pipe directly to the outside air).

Sterilizing

Both a large autoclave, and a smaller 'flash' autoclave were provided. Theatre gowns, drapes and instruments were prepared before every list.

Patient trolleys

These should be as simple and as light as possible, with vertical fold-down side retaining bars (to save space), and with a head-tilting facility.

Operating spotlight

This was small, mobile, simple and effective and sufficient.

Absolute exclusion of 'dirty' cases

No abscesses were ever to be opened in theatre.

Intact reflexes

A decision was made never to transfer a patient from the operating theatre to the recovery room unless all reflexes were intact and the patient was properly conscious. This rule worked very well and had many unforeseen benefits, including the imperative for the surgeon to become adept and skilful in the use of local anaesthetics, thereby providing lighter general anaesthetic.

Local anaesthetics were used freely, especially during laparoscopy. This allowed the operation to be performed under lighter anaesthesia.

No opiates were used as it was found that this was the single most important factor in permitting same-day discharge of patients. Liberal use of local anaesthesia largely overcame the need for opiates.

Strict preoperative selection of patients

Only fit, healthy patients were anaesthetised in this facility, given the limited objectives of rapid turnover of minor cases. Initially an anaesthetic clinic was set up, but later on the surgeons pre-selected only healthy patients, and also performed any relevant preoperative tests. This saved much time from the patients' viewpoint. Also, by putting part of the obligation on the surgeon, it gave an extra dimension of cohesiveness and safety to the system. Of course, all patients were fully assessed preoperatively by the anaesthetist.

Preoperative preparation of the patient

Extensive preoperative explanations were given by the surgeon and the nursing staff. Printed letters of what to expect before and after operation were given out preoperatively. Specific operations had specific postoperative sheets issued. Included were after-hours telephone numbers for the surgeon.

Patient anxiety

The essence of a small complex is its personal nature, and by implication the warmth and supportive nature of the staff. Sensitive staff, by thorough explanation and support, can calm the most anxious patient. The most useful component for easing patient anxiety, however, was the fact that the preanaesthetic rooms were shared. Inevitably there was a patient, frequently with prior experience, who took it upon him/herself to calm down the other patients. Preoperative anxiolytic drugs are advisable and background music is also useful.

Specific techniques

These were left to the individual surgeon and anaesthetist. All anaesthetists working at the complex had had vast experience in outpatient anaesthesia. Other than the avoidance of opiates and the extensive usage of local anaesthetic supplement, no specific guidelines needed to be given. (It was found relatively early that vomiting due to opiates was relatively frequent and immensely distressing, to both patient and staff.)

Patient acceptance

Virtually every patient expressed a preference for the surgical facility as against being admitted to hospital. This was an unexpected but welcome finding.

Transfer of patients due to complications

Transfers were extremely rare. There was one case of undiagnosed ectopic pregnancy which had not bled significantly intraperitoneally. There were four cases of perforated uterus on curettage. As soon as the perforation was recognized, laparoscopy was performed. In no case was there any significant bleeding from the perforation.

Nevertheless, for medico-legal reasons the patient was transferred to hospital overnight. There was one case of scoliosis apnoea. This patient required oxygenation for 20 min or so, before spontaneous breathing recurred.

Some hints for operating efficiency

Time and motion studies

These demonstrated that the 'pressure points' delaying the turnover rate were during the induction of anaesthesia, transfer of patient onto the operating table and transferring the patient back off the trolley. An extra set of hands was needed here, and it was found that if the surgeon, the anaesthetist and the theatre staff cooperated, then the turnover was very smooth with minimal time delay. Theatre staff consisted of scrub nurse and two scout nurses. Everyone cooperated in the transfer of the patient and the transfer of the trolleys from room to room.

Multiple set-ups

These were used with their requirements for each case, pre-prepared in sterile pack, i.e. for curettes, a much reduced number of instruments was used and was limited, for instance, to a few dilators, sound, a choice of two curettes.

Patient belongings

The trolleys were all provided with a lower tray. On entry the patient changed to a special theatre gown and placed his/her belongings on the bottom of the trolley. This eliminated the problem of lockers, loss of belongings, etc.

Stock and servicing systems

A diary and protocols for ordering disposables and servicing of equipment was set up. Stable suppliers greatly reduced effort here, as they called in regularly and actually advised on the amount of stock needed.

Staff flexibility

Staff flexibility in job allocation was the key to the efficient functioning of the unit. There were no demarcation lines. Surgeons, anaesthetists and nursing staff all cooperated, where necessary, in every part of the theatre function, even at times assisting in washing down the walls and the floors, which were invariably performed by the nursing staff at the end of each operating list. The charge nurse also worked in the clinic, and one of the clerical staff had previous nursing experience. Therefore the patients were already familiar with two of the staff, so that going to an operating theatre was not such a frightening experience.

Conclusion

The healthcare system has been afflicted by excessive capital and running expenses due to 'over-engineering', i.e. using tertiary referral facilities for many procedures which could be safely and efficiently performed in a simpler facility. A small free-standing centre such as described is a perfect medium for the less invasive procedures certain to become routine in the 21st century.

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Postoperative admissions from a hospital-based day surgery unit

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Postoperative admissions from a hospital-based day surgery unit were analysed over a two year period (1991-2). The overall admission rate was 5.8% with anaesthesia-related causes accounting for 44% and surgery-related causes for 34% of these admissions. The three commonest anaesthetic reasons compelling postoperative admission were drowsiness or slow recovery, nausea or vomiting, and dizziness or faintness. Certain areas of deficiency in the organization of the unit were identified and changes have been implemented. If a 'best anaesthetic technique' for day surgery could be found, this would surely lead to a reduction in postoperative anaesthetic morbidity compelling admission.

Key words: Day case surgery, ambulatory surgery, unplanned admissions

Introduction

The advantages of day case surgery in comparison with inpatient surgery have been widely acknowledged. However, the benefits to both hospital and patients are lost when overnight admission is necessary after surgery. The rate of overnight admission may therefore be used as one indicator of a unit's efficiency. By analysing the factors that precipitate hospital admission following surgery it is also possible to assess the contribution of anaesthesia to the early postoperative morbidity.

Many day surgery units have analysed their postoperative admission rates following surgery. However, we felt that it was essential to examine our own performance as the data from other studies would not be directly applicable to our unit. At Dudley Road Hospital day surgery patients are accommodated in a separate ward, but are treated in the main operating theatre, sharing the operating sessions with inpatients. This study was carried out to determine our unit's postoperative admission rate so that a standard could be established for future audit. The factors that compelled hospital admission were also analysed to assess the contribution of anaesthesia to the early postoperative morbidity.

Method

The total number of patients that attended the day surgery unit under the care of five surgical specialities during a two-year period (1991-2) was recorded from the unit's register. Those patients admitted to a hospital ward after surgery were identified and from their case notes the following were recorded: details of the patient, medical personnel, operation and anaesthetic technique. For each patient the compelling reason for admission was determined. Patients were excluded from further analysis either if they were admitted without undergoing the intended procedure, or if the procedure was performed under sedation (e.g. upper gastrointestinal (GI) endoscopy, endoscopic retrograde cholangiopancreatography (ERCP) and colonoscopy). Descriptive statistics were used to analyse the data.

Results

Table 1 shows that there was a large variation in utilization of the day surgery unit by the five surgical specialities: gynaecology, urology, general surgery, orthopaedics and oral and maxillofacial surgery (oral/max). The overall admission rate was 5.8% and the number of postoperative admissions in each speciality was generally consistent with the workload, except for orthopaedics which had a disproportionately high admission rate (number of admissions from a speciality divided by the total number of patients treated by that speciality).

Out of the 250 admissions we analysed 157 case notes (63%). One gynaecology and two general surgical patients were admitted without undergoing the intended

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Table 1. Workload and admission rates of surgical specialities 1991–92

<i>Surgical speciality</i>	<i>Total no. patients (%)</i>		<i>Patients admitted (%)</i>		<i>Case notes obtained (%)</i>		<i>Admission rate (%)</i>
Gynaecology	1575	(36)	90	(36)	70	(45)	5.7
Urology	1294	(30)	51	(20)	31	(19)	3.9
General surgery	899	(21)	45	(18)	25	(16)	5.0
Orthopaedics	379	(9)	49	(20)	23	(15)	12.9
Oral/max	181	(4)	15	(6)	8	(5)	8.3
Total	4328	(100)	250	(100)	157	(100)	5.8 (overall)

Table 2. Demographic details of patients admitted post-operatively

Age (yr)	30	median
	3–81	range
Sex (M/F)	53/104	34/66%
Weight (kg)	67	median
	16–110	range
Duration of anaesthesia (min)	24	median
	10–100	range
ASA 1	119	75.8%
ASA 2	36	22.9%
ASA 3	1	0.65%
ASA 4	1	0.65%

Table 3. Grade of the most senior medical personnel at operation

<i>Grade</i>	<i>Anaesthetist (%)</i>		<i>Surgeon (%)</i>	
Consultant or senior registrar	126	(80)	92	(59)
Registrar	23	(15)	44	(28)
Senior house officer	5	(3)	11	(7)
Grade not known	3	(2)	10	(6)

procedure because of medical complications and 90 case notes were not retrieved. The distribution of surgical specialities in the 157 case notes was broadly similar to the specialities of the 250 admissions, with the exception that relatively more gynaecology case notes were retrieved (Table 1).

Patient details

The demographic data of the 157 patients is summarized in Table 2.

Grade of most senior anaesthetist and surgeon present at operation

Table 3 shows that the patients in 80% of the cases reviewed were anaesthetized by either a senior registrar

or consultant anaesthetist. This contrasts with the 59% of cases where the surgeon was of a similar senior grade.

Reasons for admission

The complications that compelled overnight admission were grouped under four main categories as summarized in Table 4 and their overall frequency is illustrated in Figure 1.

Complications by speciality

The relative frequency of admission categories varied according to the surgical speciality as shown in Table 5.

Gynaecology admissions

Sixty per cent of these patients were admitted because of anaesthesia-related complications. Nausea or vomiting, drowsiness or slow recovery, dizziness or faintness and pain accounted for 29, 26, 21 and 19% of anaesthetic causes respectively. More than 40% of the gynaecology admissions followed laparoscopic sterilization and a further 43% had undergone some other laparoscopic procedure. Three-quarters of the admissions that had a surgical complication were due either to suspected viscus perforation or unanticipated extended surgery.

Urology admissions

Nearly half of the patients in this speciality were admitted because of surgery-related factors such as, extended surgery following cystoscopy, postoperative bleeding and postoperative urinary retention. Some of the patients admitted with urinary retention had been given caudal local anaesthetic injections. Other anaesthetic complications present in this speciality included nausea and vomiting, drowsiness or dizziness.

General surgery admissions

The reasons for admission were equally distributed between surgical, anaesthetic and social and administrative factors.

Orthopaedic admissions

Eighty per cent of the orthopaedic admissions had undergone arthroscopic surgery and the principal surgical rea-

Table 4. Categories and complications that led to postoperative admission

<i>Category (% of admissions)</i>	<i>Complication (% of each category)</i>				
Anaesthesia	Drowsiness or slow recovery	Dizziness or faintness	Pain	Nausea or vomiting	General & regional anaesthetic complication
(44)	(28)	(25)	(13)	(26)	(4) & (4)
Surgery	Bleeding	Extended unplanned surgery	Inpatient postoperative management	Surgical technique complication	
(34)	(20)	(32)	(24)	(13)	
Social and administrative	No supervision at home	Too late to discharge home			
(16)	(52)	(48)			
General medical and miscellaneous	Observation of medical condition	Non specific discomfort			
(6)	(44)	(56)			

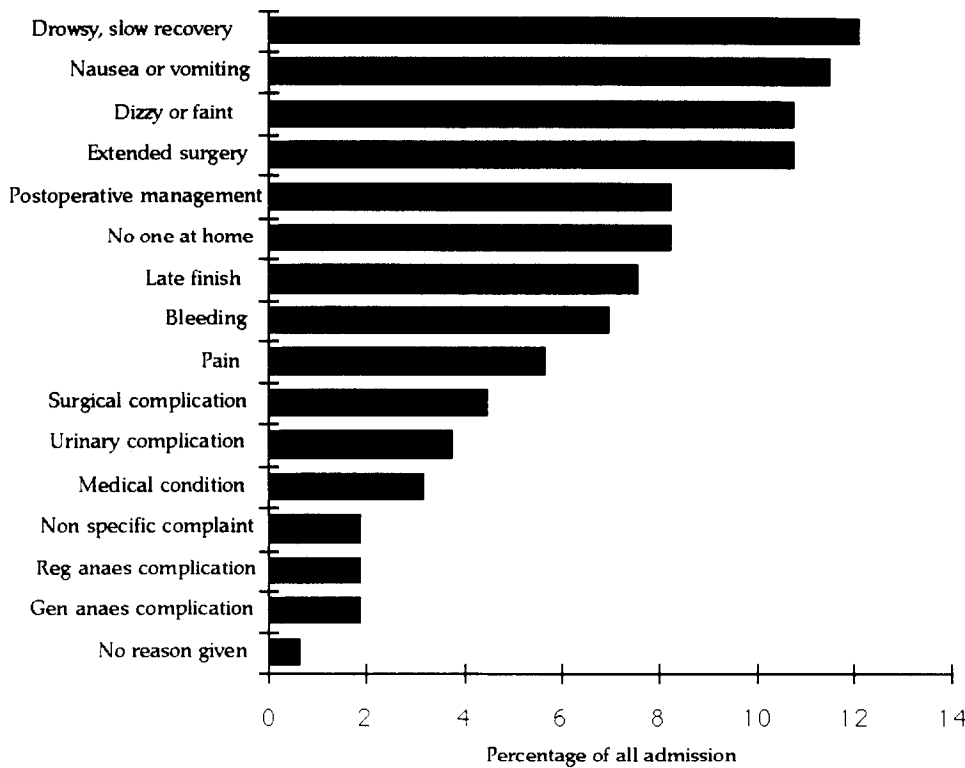


Figure 1. Frequency of complications that compelled admission

Table 5. Distribution of admission categories between the different surgical specialities

<i>Speciality (No. patients)</i>	<i>Gyn (70)</i>	<i>Urol (31)</i>	<i>Gen surg (25)</i>	<i>Ortho (23)</i>	<i>Oral/max (8)</i>	<i>All* (157)</i>
Admission Category	<i>Percentage of admissions from each surgical speciality in the admission category (%)</i>					
Anaesthesia	60	32	28	26	50	44
Surgery	29	48	32	39	25	34
Social/admin	8	16	28	30	0	16
Gen med/misc	3	3	12	4	25	6

*All specialities.

Table 6. Anaesthetic agents used in the patients admitted

	<i>Agents</i>	<i>No.</i>	<i>(%)</i>	
Premedication	Yes/no	20/137	13/87	
Induction agent	Propofol	110	70	
	Thiopentone	43	27	
	Etomidate	1		
	None used	2		
	Not recorded	1		
Antiemetic	Given/not given	48/103	31/66	
	Not recorded	6	3	
Maintenance	Enflurane, O ₂ , N ₂ O	137	87	
	Halothane, O ₂ , N ₂ O	10	6	
	Isoflurane, O ₂ , N ₂ O	6	4	
	Propofol	1		
	None	1		
	Not recorded	2		
Muscle relaxant	Alcuronium	27	17	
	Atracurium	14	9	
	Suxamethonium	12	8	
	Vecuronium	13	8	
	Vec & Sux	1		
	None used	90	57	
	Analgesic	None	31	20
		Biers block	1	
Local		1		
Spinal		1		
Caudal		5		
Caudal & opioid		2		
NSAID		2		
Opioid & NSAID		9	6	
Local & opioid ± NSAID		3		
Opioid combinations		11	7	
Opioid only		91	58	
Alfentanil (3)				
Fentanyl (80)				
DF118 (3)				
Morphine (2)				
Papavaretum (3)				

sons for admission were extended surgery and the need for inpatient postoperative management. The commonest anaesthetic complication was dizziness or faintness.

Oral/maxillofacial admissions

The eight patients in this speciality were admitted principally because of postoperative bleeding or drowsiness and vomiting.

Anaesthetic technique

Table 6 summarizes the anaesthetic agents used. Except in two patients who received spinal or intravenous regional anaesthesia, general anaesthesia was employed in all the admissions. Premedication was given in 13% of patients. Propofol was the preferred induction agent and was used in 70% of patients. An antiemetic was given to 33% of patients either with the premedication or intraoperatively. Maintenance of anaesthesia almost invariably included a volatile agent which was usually enflurane. More than 40% of patients received a neuromuscular blocking drug. An analgesic was given in

80% of patients and over 90% of these patients received either an opioid alone or in combination with another agent.

Discussion

Unplanned postoperative admission is a useful measure of outcome following day surgery. This audit has revealed that the postoperative admission rate in our unit ranged from 3.9–12.9% depending on the surgical speciality, but the overall rate was 5.8%

Studies of other day surgery units have found unplanned admission rates that range from less than 1%¹ to 9.5%². The rate is influenced by the type of unit and it is recognized that hospital-based units tend to have higher admission rates compared to free-standing units. When patients cannot be readily admitted into a hospital bed, strict adherence to patient selection criteria and careful choice of surgery and anaesthesia becomes obligatory to minimize the likelihood of postoperative admission.

Compared to many of the published rates, the admission rate from our day surgery unit is high. This may be the result of a number of factors. Dudley Road Hospital

serves the fourth most deprived population in UK health districts. About half of our 'social' admissions were patients who would have been alone at home on the night after surgery. Patients were not assessed by either the nursing staff or the anaesthetist to ensure their suitability as day cases prior to admission. The unit is hospital-based and on the day of operation, given the relative ease of postoperative admission, patients considered inappropriate for day surgery were seldom postponed or reallocated to inpatient surgery.

Apart from a separate day ward where they receive preoperative and postoperative care, the patients in our unit are treated in the same operating session as the inpatients. This may have tended to blur the distinction between the two types of patient so that surgical management was not constrained necessarily by the need to discharge the patient later in the day; diagnostic procedures could proceed to definitive surgery which might entail a period of inpatient postoperative management.

The day surgery ward had to close by 18.00 h and this limited the time available for postoperative recovery, particularly after operations performed in the afternoon. If it was anticipated that the patient might not be ready to return home by 18.00 h a decision had to be made earlier so that a bed could be located for the patient to stay in hospital overnight. As a result a number of patients ('late finish') were admitted because it was considered too late in the day to discharge them.

Since this audit patients proposed for day case surgery at the outpatient clinic are first assessed by nursing staff and, when necessary by an anaesthetist, before they are listed for surgery. The day ward hours have been extended and these changes should ensure that fewer patients will require postoperative admission.

In common with the findings of other investigators^{3,4}, we found high admission rates following orthopaedic and gynaecology procedures. In our unit, orthopaedic surgery resulted in the highest admission rate (12.9%), the large majority of these admissions had undergone diagnostic arthroscopy – a procedure which often led to further surgery, requiring admission for postoperative inpatient management. Laparoscopic gynaecological procedures predisposed to the development of postoperative anaesthetic complications, especially nausea and vomiting.

Overall, the three commonest reasons compelling postoperative admission were related to anaesthesia. This is in contrast to the findings in most of the published studies, where surgery-related complications were the principal reason for admission. However, gynaecology patients accounted for the largest group of admissions in our unit and the commonest reason for postoperative admission in these patients, as in a survey of day case gynaecological surgery⁵, was nausea and vomiting. We also regarded postoperative pain requiring management in hospital as an anaesthetic complication, whereas most other studies consider this to be a surgery-related problem.

It may be possible to reduce some of the anaesthetic causes of unplanned admissions following day surgery

by a change in anaesthetic technique. Johnson and Jarrett¹ noted that admissions for anaesthetic reasons decreased after the introduction of propofol. Kortilla and colleagues⁶ found that patients who were given propofol for induction and maintenance of anaesthesia had less nausea and vomiting and were ready for discharge home sooner than control patients who received thiopentone for induction and isoflurane for maintenance. Twenty-seven per cent of admissions in our unit received thiopentone. Would the exclusive use of propofol for day surgery lead to a reduction in anaesthesia-related admissions?

Although 13% of the patients admitted received a premedicant drug (temazepam in all cases), only two of these patients were admitted because of drowsiness.

The second commonest cause of admission was due to nausea and/or vomiting. As 66% of these admissions did not receive any antiemetic, it is tempting to speculate that the use of a prophylactic antiemetic in these patients could have reduced these admissions. Many of the antiemetics in current use, however, are either ineffective^{3,7} or may have unacceptable side effects. The new 5-hydroxytryptamine-3 antagonists have shown promise in the prevention of nausea and vomiting during cancer chemotherapy, and their use in day case anaesthesia should be explored.

The use of opioid analgesics, in particular fentanyl, was common in our patients. However, this practice would almost certainly predispose to nausea and vomiting. We feel that there is more scope for increased use of non-steroidal anti-inflammatory drugs (NSAIDs) in day case surgery. There is some evidence that the use of NSAIDs before body surface surgery may provide better postoperative pain relief without the concomitant side effects seen with opioid drugs⁸.

Caudal analgesia led to four admissions because of postoperative urinary retention – a well recognized side effect. Further studies are required to clarify the place of caudal analgesic techniques in day surgery.

In agreement with most other studies, our main surgical reasons compelling admission were extended surgery and the need for inpatient management. This reflects the nature of some of the commonly performed day case procedures (cystoscopy, arthroscopy and laparoscopy) which may entail further surgery.

This study has demonstrated that many different factors contribute towards unplanned admission following day case surgery. Changes have already been implemented in the organization of the day surgery unit and plans are in place to establish dedicated day case operating lists early in 1994. If a 'best anaesthetic technique' for day surgery could be identified and adopted, then this would surely lead to a reduction in anaesthesia-related complications.

Successful day case surgery relies on careful patient selection, the appropriate choice of surgery and good anaesthetic management – requirements which will increasingly be challenged with the trend towards performing more day surgery, including more ambitious procedures, and on less fit patients.

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An open randomized study of the effects of intravenous fluid replacement during day case anaesthesia

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We examined the effect of hydration on recovery from anaesthesia in 66 patients undergoing therapeutic abortion as day cases. Patients received a standard anaesthetic technique. Group 1 received 1 litre of 5% dextrose over 1 h preoperatively. Group 2 received no preoperative fluid. Patients were asked to complete a questionnaire before and after the operation to detect minor morbidity. Pain and 'well-being' scores were measured postoperatively. There was a significantly lower incidence of dizziness and thirst in group 1 postoperatively compared to group 2. Other symptoms were similar in both groups. Fluids before day-stay operations may have beneficial effects.

Key words: Day surgery, anaesthesia, preoperative fasting, intravenous fluids

Introduction

Patients undergoing surgery are routinely starved preoperatively to minimize the risks of anaesthesia associated with a full stomach. For a long time there has been a suspicion that the well-being and recovery of patients after anaesthesia is prejudiced by dehydration and preoperative starvation. This is, perhaps, of even greater importance in day case work.

The question of perioperative fluid replacement in minor surgery has not been fully answered. However, recent studies suggest that such patients may benefit significantly from fluid replacement¹⁻³.

Method

The study was approved by the local District Ethics Committee. Sixty-six women undergoing therapeutic abortion as day cases were seen preoperatively and gave written informed consent. All patients were ASA 1 and aged between 17 and 30. Each patient was given a preoperative questionnaire on which she was asked to reply

“yes” or “no” to whether she had suffered the following symptoms: dizziness; nausea; vomiting; drowsiness; headache; sore throat and thirst.

An 18 gauge intravenous cannula was placed in the non-dominant arm under local anaesthetic. Each patient was allocated randomly to one of two groups. Patients in group 1 received 1 litre of 5% dextrose intravenously over 1 h, while patients in group 2 received no fluid. Both groups received a standard anaesthetic technique for this procedure: No premedication; Fentanyl ($1 \mu\text{g kg}^{-1}$) followed by a sleep dose of propofol ($2.0\text{--}2.5 \text{ mg kg}^{-1}$). The patient then breathed nitrous oxide (66%) and oxygen (34%) from a Bain circuit delivered to a face mask. Anaesthesia was maintained with 25 mg incremental boluses of propofol at the discretion of the anaesthetist.

In addition, all patients received glycopyrrolate (0.1 mg) and metoclopramide (10 mg). They also received 5 iu of syntocinon prior to starting suction termination of pregnancy. Pulse rate, blood pressure, electrocardiogram, respiratory rate and oxygen saturation were monitored before induction, throughout anaesthesia and in the recovery area. Once the patient was adequately awake and able to mobilize, they were transferred to a step-down unit for further recovery. Here they were asked to complete a postoperative questionnaire which required them to indicate whether or not they had suffered the following symptoms (“yes” or “no”): dizziness; nausea; vomiting; pain; arm discomfort; sore throat and thirst. In addition, they were asked to indicate on visual

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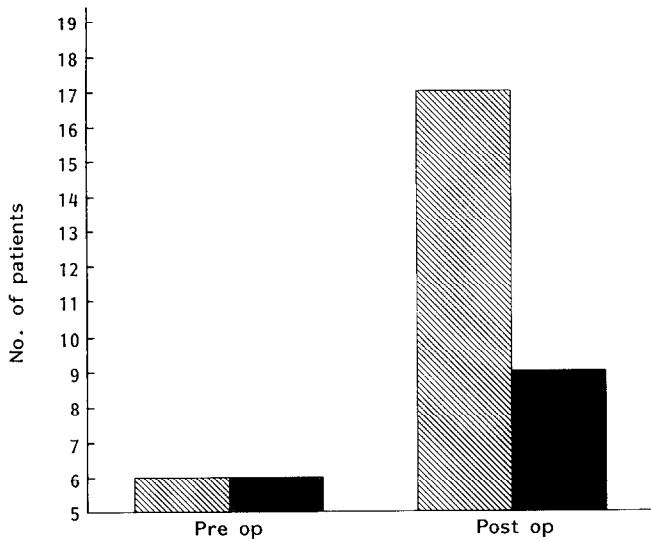


Figure 1. Dizziness ($P < 0.05$). ▨ No drip; ■ drip.

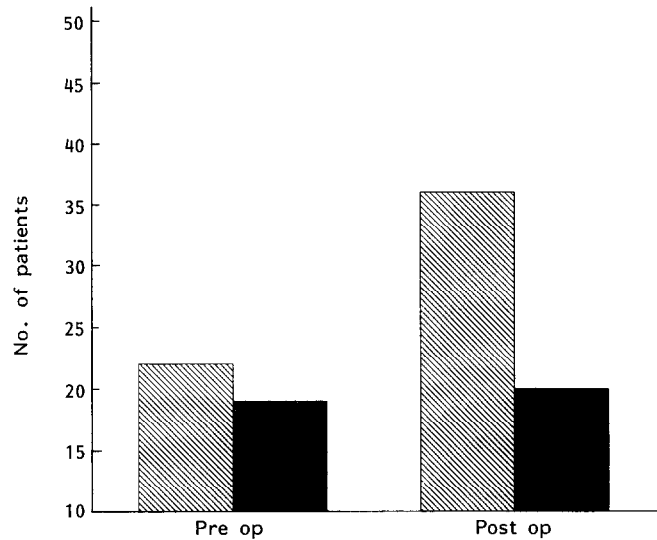


Figure 2. Thirst ($P < 0.05$). ▨ No drip; ■ drip.

analogue scales how they felt when they woke up (0 = terrible, 10 = wonderful) and if they were in any pain (0 = no pain, 10 = severe pain). The two groups were compared pre- and postoperatively. Results were analysed using the χ^2 test.

Results

There was no significant difference between the groups in either duration of anaesthesia (7–10 min) or total propofol (150–200 mg) and total fentanyl administered.

Dizziness

Patients in group 1 (iv fluids) had a significantly lower incidence of dizziness ($P < 0.05$) compared with those in group 2 (no fluid). There was also a significant increase in dizziness postoperatively compared with preoperatively in group 2 ($P < 0.05$). However, there was no increase in incidence postoperatively in group 1 (Figure 1).

Thirst

There was a significantly higher incidence of thirst in group 2 postoperatively compared to group 1 ($P < 0.05$). However the incidence was similar in both groups preoperatively. In addition, the incidence of this symptom increased postoperatively in group 2 when compared to preoperatively. This was not the case for group 1 (Figure 2).

Nausea

Both groups showed a significant decrease in this symptom postoperatively. However there was no significant difference between the groups (Figure 3).

The incidence of vomiting and arm discomfort was similar in both groups. Both groups also showed similar scores for pain and ‘overall well-being’ in the operative

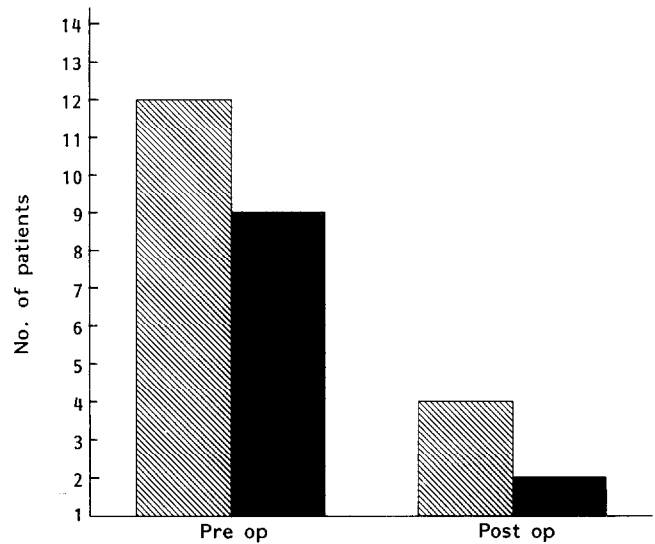


Figure 3. Nausea ($P < 0.05$). ▨ No drip; ■ drip.

period. Cardiovascular and respiratory parameters remained stable postoperatively in both groups and there were no clinically or statistically significant differences between the groups.

Discussion

Patients presenting for day case surgery may be starved for up to 12 h. In addition this group of patients lose blood during the procedure. The resulting depletion of intracellular and extracellular fluids (especially in warm weather) may contribute to minor morbidity postoperatively. Routine monitoring of the patients did not show any differences in cardiovascular parameters between the two groups postoperatively. However it is likely that

compensatory mechanisms would have masked any effects.

In 1986 Keane et al.¹ showed that there was a reduction in drowsiness and thirst postoperatively following perioperative fluid therapy. Similarly, Spencer² has provided evidence of some benefit in minor gynaecological surgery of this type of fluid replacement. Cooke et al.³ assessed the effect of fluid and dextrose administration on recovery in patients undergoing day case laparoscopy. They found a lower incidence of minor symptoms (for example nausea) in those given fluid, and a lower incidence of sore throat and dizziness in those who received dextrose. However, they were unable to establish unequivocally an overall difference when a number of variables were considered. They concluded that a trend was established suggesting an advantage to fluid administration but further studies were required.

Recently, Ooi et al.⁴ examined the effect of hydration on immediate recovery from anaesthesia in two groups of 15 patients undergoing therapeutic abortion. They assessed subjective symptoms using a questionnaire. In addition, they used objective tests of psychodynamic function and reaction times. In this study they were unable to demonstrate any obvious benefit of intravenous fluid administration.

Our findings of a lower incidence of dizziness and thirst in patients receiving intravenous fluid and dextrose support those of previous studies¹⁻³. Nausea is common in early pregnancy. In our study, we showed a decrease in nausea in both groups postoperatively with no difference between the groups. This is contrary to the findings of Cook et al.³. All our patients received metoclopramide on induction, however, and propofol is associated with a good quality of recovery and a low incidence of nausea.

Pain scores were similar for both groups. This procedure is not normally associated with severe postoperative pain and all patients received fentanyl on induction. Ooi et al.⁴ noted in their study that the emotional overlay of therapeutic abortion may effect the results of both subjective and objective tests of recovery. This may be why there was no obvious difference in overall well-being between the groups. We must also consider the sensitivity of our tests in detecting such differences.

Day surgery is generally well accepted by patients for minor and intermediate surgery where modern anaesthetic techniques and minimally invasive surgery are associated with rapid patient mobilization. So called 'minor' side effects such as nausea and dizziness are therefore perceived as of greater importance by such patients. Our findings do lend support to the view that intravenous fluids before operation may have a beneficial effect on minor postoperative morbidity, however there are other issues to be considered. In our day case unit, patients are

allowed to be mobile prior to operation and many patients found the intravenous infusion inconvenient. In addition previous studies have commented on the cost effectiveness of administering intravenous infusions routinely to all day case patients⁴.

A recent study by Phillips et al.⁵ compared the effect of allowing elective surgical patients to drink clear fluids until 2 h before anaesthesia with conventional fasting. There was no increase in either gastric volume or pH in the study group compared with the control group. Other studies have shown that modest oral fluid administration before premedication is tolerated well⁶. However, Goodwin et al.⁷ found no significant difference in the incidence of pain, nausea or headache in 100 day surgical patients undergoing first trimester termination of pregnancy, who were randomly allocated to receive either 150 ml of clear fluid 1.5-2 hours before anaesthesia or to fast from midnight the night before. Further work needs to be performed to determine which of these two approaches offers the best option for day case surgery.

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Congress report

Panel on Ambulatory Surgery: Creative, efficacious and cost effective choices in ambulatory surgery Presented at the 1993 Annual Meeting, American Society of Anesthesiologists, Washington, DC, USA

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Over 50% of surgery in the US is now performed on an outpatient basis and is predicted to increase to 70% over the next few years. The challenge that we face as anesthesiologists is to provide effective, quality, safe anesthetic care in an increasingly cost-conscious ambulatory surgery environment. Dr Roizen's presentation, 'Laboratory

testing in the healthy adult: When are HCG, CXR, EKG, electrolytes or UA really necessary?' covered the theory and value of laboratory testing, evaluation of specific tests, and methods to ensure that a patient is asymptomatic and without risk factors for disease. Health care expenditures in the US have been rising rapidly since 1965 and if the same rate of growth continues, are expected to reach 100% of the gross national product by the year 2100. However, the amount spent on health care, including testing, does not equate with improved health of the population. According to a curve plotting wellbeing vs. health expenditures, once the

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optimal point on the curve is exceeded, benefit declines and risk increases. Tests in asymptomatic individuals are not beneficial in screening for disease and may result in more harm than benefit. The value of each test must be considered in the context of its predictive value (sensitivity, specificity), disease prevalence and risk/benefit ratio. For example, if 13 blood tests were ordered in a group of healthy, asymptomatic individuals, the chance of one test being abnormal would be 64%. The chance of one being significantly abnormal would be slight, probably <1%. Tests are more valuable for case finding in high risk groups: electrocardiogram (EKG) in males over 40, PAP smear every 1–3 years in females of childbearing age) or optimization of a known medical condition (glucose in diabetes). The key point in determining which tests to order is history.

Dr Roizen next discussed individual tests. For pregnancy, enquiry is the best tool. Human chorionic gonadotrophin (HCG) testing is only useful when the pregnancy status of a woman of childbearing age is uncertain. Chest X-ray is indicated for many categories of pulmonary/cardiovascular and other disease states. For example, in patients with arthritis, chest X-rays revealed a 68% incidence of abnormalities, of which 31% were significant; for patients post-heart-surgery over 50% of X-rays were significantly abnormal. Of 30 studies reported in the literature representing 26 000 asymptomatic patients under age 40, 31.9% had chest X-ray abnormalities of which 0.4% were significant. Of 9000 patients over age 74, 8.5% had significant abnormalities. According to risk/benefit analysis there would need to be at least 2.6% new and significant abnormalities for the screening benefit of the chest X-ray to outweigh its risk. This was found only in patients age 74 or over. Care was not changed nor outcome improved for asymptomatic patients who had chest X-rays. In a recent study by Warner in the *Journal of the American Medical Association* of long-term morbidity/mortality following ambulatory surgery in asymptomatic patients, preoperative chest X-ray did not prevent death by motor vehicle accident, myocardial infarction, pulmonary embolus, or stroke.

Indications for EKG are complex and include history of cardiac disease and many noncardiac conditions. For patients with angina, there is a 51.7% incidence of EKG abnormalities of which 27% are significant, while EKGs obtained in an asymptomatic population revealed a 5.6% incidence of abnormalities, with no significant abnormalities. Significant abnormalities increase with age. Based on risk/benefit analysis, routine EKGs are justified only in men over 40 and women over 50. Electrolytes are not recommended under the age of 40 except for specific indications. In patients receiving potassium supplementation there was an 8% incidence of significant electrolyte abnormalities compared to 1% in asymptomatic patients. Screening urinalysis detected less than 2% significant abnormalities and should never be done without indication.

Based on the above analysis, Dr Roizen has developed a series of recommendations for laboratory testing as

Table 1. Recommendations for laboratory testing

Age	Male	Female
6 months – 40 yr	None	Hct Pregnancy test (age 12–40)
40–50	EKG	Hct Pregnancy test (age 12–40)
50–64	EKG	Hct, EKG
60–74	Hct, EKG, BUN, glucose	Hct, EKG, BUN, glucose
> 74	Hct, EKG, BUN, glucose Chest X-ray	Hct, EKG, BUN, glucose Chest X-ray

shown in Table 1. At least \$4 billion/year is spent in initial preoperative laboratory testing plus 10 times that in additional expenditures for follow-up of abnormalities. Dr Roizen's conclusion, based on statistical analysis, is that 60–70% of laboratory tests now being ordered are not indicated. The danger of no history is missing significant abnormalities. It is not useful to get tests for everyone and it may be dangerous not to get tests and not to do a history.

Dr Philip, in discussing 'Does choice of general anesthesia really make a difference?' considered cost-effective options for general anesthesia in the context of a prototype ambulatory surgery procedure: 33-year-old ASA I patient for laparoscopy. She defined the goals of general anesthesia for ambulatory surgery as a smooth onset, providing favorable intraoperative conditions, rapid immediate recovery, associated with minimum postoperative sequelae and prompt return to street fitness. Factors affecting the ultimate anesthetic cost in addition to drug acquisition cost are the extent of pharmacy mark-up (charge to patient), charge for extra preparation/control, billings to various hospital budgets, separate anesthesia charges (MD and supply), waste, cost of equipment required for drug administration, and surgeon/patient preferences.

Several studies have compared the effects of induction agents thiopental, methohexital, and propofol on recovery. Immediate recovery was slower with thiopental, while propofol showed an advantage for early awakening and recovery (ability to cooperate) compared to methohexital, but only for the first 15 min. There was, however, a greatly reduced incidence of nausea and vomiting with propofol compared to methohexital (43 vs 17%). The relative costs were calculated for each drug: thiopental (\$0.51), methohexital (\$1.54), and propofol (\$6.34). Although there is a fourfold difference in cost between propofol and methohexital, the reduction of emesis by propofol may justify its increased cost.

Other studies compared recoveries with different maintenance techniques. Following a 1–2 h anesthetic, desflurane compared to isoflurane was associated with immediate recovery in half the time (eye opening, response to command) but conferred no advantage after 90

min or in ultimate recovery (home readiness). All patients in this study received heavy sedation plus thiopental for induction. In another study of isoflurane and sevoflurane recoveries following propofol induction and 1 h of anesthesia, although an early advantage was found with sevoflurane because of less nausea/vomiting and somnolence, there was no difference in time to first analgesic need or discharge. Comparing isoflurane vs. propofol by infusion following propofol induction, the initial wakeup and intermediate progression was faster with propofol with no difference in incidence of nausea and vomiting. In this study costs for isoflurane were \$11, compared to \$15 (plus \$5 waste) for propofol. One study compared differential recovery times with estimated workload reduction in the postanesthesia care unit (PACU). Use of propofol compared to thiopental/isoflurane resulted in a 5.4–8.5 h workload reduction. To benefit from this potential savings would require an increase in PACU volume or a decrease in staffing. In another study patients who received propofol compared to thiopental/isoflurane for breast biopsy had less vomiting, improved ability to engage in light activity, and returned to work one half day sooner. The significance of this benefit is uncertain.

The relative costs of commonly used anesthetics were calculated by Dr Philip. Based on cost per liter of vapor, assuming 3 l diluent gas flow at 1 MAC for 1 h, costs were less than \$1 for halothane, \$12 for enflurane or isoflurane, and \$6–17 for desflurane, depending on diluent gas flow (1–3 l). The cost of narcotics ranged from 7 cents per dose of fentanyl, \$1 for sufentanyl, and \$2 for alfentanil. For relaxants, considering the cost of intubation plus maintenance doses for 1 h, succinylcholine was only \$2–3, vecuronium or mivacurium \$14, and atracurium \$18. The costs of pancuronium and curare for maintenance alone were \$1–2. Dr Philip encourages us to question what value we are getting for what price. In order to properly assess the relative costs of general anesthesia for ambulatory surgery, specific recovery goals for early, intermediate, or late recovery must be defined. The benefits of a particular agent are specific to a procedure, its duration, an institution and its policies. Time savings do not translate into cost savings. Patient satisfaction may not be quantifiable. In conclusion, for analysis of cost effectiveness, determining the price is simple but determining the value is complicated.

Dr Mulroy considered 'Is regional anesthesia a viable choice?' for the same healthy ambulatory surgery patient undergoing laparoscopy. He practices at the Virginia Mason Clinic, where 60% of procedures involve outpatients of whom 60% receive regional anesthesia. The advantages of regional anesthesia are highlighted in the recovery process: decreased incidence of nausea and vomiting, readiness for rapid discharge, and persistence of analgesia during the postoperative period. It must be understood that pain and nausea/vomiting are complications in outpatients, generating cost for treatment and heading the list of unplanned admissions. In one British study of orthopedic patients who received narcotics,

40% vomited, of whom 23% were admitted. Although propofol has improved the quality of general anesthesia for the ambulatory patient by producing rapid recovery, the incidence of nausea/vomiting is still 15–25%.

At the Virginia Mason Clinic a prospective, randomized study was conducted this year comparing propofol general anesthesia vs. axillary block for hand surgery. The cost of drugs and equipment were comparable for either technique. The major difference was in discharge times. The discharge time for axillary block was 1 h compared to more than 2 h for propofol, representing recovery room cost savings. The anesthesia time was 16 min longer for the axillary block, which was performed in the induction room and did not delay surgery. Interestingly Dr Mulroy believes that recovery room time could have even been 30 min less for the regional group if discharge was aggressively promoted. These times and cost savings are important, especially when little sedative is administered and patients can be advanced directly to phase two recovery.

In an earlier study at the same institution comparing enflurane general anesthesia, fentanyl/N₂O general anesthesia, and chloroprocaine epidural for laparoscopy, the recovery times were 2 h for the regional, 2½ h for the inhalational, and 3 h for the narcotic technique. The incidences of nausea and vomiting were 10%, 25%, and 40% respectively. The differences in recovery stay were attributable to differences in the incidence of nausea and vomiting. Based on this study, narcotics are no longer used at Dr Mulroy's institution for general anesthesia for laparoscopy. Some might question whether epidural anesthesia is a reasonable choice for laparoscopy. Dr Mulroy responds that epidural anesthesia is not suitable for lengthy laparoscopies for infertility associated with a high anxiety state. Epidural is recommended for selected laparoscopies expected to be of short duration, with minimum distension, and for a cooperative patient. He asserts that in the right situation, epidural anesthesia is a very pleasant experience for laparoscopy.

Dr Kapur's presentation, 'Innovative options for postoperative pain control: RA, PCA, combined techniques, local infiltration, NSAIDS, intra-articular narcotic' concentrated on the decision-making process involving postoperative pain control. She noted that factors dictating choices for postoperative pain control are related to the specific modality itself, the type of surgery and the patient. Narcotics, the primary option, are the mainstay of postoperative pain management. Negative associations about narcotics stem from experience with prolonged recovery room stays and various side effects: sedation/somnolence, nausea/vomiting, constipation and pruritis. If systemic narcotics are selected for pain control, efforts should be made to use generic forms to lower cost and anesthesia techniques such as inclusion of propofol, administration of prophylactic antiemetic, and careful titration to diminish side effects. Dr Kapur outlines three phases of narcotic administration therapy for the recovery room: use of short onset drugs (fentanyl) intravenously, followed by moderate duration drugs

(hydromorphone) intravenously, and accompanied by moderate duration drugs orally. Narcotics must be aggressively titrated to maintain momentum, which should be continued with a prescription ready at discharge.

Nonsteroidal drugs, especially Ketorolac have received mixed reviews as to their narcotic sparing effect. They may be given orally or parenterally, alone or in combination with other agents. Early administration is important since time is required for effect. The only major reported risk is bleeding. Advantages of local infiltration are low cost of generic preparations and ability to decrease requirements for systemic narcotics by depression of neural feedback loops. While local anesthetics are particularly effective prior to surgical incision, new data indicates that they are also effective postprocedure. Intra-articular narcotics such as Duramorph have also proven to be very effective in postoperative pain control and may be used with or without local anesthetic. Systemic absorption does occur. Time should be allowed for onset of effect prior to joint irrigation.

Regional anesthesia (RA) is an ideal primary technique for extremity surgery, decreasing the need for analgesics intra- or postoperatively. This technique may be combined with sedative/hypnotics and also has pediatric applications. 'Kiddie caudal' is especially useful for urologic procedures. Patients who have not fully recovered from regional anesthesia at discharge should be given specific instructions for protection of the extremity. Patient-controlled analgesia (PCA) is best administered in a 23-h observation unit or at home for procedures requiring more intensive postoperative pain management such as laparoscopic cholecystectomy or anterior cruciate ligament repair. While resulting in greater patient satisfaction with less intensive nursing care, side effects are encountered and costs for equipment and drug preparation may be considerable. Whatever the choice, Dr Kapur recommends addressing the plan for postoperative pain control prospectively with the patient. The recovery room staff is encouraged to 'buy in' when clear-cut protocols are established and commitment is made to early pain treatment.

Dr Apfelbaum explored the provocative, complex, and controversial question of 'Post-operative care management: Is phase I recovery always necessary? What are appropriate discharge criteria in the 90s?' In an era of cost consciousness and outpatient cases of increasing complexity, he urges development of creative strategies for management of the recovery process. PACU care is in fact 'intensive care', and the luxury and expense of prolonged recovery room care is extinct. It must be recognized that ambulatory patients have very different needs from inpatients and place special demands on our anesthetic management for a rapid, yet safe recovery. With introduction of newer anesthetic agents, some patients already meet discharge criteria on arrival to the PACU.

Our decisions about the postoperative management of patients are influenced by measurements of recovery by

existing scoring systems, Joint Commission on Accreditation of Healthcare Organizations (JCAHO) and American Society of Anesthesiologists (ASA) standards, and practical discharge criteria. Stewart in 1977 defined three stages of recovery from anesthesia. Phase 1 or immediate recovery, measured by most recovery scores includes stable vital signs, return of consciousness, presence of airway reflexes, ability to follow commands, and gross motor activity. Phase 2 or intermediate recovery includes home readiness, coordination, absence of dizziness, drowsiness, minimal pain, minimal nausea/vomiting. Phase 3 is long-term recovery, encompassing hours or days, and determined by sophisticated psychomotor testing. Current recovery room scoring systems measure only immediate recovery, appropriate in determining readiness of inpatients to return to the floor, and lack validation data related to what is safe. We need to concentrate on intermediate recovery.

According to the Surgery and Anesthesia section of its manual, the JCAHO requires postoperative status to be evaluated upon admission to and discharge from the recovery room. Documentation is required of vital signs, level of consciousness, fluids, drugs, and blood administered, unusual events or postoperative complications and management. The responsibility for discharge is assigned to a licensed independent practitioner with appropriate privileges. If the practitioner is not present or does not sign the discharge order, relevant discharge criteria must be established and rigorously applied. Following general, regional, or monitored anesthesia care, the ASA specifies that appropriate postanesthesia care, such as PACU or equivalent should be available, and that all patients should be admitted to a PACU except by specific order of the anesthesiologist responsible for their care, allowing for latitude based on medical judgement.

Practical discharge criteria for phase 1 recovery include baseline Aldrete score, stable vital signs, baseline orientation, ability to sit, stand and ambulate. Patients should be assessed while still in the operating room (OR) to determine if there is a need for phase 1 recovery. Now with titration of newer agents, about 15% of patients receiving general anesthesia may progress directly to phase 2 if they meet criteria. Criteria for phase 2 recovery include presence of responsible escort, plus or minus the ability to take oral fluids or void, and no excessive pain or nausea/vomiting. Ambulatory surgery challenges us to provide anesthesia for the shortest time at the lowest anesthetic concentration; then to recover the patient with the goal of a safe and timely discharge. Medical decision-making is critical and must be based on aggressive pursuit of the patients' needs. Flexibility and practicality in managing recovery and discharge should be the key, but these should not be achieved at the expense of safety.

Dr Levy welcomed the audience to the wonderful new world of aftercare in her presentation, 'Reasonable options after discharge from the PACU: What's better than chicken soup?' It is in aftercare that there is blurring of the distinction between inpatient and outpatient surgery. By 1995 it is predicted that 90% of cholecystecto-

mies, 80% of nephrectomies, 70% of herniorrhaphies, appendectomies and hysterectomies will be done on an outpatient basis. Therefore, more innovative and intensive postoperative management will be required. Ability to perform major surgery with a minor operation fuels aftercare. Dr Levy stated that aftercare forces reflect first, efforts at cost containment, competition of hospitals for market share, convenience to their patients, and desire for efficiency; and second, technological advances, including endoscopic surgery, designer pharmaceuticals and the availability of infusion devices. Options for aftercare include the 23-h recovery facility, free-standing recovery centers, home healthcare and hospital hotels. The successes and difficulties of each were discussed by Dr Levy.

The advantages of a 23-h observation facility are: competitive pricing at a level less than an inpatient and more than an outpatient; convenience for unexpected admissions due to pain, nausea/vomiting etc.; and the ability to use existing inpatient hospital facilities without the need for admission, certificate of need, or capital outlay. However, in hospitals with high occupancy such an arrangement may waste inpatient beds. Placing outpatients in an inpatient setting increases the level of care with greater overheads and problems exist with reimbursement, although many insurance carriers will reimburse for up to 72 h of care. Another option, the hospital hotel offers low overheads (without nurses or ancillary personnel), improved ambience and comfort for patients, and immediate access to the hospital. At the University of Michigan the cost for the hospital hotel is \$51 a night. No medical care is given. For reimbursement, approval is required by a case manager and patient eligibility is limited to the elderly or patients living at a distance from the hospital.

The concept of postsurgical recovery centers was developed as a demonstration project in California between 1986 and 1989. The idea originated in response to a perceived need to decrease aftercare costs. The state authorized the creation of centers over a three-year period (which was later extended), specifying requirements for size, length of stay, availability of skilled nursing care and proximity to the hospital. The admissions were to be planned and medical criteria established. Dr Levy presented actual data for one quarter of 1992-93: 602 discharges; average stay of 39 h; length of stay > 2 days for 25% of patients; hospital transfer rate 0.4%. Cases recovered in these facilities included laparoscopic cholecystectomy, cruciate ligament repair, hysterectomy, shoulder repair, mammoplasty. Average fee for surgery was \$5000. Average recovery charge was \$912. Payment sources were health maintenance organization (HMO), private insurance, Blue Cross/Blue Shield, but not Medicaid/Medicare, which refused to reimburse because "licensing was not required, quality issues were not addressed and cost savings were not proven." Presently only three centers remain and the project is judged a qualified failure. Dropout was attributable to problems with reimbursement, especially Medicare.

Figures show that expenditure for home healthcare

services was \$4.7 billion in 1987 increasing to \$16.5 billion in 1993. Costs at the University of Michigan Medical Center are considerable, averaging \$70/80 per visit (15 min to 2 h). Most of these charges are reimbursed by insurance, although there is limited eligibility. Drugs and durable goods are billed separately. A study funded by the National Institute of Health (NIH) was conducted at the University of Pennsylvania of 200 women post-hysterectomy randomized to early vs. later discharge to home. Those who were discharged early received home healthcare services and follow-up by a nurse. For those who were discharged early, there was only half a day decrease in length of hospital stay and no cost difference, but increased patient satisfaction and knowledge. Problems encountered were limited eligibility/reimbursement and nonreimbursement for required physician oversight of nursing care. The Congressional Budget Office concluded that this mode of care could result in increased Medicare spending.

Dr Levy cautioned that in our current environment as costs become the paramount issue, we must be aware that one alternative to aftercare is no care. In a study of outpatient laparoscopic cholecystectomies currently being conducted by Chung in Canada, 10 out of 43 patients were admitted for surgical and personal reasons, rarely related to anesthesia. Fear is that pressure will now be exerted to send everyone home. Chung's outcome data indicate that no aftercare may be safe and appropriate in terms of major complications, but what about subtler changes affecting ultimate recovery? Dr Levy advises that outcome studies are needed to assess different anesthetic techniques, pain management regimens and modes of aftercare to determine which are most beneficial to outpatients.

In 'Choices for the healthy pediatric outpatient: Laboratory testing, intraoperative techniques, postoperative pain control, discharge criteria' Dr Lichtor addressed several issues relevant to pediatric ambulatory anesthesia. Routine laboratory testing is not the norm in children. In a study of 1800 patients by Baron in 1992, there was a 1% incidence of abnormal hematocrit (< 30 or > 50), and in no case was surgery cancelled. History and physical examination were the best predictors of anemia, of which there is low prevalence. In an earlier inpatient study by O'Connor, there was a 12% incidence of anemia in children but 74% of children found with anemia were not followed up. For children with a history of prematurity, there was an increased incidence of apnea for those with decreased hematocrit. Therefore, according to Dr Lichtor, for healthy children, hematocrit is not necessary. For unhealthy children, those with sickle cell disease, upper respiratory infection, fever, failure to thrive or prematurity, hematocrit should be performed.

Should an ex-premature infant go home after spinal anesthesia? The technique of spinal anesthesia in children was reviewed. Wellborn in 1990 conducted a study of spinal vs. general anesthesia for inguinal herniorrhaphy in children and found that postoperative apnea was

nonexistent for those who received spinal alone. For those who received spinal plus sedation (ketamine) or general anesthesia, postoperative apnea occurred. One study reported that all patients who experienced postoperative apnea had general anesthesia. In another study of 133 exremies, only one experienced postoperative apnea, after receiving supplemental postoperative midazolam. Therefore, although controversial, Dr Lichtor believes it is safe for healthy exremies without other medical problems and who have not received other medications to go home following spinal anesthesia.

Is the time to discharge quicker with the newer anesthetic agents propofol and desflurane? Most benefit with propofol is seen after longer operations (> 1h). In comparing propofol and thiopental for strabismus surgery, there was a clinically significant increase in oculocardiac reflex with propofol. Vomiting was less with propofol than halothane, and there was decreased incidence of airway obstruction. To avoid pain after injection, the

patient should be induced with halothane and the i.v. placed after the patient is asleep; anesthesia is maintained with propofol. Desflurane inhalation induction is associated with problems such as coughing and laryngospasm. This agent should not be used in children except for maintenance. No pediatric data are available regarding time to discharge with desflurane.

To determine postoperative oral fluid requirements, a study was done in which children were divided into two groups, mandatory vs. elective drinkers. Both groups actually drank the same amount. The time to discharge was shorter for the elective drinkers, who experienced less vomiting. Kiddie caudal with or without epinephrine compared to ilioinguinal nerve block did not affect pain score or time to void and did not affect recovery room stay if the patient was healthy and well hydrated. Therefore, Dr Lichtor concludes that children do not need to drink prior to discharge, and that kiddie caudal does not prolong recovery room stay.

ONE DAY SURGERY

Milan, 29-30th June - 1st July

The 1994 One-Day Surgery meeting will be held at: The Department of General and Oncological Surgery, Aula Padiglione Monteggia, Ospedale Maggiore, Policlinico, Via F. Sforza, 15, 20122 - Milano, Spain.

Conference topics:

- Organization
- Laparoscopy
- Phlebology
- Anaesthesia
- Inguinal hernia
- Proctology

The Conference language is Italian.

Organizing Secretariat: ECON Srl. Tel: +39 02 25 005745 or Fax +39 01 2900 5790

Scientific Secretariat, U. Baccaglioni, MD, University of Padova, 2nd Department of General Surgery. Tel: +39 49 821 5671 or Fax: +39 49 665 685.

Letter to the Editors

What is today's score?

I read with great interest the recent paper by Chung et al. (*Ambulatory Surgery* 1993; 1: 189-94) which proposes a new scoring system for postanesthetic discharge. Anaesthetists seem to love recovery scoring systems, why else would there be such a proliferation of Aldrete, Steward, Robertson and now PADSS? For all those (like myself) who hate such artificial concepts, may I suggest a new scoring system which indicates the state of wellbeing of the anaesthetist in the Day Surgery Centre, the General Rage and Tension Expression or GRATE Index. This index (Table 1) has been extensively investi-

gated in our own Centre and is found to be a very accurate predictor of the smooth running of any surgical list. There are rumours of a similar index used by those who operate in day units which is known as the Direct Expression of No Surgical Ease (DENSE) but this remains as pure conjecture at present.

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Table 1. General Rage and Tension Expression (GRATE) Index

1. Timing	2 = Surgeon changed, scrubbed and waiting in theatre. 1 = Surgeon sent message that he/she will be a bit late. 0 = No sign of surgeon.
2. The list	2 = Operating list order and names unchanged from printed list. 1 = One change in list order from printed list. 0 = Printed list bears no relation to patients awaiting operation.
3. The patients	2 = Patients have followed their written preoperative instructions. 1 = One patient has had their normal full breakfast. 0 = Everyone has been eating and/or drinking and no one has taken their routine medication.
4. The notes	2 = All the notes and investigations are ready. 1 = Two patients need their consent forms signed. 0 = The notes are lost.
5. The staff	2 = The unit's staff are on duty. 1 = There is a new agency staff nurse in recovery who has never been in a day unit or recovery before. 0 = There is a new agency ODA, theatre sister and recovery nurse today.
6. Assistance	2 = There is an experienced registrar helping you with the list. 1 = You are on your own. 0 = You have the new keen SHO with you today and it is his first day in anaesthesia.
7. Forms	2 = The department has run out of audit forms. 1 = The registrar has filled in the forms. 0 = There is a new audit form today.
8. Research	2 = No one is doing any research projects today. 1 = There is only one patient suitable for research today. 0 = The research registrar has consented six patients for the new trial on reinforced laryngeal mask airways.
9. Surgical equipment	2 = The surgeon is performing the usual slow operation. 1 = The surgeon wants to try his new laser on the second case. 0 = There is a whole list of laser assisted cases and no one is sure of the correct setting for the laser and someone has changed the microscope.
10. Discharge	2 = Everyone is dressed and ready to go home. 1 = The GP's wife is still being sick and is in severe pain. 0 = The child of your most lucrative private surgeon is still being sick and is in severe pain.

There is a maximum GRATE score of 20. This is a nebulous concept and cannot be achieved. There is a minimum score of 0. This is incompatible with normal life and is often seen.