# Editorial

**Everything has been thought of before**

The 20th century should be viewed as the time when ambulatory surgery became viable, when it slowly came into acceptance, when we realized that hospitalization was not the only method of providing quality care, and when within its last decade we have seen the number of ambulatory surgical procedures in the United States exceeding the number of inpatient procedures[1]. We should no longer try to determine why this has happened; physicians and the public are now accepting ambulatory surgery. Ambulatory surgical care has proven itself to be cost effective, safe and convenient to the patient, the patient's family and the physician.

Even though ambulatory surgery was successfully performed during the early 1900s, there were few reports in the literature. Beginning in the 1960s, improvements in anaesthesia allowed for a significant increase in the numbers of ambulatory surgical procedures. In the 1970s hospitals began to support ambulatory surgery to allow for more beds to accommodate sicker patients in need of inpatient care.

Ambulatory surgery was first documented in 1909 when JH Nicoll of Glasgow informed the British Medical Association that 8988 operations on outpatients were performed at the Glasgow Royal Hospital for Sick Children[2]. Surgical results were as successful for outpatients as for inpatients. In 1916 Ralph Waters opened the Down-Town Anesthesia Clinic in Sioux City, Iowa (USA) for dental cases and minor surgery[3]. Within two years he enlarged the facility, moving into an office building in which 50 physicians and dentists had their offices. In 1937 Gertrude Herzfeld of Edinburgh reported on more than 1000 hernia repairs performed on children; many of these were done on an ambulatory basis using general anaesthesia[4]. In the late 1950s, a shortage of hospital beds in Canada provided the impetus for expanding outpatient surgical facilities in that country.

In the United States in the mid 1960s hospital ambulatory programmes were started at the University of California at Los Angeles and at George Washington University (Washington, DC). In 1970, the Phoenix Surgicenter (Phoenix, Arizona) opened its doors. A plaque in its lobby proclaims, "Dedicated to the principle that high-quality outpatient surgical care can be provided in a caring, personal environment, in a free-standing ambulatory facility at a lower cost than other alternatives." The free-standing ambulatory surgery programme had officially been launched; ambulatory surgery was rediscovered.

Whereas originally ambulatory surgery meant short procedures on American Society of Anesthesiologists physical status 1 or 2 patients, we are currently seeing more physical status 3 patients, more geriatric patients, and because of improved surgical techniques and instrumentation, a continually expanding list of acceptable procedures. As we view the future, less complicated procedures will be performed in physicians' offices, while more complicated surgeries will shift to the ambulatory setting. Add to this innovative methods of postoperative care (i.e. medical motels, home healthcare nursing, free-standing surgical recovery centres), and there is little doubt that the increasing complexity of procedures performed in an ambulatory setting will continue into the 21st century.

Developments that account for the recent rediscovery and growth of ambulatory surgery include: improved anaesthetic drugs, growing public interest in participating in personal healthcare, growing acceptance by surgeons, endorsement and encouragement by industry and health insurers, and the demonstrated safety of surgery in the ambulatory environment[5]. As ambulatory surgery continues to grow, we must never lose sight of a most important ingredient to ensure patient safety and overall quality of care in ambulatory surgery: careful selection of the patient and the surgical procedure.

In this issue, Gail Durant provides valuable insight into the growth of ambulatory surgery in the non-hospital setting, in the excellent article, 'Expanding the scope of ambulatory surgery in the United States' (pp. 173–178). The fact that the hospital is still a most important player in ambulatory surgery delivery should not be lost. However, as the surgical pie is being further divided more procedures are moving away from the hospital

setting to other outpatient sites. This shift in total ambulatory surgical activity is clear when one realizes that hospitals in the United States controlled slightly over 70% of ambulatory surgery in 1990 compared to nearly 90% in 1984.

Hospitals have always had an important role in ambulatory surgery. Free-standing surgery centres, on the other hand, as relatively new entrants, have grown and positioned themselves as strong competitors to hospital-based care. As a result, within a short span of time, we have noted an increased participation of hospitals in the free-standing arena, an increase in the number of free-standing centres owned and managed by hospital corporate chains, and an increase in the number of physicians' office-based surgery suites.

Achieving more cost-effective care has been a significant stimulus in the development of ambulatory surgery. However, unless the hospital bed the outpatient would have used is left empty, the healthcare system as a whole experiences greater costs because the system has effectively been enlarged. Thus, true savings from ambulatory surgery can only come from a global effort to contain, if not shrink, the healthcare system. Such appropriate initiatives include a greater reduction in inpatient surgical caseloads through bed closures, conversion of some acute care beds for chronic care, control of possibly excessive ambulatory surgery utilization, and a moratorium, or at least a reduction in, future facility expansion[5]. Nonetheless, it is incumbent on each of us to make selection decisions that put as much surgery as possible in the ambulatory setting without compromising quality of care.

Free-standing ambulatory surgical facilities may not be for everyone nor may they be the ideal method for every country. Being a medical director since the mid-1970s of a hospital ambulatory surgical programme that has cared for over 175 000 patients, I feel that hospital programmes with good planning can provide efficiencies that are the equivalent of free-standing facilities with the added security of support from all hospital services. The key to a successful hospital facility is to maintain separation of the outpatient from the inpatient whenever possible: registration areas, waiting rooms, holding areas, and postanaesthesia care are some examples. Physicians, nurses and ancillary personnel should never lose sight of the importance of taking care of the healthy ambulatory surgery patient; ambulatory cases should be scheduled as the first cases in every operating room theatre. Ambulatory surgery patients are not second class citizens compared to neurosurgical or cardiovascular inpatients.

Under healthcare reform that is being proposed in the United States it is likely that reimbursement for ambulatory procedures will be the same whether they are performed in a hospital or a free-standing facility. The advantage of cost-effectiveness will no longer be on the side of the free-standing facility. Hospitals will learn to compete; hospitals will have to become cost effective if they are to survive, whether it be their outpatient or their inpatient programmes.

To provide cost-effective care with satisfactory outcomes, in addition to the facility where surgery is performed, we must continually assess the importance of selection of appropriate surgical procedures, patients, patient preparation, equipment, technology, choice of anaesthetic, postanaesthesia care and discharge criteria. I am an advocate of ambulatory surgery and I feel that when a programme is properly thought out and implemented, ambulatory surgery can be performed to the satisfaction of the patient, patient's family and physician in either a hospital-based or free-standing facility.

Everything has been thought of before, Goethe suggested; the challenge is to continually improve, learning from our past experiences. And so it must be with ambulatory surgery.

**Bernard V Wetchler**

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## Review

# Expanding the scope of ambulatory surgery in the USA

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This paper will look at the growth and widening scope of ambulatory surgery in the USA. Factors included are the ability to perform advanced procedures in ambulatory surgery centres due to new medical technology such as arthroscopic and endoscopic surgery. This paper also looks at the advent of recovery care facilities used in conjunction with ambulatory surgery centres and their impact on utilization of surgery centres.

Key words: Ambulatory surgery, surgery centres, USA

The scope of ambulatory surgery in the non-hospital setting has seen great growth since the first freestanding ambulatory surgery centre opened in 1970 in the USA. Today, over 1500 facilities have been developed. These facilities, which are not housed within hospitals, are completely separate entities in structure, ownership and management. They currently provide outpatient surgical care for over 2½ million patients a year and those numbers continue to grow.

One of the primary reasons for the scope of ambulatory surgery being able to expand beyond the confines of the hospital to the efficient, lower costing surgery centre setting is the doctors' ability to perform more minimally-invasive surgery with fewer serious side effects experienced by the patient, caused by anaesthesia and post-operative pain. This is due to the advancements in analgesia and medical technology such as laser and arthroscopic surgery.

To take a more complete look at why there is such growth in the non-hospital outpatient surgical setting in the USA we will address the current status of ambulatory surgery centres in the USA and the ability to perform advanced procedures at surgery centres with the advent of recovery care facilities.

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## Current status of ambulatory surgery centres

### *The cost of healthcare*

The increasing cost of healthcare is a serious problem in the USA. The US Department of Health and Human Services reported that healthcare spending went up to 10.5% in 1990. That meant that $643 billion was spent that year with federal, state and local governments paying $212 billion of the total; businesses spending $186.2 billion and households spending $224.7 billion[1].

In its 1992 economic forecast the US Department of Commerce stated that in 1991 US healthcare spending represented 13% of the country's gross national product (GNP). This was up from 12% of the GNP in 1990 and they projected it to be 14% in 1992[2].

Another study noted that 12% of a US family's annual income went to healthcare[3]. This includes out-of-pocket expenses for drugs, insurance deductibles and premiums. Thus, the average family in the USA spends $4296 on healthcare per annum. It is predicted that they will spend 16% of their annual income on healthcare by the year 2000.

### *Growth in the number of surgery centres*

Due to increasing medical costs, patients, third party payors and the government are looking for cost efficient healthcare providers that can provide high quality care. Doctors are also seeking healthcare facilities that provide modern technology, easy access and more personalized care for their patients. The doctors need facilities for their ambulatory surgery patients that allow easy access for scheduling operating room time. The facility must be modern, with the latest medical technology, and have

**Table 1.** Ownership of surgery centres

| | % |
|---|---|
| Independent | 79.7 |
| Corporate | 12.7 |
| Hospital | 7.6 |

**Table 2.** Percentage of surgery centres with contracts

| | % |
|---|---|
| HMOs | 51.2 |
| PPOs | 51.0 |

trained nurses and technicians. The surgery centre provides such an environment because it is smaller and less bureaucratic than the hospitals. Since the operating rooms at surgery centres are only used for outpatient surgery, doctors are assured that their scheduled times will not be delayed or cancelled due to emergency surgery or more complicated surgery that inpatients receive in the hospital setting.

Many of the surgery centres are independently owned by doctors making it easier for the owners to decide upon and vote the appropriate funds to purchase more modern, advanced equipment (see Table 1)[4]. They do not face the more severe budgetary restraints and procedures they would have to go through in a large hospital to approve and acquire new equipment.

Patients prefer having their outpatient surgery performed in the freestanding ambulatory surgery setting rather than the hospital[5]. They find that the surgery centre setting is smaller and less hectic. They do not have as much paperwork to complete and find the smaller setting more personalized. In addition, many patients must pay a co-insurance payment for their medical care. This will be a percentage of the bill. For example, the insurer may pay 80% of the patient's bill and the patient pays the remaining 20%. Thus, the lower costing surgery centre will help the patient effect a saving on their healthcare expenses.

The third party payors also appreciate the lower cost setting the surgery centre provides. In 1991 more surgery centres were contracting with health maintenance organizations (HMO) and prospective payment organizations (PPO) to provide outpatient surgery for their beneficiaries (see Table 2)[6].

By meeting the needs of the patient and doctor as well as providing a more cost efficient system, surgery centres have become popular with the doctor, patient and payor. The result of this popularity is that the number of surgery centres opening each year has increased dramatically.

In 1970 there were only two freestanding surgery centres in the USA; by 1975 there were 42; in 1980 127 surgery centres had opened. The number more than doubled in the next five years and by 1985, 459 facilities were operating. By the end of the decade that number had almost tripled with 1383 surgery centres[4], and in 1991 there were 1556 facilities (see Table 3).

**Table 3.** Growth of surgery centres (1970–91)

| *Year* | *No. of surgery centres* |
|---|---|
| 1970 | 2 |
| 1975 | 42 |
| 1980 | 127 |
| 1985 | 459 |
| 1990 | 1383 |
| 1991 | 1556 |

*Changes in government regulations*

Changes in the way the US government reimburses healthcare providers for beneficiaries of government healthcare programmes (such as Medicare for citizens over 65 years of age) affect surgery centres. Changes in the regulations affecting ownership of medical facilities also affect surgery centres.

## Reimbursements

With respect to reimbursements for outpatient surgery, the federal government is considering ways to lower costs of healthcare for the millions of beneficiaries of government-sponsored medical programmes. Due to the nature of the procedures required for older patients under the Medicare programme, a large number of these procedures, such as cataract surgery, are performed on an outpatient basis. In 1990 almost 30% of all surgeries performed in surgery centres were cataract procedures.

A 1988 study conducted by the US Department of Health and Human Services[7] found that Medicare payments to hospital outpatient departments exceeded payments to ambulatory surgery centres by 73.6% for cataract surgery. For upper gastrointestinal (GI) surgery Medicare payments were 26.3% higher in the hospital outpatient department compared to the surgery centre and for colonoscopies they were 43.8% more expensive. The Medicare facility reimbursement for cataract surgery averaged $489 to the surgery centre and $879 to the hospital outpatient department. For GI endoscopies Medicare was reimbursing surgery centres $218 and the outpatient department $276. The hospital averaged $331 for outpatient department colonoscopies and $213 at the surgery centre.

Currently the US government is considering paying surgery centres and hospitals the same reimbursement amount for outpatient surgery resulting in great savings to the Medicare programme. The estimated annual savings on cataract surgeries alone would be over $107 million.

In addition to levelling the reimbursement rates to hospitals and surgery centres for outpatient procedures

**Table 4. Percentage of Medicare surgeries at surgery centres in 1990**

| *By type of ownership* | *%* |
|---|---|
| Independent | 48.23 |
| Corporate chain | 38.25 |
| Hospital-owned centre | 30.92 |
| Total (average) | 39.13 |

Medicare has also expanded the list of procedures it will reimburse if performed in a freestanding ambulatory surgery centre. Despite the fact that any procedure the doctor deems suitable to be performed on an outpatient basis is reimbursed by Medicare if performed in a hospital outpatient department, there is a limited list of procedures Medicare will reimburse if performed in a surgery centre. This results in many outpatient procedures being performed on Medicare beneficiaries in the more costly hospital setting. This practice exists despite the fact that a government report proclaimed ambulatory surgery centres just as safe an environment for outpatient surgery as a hospital[5].

A decade ago, in 1982, Medicare approved 200 procedures that it would reimburse if performed in a surgery centre. Today that list has been expanded to over 2000 procedures. However, further expansion would increase the number of Medicare patients who could have their outpatient surgery performed at ambulatory surgery centres (see Table 4)[4]. With Medicare's expansion of this procedures list more patients will be utilizing the surgery centre setting, thus creating additional growth of such facilities.

## Ownership

Some changes in the past few years affecting ambulatory surgery centres are due to new federal guidelines called 'safe harbour' regulations. These regulations are issued by the Office of the Inspector General of the Department of Health and Human Services and have an impact on the ownership of many medical facilities in addition to surgery centres, such as diagnostic centres, therapy centres and radiation centres. The regulations are designed as 'antikickback' preventive measures. Their purpose is to prevent doctors from referring patients for tests, therapy and other forms of medical treatment to facilities with which the referring doctor has an ownership or other form of financial interest.

The federal government has issued some 'safe harbours' and will be issuing more in the future. These 'safe harbours' outline ownership and other practices that are not regarded as violating the 'antikickback' regulations. At the present surgery centres that are independently owned by doctors who refer patients to them are not protected under the existing 'safe harbours'. However, the Office of the Inspector General plans to publish additional 'safe harbours' in the future which they have stated will include 'safe harbours' for such surgery centres.

It is felt that the surgery centre, unlike a diagnostic centre or therapy centre, is more of an extension of the doctor's workplace, such as the hospital, and therefore a doctor should be able to refer patients to a surgery centre in which he or she has an ownership interest. One extensive study on ownership of different types of medical facilities found very little abuse of doctors referring patients for unnecessary treatment to surgery centres in which they had a finanical interest[8]. In the meantime, some doctors have been seeking publicly traded firms to buy ownership in their facilities to provide them protection under the present 'safe harbours' and some firms have been actively trying to acquire these facilities. Other centres are waiting until the additional 'safe harbours' are issued.

Until additional 'safe harbours' for surgery centres are issued these 'antikickback' regulations may cause some doctors who are considering opening a surgery centre to wait until the new regulations are issued. Alternatively, these doctors can consider going into partnership with a publicly traded firm which would allow the centre to fall within the current 'safe harbour' guidelines.

## The advent of recovery care facilities

Another reason for the expanding growth of surgery centres is the ability to perform more complicated procedures at these facilities. This is due primarily to advancements in analgesia, medical technology and the addition of recovery care to the surgery centre.

### *Advanced procedures*

A study conducted by the American Hospital Association of surgeries performed in 1990 indicated that, for the first time, more outpatient procedures were performed at hospitals than inpatient surgeries[9]. Over 11 million of the 22 million surgeries conducted that year were outpatient procedures. While the number of inpatient surgeries decreased at hospitals, outpatient surgeries have quadrupled in the decade from 1980 to 1990.

The volume of outpatient surgeries at ambulatory surgery centres has also increased dramatically[5]. In 1988 over 1.7 million surgeries were performed at these centres, which was an increase of over 25% from the previous year. In 1991 over 2.5 million procedures were performed at surgery centres. Advancements in medical technology have played a major factor in determining the types of procedures that were previously performed on an inpatient basis, and now can be performed on an outpatient basis at the hospital and in surgery centres.

### *Recovery care facilities*

However, another trend having an impact on the utilization of surgery centres, by allowing more complicated procedures to be performed there, is the advent of recovery care facilities. Recovery care in conjunction with the surgery centre can be provided in a number of different

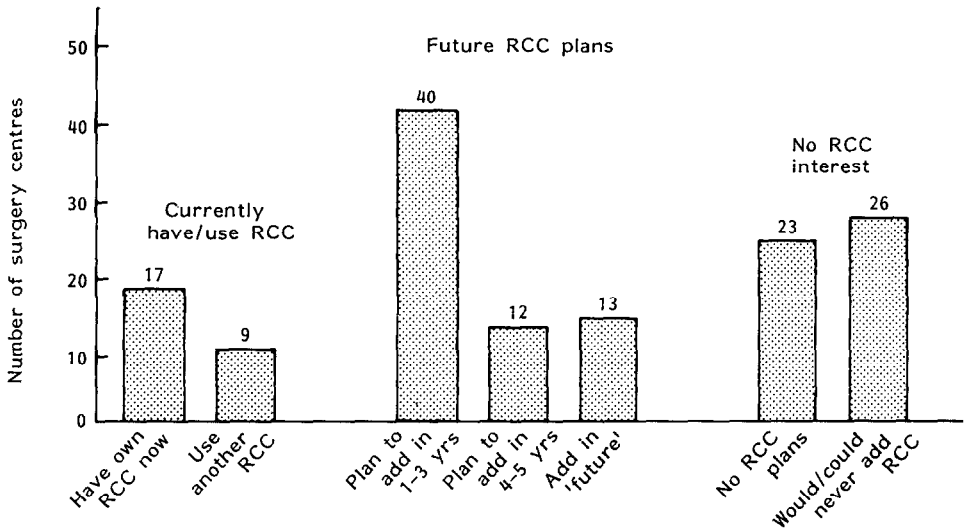


**Figure 1.** Two-thirds of ambulatory surgery centres have, use or plan to add recovery care capabilities ($n$ = 140).

settings. The more prevalent at this time are the 23-h recovery care beds, recovery care centres, medical hotels and home care. All offer the patient who does not require hospitalization the opportunity to recuperate after surgery in a medically-supervised environment that is less costly than the hospital setting.

Currently over 16 states in the USA allow surgery centres to provide up to 23 hours of care. This allows the doctor to keep the patient overnight for observation or pain control following surgery, thus allowing procedures to be performed at the surgery centre that would otherwise have had to be performed in the hospital. In some instances the state has allowed surgery centres to provide recovery care for a longer period than 23 h.

The types of facilities at which the surgery centres provide overnight care are proving to be very competitive with the less attractive and more costly hospital setting. For example, two recovery care facilities built in the state of North Carolina, which has a 23-h rule, for extended recovery care to surgery centre patients, provide attractive, homelike bedrooms and private bathrooms for patients. The furnishings are not standard metal hospital beds and a visitor's chair, but hospital beds that have wood-finished headboards with matching chairs, bureaux and sofas in the rooms. In many instances the sofas convert into beds, allowing a patient's spouse or parent to stay during the night. Each room still has the necessary hook-ups for oxygen but they are concealed in bedside wall compartments that fit in with the decor of the room.

The medical hotels are very similar to the recovery care centres. Some of them had been built in conjunction with hospitals which had high occupancy rates for their beds. To free hospital beds for more acute patients, hospitals would place less acute patients in the medical hotel for care. Like the recovery care centre the medical hotel has a licensed nurse and nursing aides overseeing the medical needs of the patients. The charges at the medical hotels can be considerably less than the hospital costs. One such New England facility charges $190 per day compared to $800–900 per day for care at the nearby hospital, thus offering savings to the patient and third party payor. Several medical inns in California link up surgery centres with luxury recovery hotels. They charge $700 per day which includes the outpatient surgery facility fee, meals and lodging. Patients utilizing the recovery care inns have procedures performed such as hysterectomies and gall bladder removals.

Home health care is another means of allowing surgery centre patients to have more advanced procedures performed in the outpatient setting and allow recuperation in the comfort and privacy of one's own home. With the assistance of a visiting nurse, a patient can return to their home after outpatient surgery and receive injections for pain control and recovery monitoring without having to stay overnight in a strange setting. Surgery centres contract with visiting nurse agencies to provide services. Only patients who are deemed by the doctor as appropriate for this type of recuperation participate in home recovery. However, it does provide a less stressful setting for the patient.

**Table 5.** Annual operating room utilization

| | *Patients per OR* |
|---|---|
| With recovery care | 779 |
| Without recovery care | 744 |

There are currently 32 recovery care facilities in the USA. Respondents to a survey conducted by the Federated Ambulatory Surgery Association (FASA)[10] noted that two-thirds of them either use their own recovery care centre in conjunction with their surgery centres, use another recovery care facility or plan to use one in the future (see Figure 1). The FASA survey showed that of the 140 responding surgery centres, those with overnight capabilities had a higher utilization rate for their operating rooms (see Table 5).

All surgery centres with recovery care capabilities were located within 10 min of a hospital and all but one of these surgery centres was a multi-speciality facility. Of the 17 facilities responding that currently had recovery care facilities most had four beds or less (see Table 6).

The surgery centres with recovery care capabilities also noted a 20% increase in the number of surgeries performed per month. Very few reported a need to transfer patients to the hospital from the recovery care facility (see Table 7).

**Table 6.** FASA survey results showing numbers of beds in 17 responding surgery centres with overnight capabilities

| *No. of beds* | *Recovery care centre on-site* |
|---|---|
| 4 or less | 12 |
| 5–9 | 1 |
| 10–14 | 2 |
| 15–19 | 1 |
| 20 or more | 1 |

**Table 7.** FASA survey results showing numbers of hospital transfers in 12 responding surgery centres

| | *No. of patients recovered* | *No. of transfers* |
|---|---|---|
| 1 | 853 | 2 |
| 2 | 728 | 2 |
| 3 | 540 | 0 |
| 4 | 487 | 2 |
| 5 | 410 | 1 |
| 6 | 53 | 2 |
| 7 | 36 | 0 |
| 8 | 26 | 0 |
| 9 | 19 | 0 |
| 10 | 18 | 0 |
| 11 | 16 | 3 |
| 12 | 10 | 0 |

The primary reason surgery centres add recovery care capabilities to their facilities is to enable them to perform more complex procedures and increase volume. The other reasons cited are given in Figure 2.

## Conclusion

The FASA survey indicated the interest on the part of surgery centres to expand their facilities to include recovery care capabilities. Of primary concern is the desire to be reimbursed by third party payors and government healthcare programmes for providing such services. Due to the cost savings of having a patient recuperate in one of these facilities compared to the hospital setting third party payors and patients are very interested in the development of such facilities.

The US federal government is also taking an interest. The Health Care Financing Administration is considering a reimbursement category for subacute care in recovery care centres for Medicare patients. Currently Medicare does not reimburse such centres and Medicare patients and the government are not experiencing the savings and services these facilities offer.

With the number of outpatient procedures performed in surgery centres expected to reach 4 million by 1994 and nearly 14 million in the hospital setting by the same year[6], overnight recovery care facilities should prosper. They provide an answer to the growing need for high quality, cost-effective healthcare in the USA.

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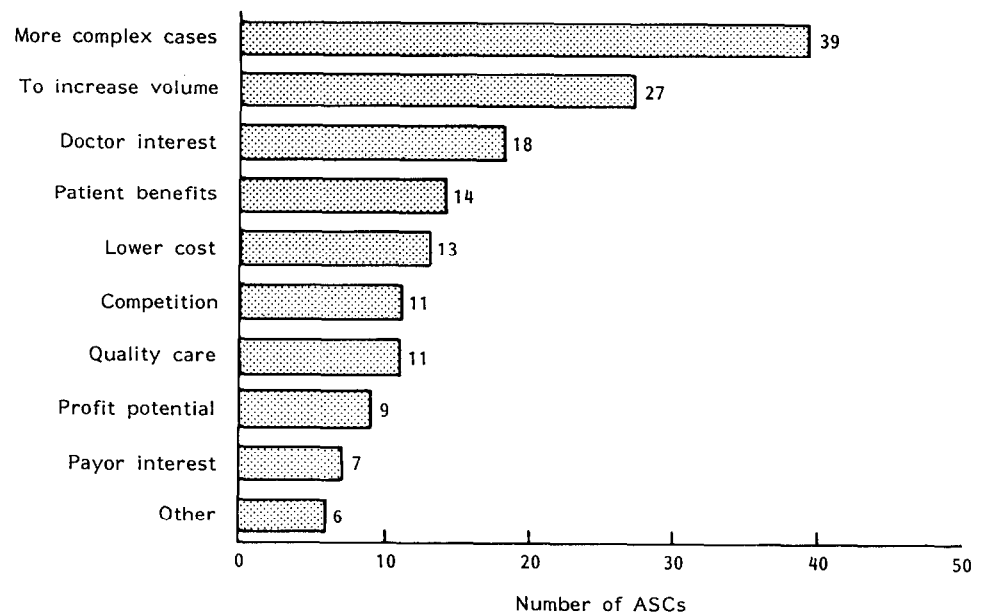


**Figure 2.** Desire for more and increasingly complex surgeries motivate ambulatory surgery centres to add recovery care capabilities ($n=103$).

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## Original papers

# Audit of day case maxillofacial surgery: a pilot assessment

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The aim of this study was to design and evaluate an audit structure for day case maxillofacial surgery, which may be applied to other surgical specialities. Retrospective and prospective data collection over a 3-month period revealed that the clinical standards set in advance of the audit procedure were achieved in five of the 11 criteria. In only two instances were the standards not met, only 46% of patients were seen within 3 months of the referral, against the 95% desired standard, and only 50% had surgery within 3 months of being seen, against the 95% standard. Future audit should be prospective but action should be taken as necessary to address the significant failure in achieving the set standards, thus completing the audit cycle.

Key words: Day surgery, maxillofacial, quality assurance

Current government policy is directed at reducing costs in the British National Health Service (NHS). As one aspect of improved efficiency within the surgical health care system, day case surgery is expanding rapidly and is associated with patient preference[1], reduced cancellation of lists[2] and value-for-money outcomes[3].

A review of day surgery by the Audit Commission[2] has indicated that there is a lack of information to assess current performance and to link that to cost benefit and patient outcome. The 'basket' of 20 procedures listed by the commission did not include operative procedures related to maxillofacial surgery.

The Royal College of Surgeons of England publication 'Guidelines for Day Surgery'[4], lists suitable procedures for maxillofacial surgery to be performed in a day case setting. These have been adopted for the present study.

There are three major stakeholders in any surgical procedure; the patient who desires to be made well, the professionals who derive satisfaction from exercising their best skills, and management whose responsibility it is to provide the best overall health care from the available resources. This study examined the provision of professional care, but it could be expanded at a later date to encompass the other stakeholders.

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### Methods

The first part of the audit process was to define the criteria by which clinical outcomes of day case patients undergoing maxillofacial surgery could be assessed. Eleven criteria (agreed by the surgeons and anaesthetists) were intended to be exhaustive, mutually exclusive and primarily orientated to meet patient needs. Standards were set for all of the criteria and agreement was reached on a level that clinical care should attain. Data forms were designed to correspond to the established criteria and standards. Demographic data was recorded including age, sex and referring source for each patient. The grades of surgeon and anaesthetist were also noted.

To validate the forms a retrospective study of patients who had undergone day case maxillofacial surgery was conducted over a 3-month period (January–March 1992). In addition all patients attending over a 4-week period (July/August 1992) were included in the prospective data analysis. Data referring to patient outcomes were retrieved from the notes, whereas those relating to professional outcomes were collected directly on the data forms for the prospective patients only. Criteria for professional outcome were assessed using a 100 mm visual analogue scale. A high score represented professional dissatisfaction with the outcome or conduct of the procedure by the surgeon or the anaesthetist concerned. Data was entered onto a laptop computer. The screens matched the forms exactly to facilitate entry. Double

**Table 1.** Criteria, standards and outcome for maxillofacial surgery

| *Criteria* | *Standard set* | *Outcome* |
|---|---|---|
| 1. Patients should be seen in outpatients soon after being referred | 95% within 3 months | 46% ⊕=10 |
| 2. Patients should have surgery soon after being put on the waiting list | 95% within 3 months | 50% ⊕ = 1 |
| 3. Procedures suitable for day case surgery should be included | 95% on a pre-specified coded list | 93% ⊕ = 0 |
| 4. Patients should be suitable for day case anaesthesia | 99% will be ASA* grade 1 or 2 | 100% ⊕ = 4 |
| 5. Surgery should not take long | 95% will have surgery lasting less than 30 min | 97% ⊕ = 4 |
| 6. Patients should return home as planned after surgery | 95% will be discharged on time | 94% ⊕ = 3 |
| 7. Patients should not need emergency advice | 95% will not seek emergency advice or treatment postoperatively | 98% ⊕ = 3 |
| 8. Patients should be free of untoward problems after surgery | 95% of patients should be free of troublesome postoperative sequelae | 90% ⊕ = 3 |
| 9. Patients should only need to use day case facilities during their treatment cycle | 99% of patients should not need to be admitted to hospital on the day of surgery or readmitted later | 98% ⊕ = 3 |
| 10. Surgical operators should deliver a high degree of professional outcome | 99% of procedures will be judged <50 mm VAS | 98% ⊕ = 5 |
| 11. Anaesthetists should deliver a high degree of professional outcome | 99% of procedures will be judged <50 mm VAS | 100% ⊕ = 4 |

*American Society of Anesthesiologists grading[6].
⊕ = frequency of missing data points.

**Table 2.** Criterion 3. Procedures suitable for day surgery

| *Procedure code* | *Procedure* | *No. of procedures* | *Cumulative %* |
|---|---|---|---|
| 01 | Excision of uncomplicated impacted teeth and buried roots | 116 | 62 |
| 02 | Exposure of unerupted teeth for orthodontic treatment | 2 | 63.1 |
| 04 | Enucleation of small cysts | 3 | 64.7 |
| 07 | Minor soft tissue surgery | 5 | 67.4 |
| 14 | Simple removal of teeth | 45 | 93 |
| 15 | Other | 13 | 100 |

data comparison was performed to confirm completeness and accuracy.

In this audit the patients were not treated as a sample of a larger population. The standards were intended to apply directly to the group of patients audited[5].

## Results

One hundred and seventy-two patients had data recorded: 128 retrospective, 44 prospective. Of these patients, 58% were female with a mean age of 21.4 yr (range 1–64, SD 10.9); 132 patients were referred by general dental practitioners, 26 by consultant orthodontists and eight from general medical practitioners. Six patients had no defined referral source.

Consultant surgeons performed 140 cases, 81.4% (three unspecified). Consultant anaesthetists performed 124 cases, 72.1%. Table 1 shows the outcome for each criterion. In particular it demonstrates the differences in achieving the standards set for criteria 1 and 2. Table 2

**Table 3.** Type and frequency of postoperative complications

| *Postoperative problems* | *No. of patients affected (⊕ – 3)* |
|---|---|
| Paraesthesiae | 6 |
| Pain and bleeding | 3 |
| Postoperative infection | 3 |
| Root damage | 1 |
| Headache | 1 |

⊕ = missing data.

(criterion 3) lists the procedures which account for 93% of the caseload in the audit. The remaining 7% required eight further coding categories.

All patients were found suitable for day case anaesthesia (criterion 4) and 97% had surgery which lasted less than 30 min (criterion 5). Ten patients were not discharged on time (criterion 6). Only three patients sought emergency advice (criterion 7). Bleeding accounted for two of them, the third had a large painful molar socket. Ninety per cent of patients were free of untoward problems after surgery (criterion 8) but this did not reach the 95% standard set at the beginning of the audit. Postoperative problems are listed in Table 3. Three cases were collected under criterion 9. Two cases were scheduled for further elective day case surgery to remove remaining impacted molar teeth which were not removed at the first operative session, while the third patient sought emergency advice for persistent bleeding from a tooth socket and was admitted. For criteria 10 only one patient was rated surgically above 50 mm on the visual analogue scale, representing a 'poor' professional outcome. This patient had residual upper, second molar root damage. There were no adverse events associated with anaesthetic technique (criterion 11).

Audit quality assurance was confirmed by the completeness of data recorded. The number of missing data points are represented for each criterion in Table 1 by '⊕'.

## Discussion

The standards for criteria 1 and 2 were not reached. Against that 16% of patients were seen in clinic within 1 week of referral; 9.9% of patients had surgery within 1 week of being put on the waiting list and 97% had surgery within 12 months. On detailed analysis both distributions appear to be multimodal and this might relate to degrees of urgency – 'requires immediate attention', 'cannot wait too long', and 'routine' for referral times; and 'urgent', 'non urgent', for time to operation. In future audits, patients should be categorized at the time of referral and clinic appointment with separate criteria and standards established for each category. If the overall criteria are retained for simplicity then either the standards are too challenging or the waiting times are indeed unacceptably long. For the latter, the factors to examine are the surgical and anaesthetic resource levels, outpatient clinic time, and day surgery unit (DSU) availability and efficiency.

There was an attempt to list those maxillofacial procedures suitable for day case surgery. Based on previous lists[4], fourteen procedures were coded, with number 15 coded as 'other'. Table 2 shows the procedures. These findings point to a need to develop an improved coding system for future audit work. All patients were suitable for day case anaesthesia indicating that the current selection criteria are successful. Surgical assessment of cases attained the set standard with 97% of cases lasting less than 30 min. In one patient the operation was deemed too complicated for day surgery to be performed: he was rebooked for inpatient treatment. In addition two patients had only two of four molars removed at operation, for technical reasons. Both were rescheduled for further day surgery at a later date. Two patients did not attend as appointments were mislaid. Prospective audit is essential to pick up problems of non-attenders and those found unsuitable for surgery on the day.

Anaesthesia beyond 30 min is thought to cause problems of slow recovery. Of the five patients whose anaesthesia lasted over 30 min, only two were discharged late. Similarly prolonged surgery may cause more trauma, and hence postoperative pain, which was seen in only three patients in the series.

Hospital admission and late discharge have important implications for day surgical organization. If staff have to stay late, after 18.00 hrs, this reduces efficiency and lowers morale. The major cost benefits of day surgery are gained from regular staff working patterns, and the avoidance of overnight patient care.

The re-admission rate of 2% includes the two patients rebooked for further treatment who should not be deemed a failure of the system. It appears from this study that criteria 6 and 9 overlap and are not therefore mutually exclusive. This will be reviewed at a later date.

All day surgical patients are discharged with written postoperative instructions and information on any expected problems. They are advised to contact the hospital if problems arise, though only three did. If other sources of help or advice were sought this would not be picked up by this audit method and may be a weakness of this system.

The incidence of postoperative sequelae was 10% (Table 3). The types of complication need to be reviewed clinically to establish whether or not they represent a set of adverse events necessarily accompanying maxillofacial surgery or whether relevant factors can be detected. These features may become clearer in a larger unit.

The professional outcome measure as a self-rated assessment cannot be used between surgeons and between anaesthetists because of the non-standardization between raters. For each surgeon and each anaesthetist, the value of the scoring system depends on the confidence with which each is able to use the full scale and comment on poor scores. If the clinical data so recorded are used for purposes other than professional self audit then this technique (and any other self-assessment technique) is of dubious value. The data entry technique should be reviewed carefully to establish whether there are alternative methods (e.g. laser read

forms/optical mark readers) with the same reliability and efficiency as the current computer-based technique.

## Conclusions and recommendations

This study has led to the following conclusions and recommendations:

1. The main audit should be prospective and include criteria and standards relating to patient perception of care in addition to assessment by professionals. It should remain simple and practical and the temptation to record data unrelated to specific criteria should be resisted.
2. The only significant failures to achieve standards in this audit relate to referral and waiting times. It is recommended that these be addressed formally at a later stage, taking actions as necessary and thereby completing the audit cycle.
3. Standards should explicity relate to a population, e.g. 90% achieve a certain target out of at least 150 sequential patients starting at a randomly chosen date. Otherwise, more complex estimation theory needs to be applied to select a sample size deciding a priori which is the key variable in a set of standards.
4. As part of any future follow-on audit, it is recommended that the maxillofacial coding system be reviewed, listing all procedures and determining which are essentially inpatient procedures, which outpatient procedures, and which are day surgery cases.
5. The main audit should detect patients failing to attend for day case surgery and those attending but being found unsuitable. Definitions of admissions/readmissions need to be clarified and criteria relating to postoperative sequelae and emergency treatment should be delineated.
6. The 100 mm visual analogue scale for self assessment of professional outcome is a significant step in the direction of simple self audit of professional care. Any established standardized methods should be reviewed together with alternative scoring systems and inter-rater standardization. If retained, the 100 mm lines should be revised to read from 'low' to 'high' for a more logical scoring system. If alternatives to this simple technique are not forthcoming then a clear understanding of the confidential nature of the data and purposes to which it can be put must be confirmed.

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# Patient selection criteria for paediatric ambulatory surgery

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The purpose of this paper is to summarize the major issues that must be considered in determining a child's eligibility for ambulatory surgery. Selection criteria for a child with a runny nose, heart murmur, asthma, bronchopulmonary dysplasia, congenital or acquired heart disease, and the ex-premature infant are discussed. Performing more complex procedures on sicker patients will be a continuing challenge for ambulatory surgery centres. The keys to success are careful patient selection and meticulous intraoperative and postoperative care.

Key words: Anaesthesia, outpatient, paediatric

During the 1980s, paediatric ambulatory surgery was limited to ASA physical status I or II patients undergoing brief surgical procedures. This is no longer true. The psychological, financial and medical benefits of minimizing the time spent in the hospital have all been cited as reasons to allow many more children, including those with significant underlying medical problems to undergo ambulatory surgery. More than 50% of all paediatric surgical procedures are now performed on an outpatient basis. As the number of ambulatory patients rises and their surgical care becomes more complex, it becomes increasingly important to have clear policies or guidelines on common problems such as fasting (NPO) times, patient selection, prophylaxis for subacute bacterial endocarditis and discharge criteria. The criteria for selecting patients for paediatric ambulatory surgery are especially important. Such guidelines vary between institutions and they are usually influenced by the condition of the patient, the attitude of the parents, the type of surgical procedure, and special considerations relating to anaesthetic management and recovery[1]. The purpose of this paper is to summarize the major issues that must be considered in determining a child's eligibility for ambulatory surgery.

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## The patient: general considerations

### *Physical condition*

The child should be in good health (ASA physical status I and II). If patients with moderately severe illness are accepted (ASA physical status III), their medical condition must be well controlled. Many children with chronic diseases benefit substantially from outpatient treatment. Immunocompromised patients benefit greatly from a limited hospital stay. Physically disabled, psychologically disturbed and mentally retarded children likewise benefit tremendously from the lack of separation and continued support of a parent or guardian that is usually fostered in outpatient facilities.

Although some centres require an anaesthetic preoperative visit, others have found that careful evaluation by the surgical staff, followed by telephone screening, is usually adequate[2]. Most problems requiring further evaluation are detected during the telephone interview and a special preoperative visit to the facility by the family may be arranged. Needs of specific groups of patients can then be detected and individual strategies developed to minimize difficulties. A special summary sheet, for example, may be completed by the oncologists for patients with cancer. The summary includes the names and dosages of chemotherapeutic agents, including steroids and adriamycin, and results of cardiac evaluation including echocardiographic findings, and ejection fraction. This summary is incorporated as part of the preoperative evaluation.

*Age*

Patients over a certain age (e.g. >80 years) are often considered inappropriate for ambulatory surgery. What about the other extreme? Is a three-day-old, full-term, otherwise healthy newborn infant an appropriate candidate for ambulatory surgery? Many ophthalmologists now prefer to perform surgery for congenital cataract on newborns as young as 2–3 days. The literature does not provide any conclusive data on which to formulate guidelines concerning the minimum acceptable age for ambulatory surgery. The first month of life is marked by rapid and profound physiological changes, such as closure of patent ductus arteriosus, decreased pulmonary vascular resistance, increased functional residual capacity, increased glomerular filtration rate, and physiological jaundice. At the Children's National Medical Center (CNMC), we have arbitrarily set the minimum age limit for ambulatory surgery for full-term infants at 2 weeks. By 2 weeks of age, the physiological jaundice would have abated, pulmonary vascular resistance decreased, and ductus arteriosus closed. We believe that ambulatory surgery is safer when these conditions have been resolved. Each centre, however, in consultation with neonatologists and surgeons, should set their own guidelines.

*Sudden infant death syndrome (SIDS)*

Full-term infants have a risk of developing SIDS during the first year of life. Although there is no evidence that anaesthesia or surgery increases the risk of SIDS[3], a recent case report by Tetzlaff et al.[4] which described a full-term infant, who developed two prolonged apnoeic spells in the postoperative period, raises concern. The cause of SIDS is not known and there is no diagnostic test available to identify SIDS-prone infants. Van der Hal et al.[5] noted that 62% of the infants with SIDS had an abnormal arousal response to hypoxia. Certain risk factors are, however, well established. If the patient has a sibling with the history of SIDS or if the mother has abused drugs during pregnancy, the risk of SIDS increases many fold. Infants whose history places them at high risk for SIDS should be closely observed during the postoperative period. It is also possible that a fatal apnoeic episode could coincidentally occur during the postoperative period, with no cause-and-effect relationship between anaesthesia and mortality.

**The patient: special problems**

*The child with a runny nose*

A child who presents for surgery with a runny nose may have a benign, noninfectious condition (e.g. seasonal or vasomotor rhinitis), in which case elective surgery may safely be performed. The runny nose, however, may signal an infectious process, in which case elective surgery should be postponed[6]. Since 20–30% of all children have a runny nose for a significant part of the year, every child with a runny nose must be evaluated on an individual basis.

The preanaesthetic assessment of these patiens consists of a complete history, a physical examination, and appropriate laboratory tests. Early in the clinical course of infection, the history is the single most important factor in the differential diagnosis. Information on allergies should be actively sought. Parents can usually tell whether their child's runny nose is a chronic condition – 'the usual runny nose' or something different. The physical examination is not always conclusive. Findings may be normal during the early part of an infectious process. Chronic allergic rhinitis, on the other hand, may be associated with local infections within the nasopharynx resulting in purulent nasal discharge. A white blood cell count >12 000–15 000 with a shift to the left suggests infection.

If surgery is postponed because of simple nasopharyngitis, it can usually be rescheduled in 1–2 weeks. If a 'flu-like syndrome that involves both the upper and lower respiratory tract is present, the surgery should be postponed until at least 1 month following resolution of symptoms.

A situation that often poses a dilemma is that of a child with a runny nose who presents for relatively brief or low-risk procedures such as the insertion of ventilation tubes for chronic serous otitis media. Many such children are scheduled several times for insertion of ear tubes but the procedures are cancelled because of a runny nose. Many anaesthesiologists are willing to proceed with this group of patients[6–8], and some have reported no increase in perioperative complications associated with uncomplicated upper respiratory infections (URIs)[7,8]. Because some of these children may be at increased risk of transient postoperative hypoxaemia, they should be given supplemental oxygen or have their oxygen saturation monitored during transport and in the postanaesthesia care unit (PACU)[9].

*The ex-premature infant*

The ex-premature infant may not be a suitable candidate for ambulatory surgery because of potential immaturity of the temperature control, respiratory centre and gag reflexes. Recent studies have reported perioperative complications such as apnoea in ex-premature infants who do not have a history of respiratory distress syndrome.

In a retrospective chart review of healthy infants undergoing herniorrhaphy, Steward[10] reported that 12% of preterm infants were observed to have prolonged apnoea up to 12 h after anaesthesia. Liu and coworkers[11] prospectively studied 214 infants including 41 former preterm infants. Eighteen infants, all of whom were less than 41 weeks' postconceptual age, had postoperative apnoea or required mechanical ventilation. None of the infants greater than 46 weeks' postconceptual age developed prolonged postoperative apnoea[11]. A large number of patients in this study required mechanical ventilation for other preexisting conditions (e.g. brain damage); consequently, the true incidence of apnoea that was pre-

cipitated solely by anaesthesia and surgery in this subgroup remains unknown.

In a study of 86 otherwise healthy infants of less than 12 months postnatal age undergoing general anaesthesia for herniorrhaphy, Welborn and coworkers[12] found no incidents of apnoea or periodic breathing with bradycardia on postoperative pneumograms. Some infants in this group had a history of preanaesthetic apnoea and were being monitored for apnoea at home[12]. Periodic breathing without bradycardia, however, was noted in 14 of 38 preterm infants during the postoperative period. Periodic breathing occurred as late as 5 h postoperatively. The lower the infant's gestational age, the more frequent the incidence of periodic breathing. Neither apnoea nor periodic breathing occurred in former premature infants whose conceptual age was more than 44 weeks and who had no major systemic disease at the time of surgery. In a later study, however, Welborn[13] reported a 73% incidence of postoperative prolonged apnoea with bradycardia in a similar group of infants whose conceptual ages ranged between 35 and 44 weeks. In still another prospective study using pneumography, Kurth and coworkers[14] reported a 37% incidence of prolonged postanaesthetic apnoea in 47 former preterm infants whose conceptual ages varied from 32–55 weeks. The initial episode of apnoea occurred as late as 12 h after anaesthesia.

Although the total cases reported in the literature to date is approximately 300, no single study has included a large number of ASA physical status I or II patients undergoing the same operative procedures with the same anaesthetic technique. Many of the data are derived from retrospective reviews of complications or from patients with preexisting disease who underwent complex surgical procedures. Therefore, it is difficult to formulate definitive guidelines for ambulatory surgery in the formerly premature infant. Further complicating the issue is a lack of understanding of the clinical significance of apnoeic episodes that result in bradycardia and arterial oxygen desaturation but eventually self-correct before cardiorespiratory arrest develops. While the spontaneous return of respiration is probable in these infants, it is possible that the apnoeic episodes may have hypoxic effects on the brain. Even a relationship to SIDS has been suggested. Failure to detect and treat breathing irregularities in these high-risk infants may increase the likelihood of sudden death. In brief, the anaesthesiologist must be aware that a history of prematurity is a 'red flag'; such infants must be observed carefully for episodes of postoperative apnoea.

The age at which the premature infant attains physiological maturity and no longer presents an increased risk must be determined individually. It appears that as the child matures, the tendency toward apnoea greatly diminishes, but no one knows the age when all babies may be safely anaesthetized on an outpatient basis. Factors that govern the decision include the infant's growth and development, problems during feeding, time to recovery from upper respiratory infections, and a history of apnoea or metabolic, endocrine, neurological or cardiac disorders.

The infants at greatest risk are those younger than 46 weeks post-conceptual age who have a history of apnoea. Beyond this, one must establish a middle ground between the conservative 60 weeks recommended by Kurth and coworkers[14] and the recommendations of Liu et al.[11] and Welborn et al.[12] who believe that ambulatory surgery may be safely performed at 44–46 weeks. Until more extensive, meticulous, prospective studies are carried out, it seems prudent to admit to the hospital all ex-premature infants scheduled for surgery at less than 50 weeks postconceptual age and to monitor them for postoperative apnoea, bradycardia, and oxygen desaturation. If the infant has bronchopulmonary dysplasia (BPD), this period should be extended for as long as the infant is symptomatic. It is also appropriate to individualize all decisions and, when in doubt, to err on the conservative side. Should any questions arise, inpatient care is recommended.

Recent reports by Welborn and coworkers[13,15] suggest that a single intravenous dose of caffeine at the beginning of surgery may control postanaesthetic apnoea in former premature infants. When a 5 mg $kg^{-1}$ dose was used, no infant developed prolonged apnoea with bradycardia; some infants, however, developed periodic breathing[13]. A 10 mg $kg^{-1}$ dose of caffeine, by contrast, controlled all types of apnoea in these infants[15]. Until more extensive experience with this approach is available, all infants at risk should be monitored for apnoea and/or bradycardia following anaesthesia.

### *Bronchopulmonary dysplasia (BPD)*

The infant with BPD presents several problems, including decreased pulmonary function with airway hyperreactivity, residual lung disease which may cause hypoxia and hypercarbia; and an abnormal response to hypoxia, which may lead to apnoea, hypoxia, bradycardia, and sometimes death[16]. Decisions regarding patients' suitability for ambulatory surgery must be made on an individual basis. Patients with persistent wheezing, hypercarbia, and oxygen dependency are generally unsuitable for ambulatory surgery. They should be admitted to the hospital for preoperative treatment that will optimize their physical condition. Cardiorespiratory monitoring is often required following surgery.

### *The child with a heart murmur*

The incidence of heart murmurs in children over one month of age is greater than 50%. The murmur is often first heard during the preanaesthetic examination. Even if the child is asymptomatic, it is imperative that the cause of the murmur be diagnosed prior to anaesthesia and surgery. Newburger et al.[17] have concluded that a paediatric cardiologist can reliably confirm an innocent murmur by physical examination alone[17]; whether other physicians including paediatricians can consistently diagnose an organic murmur is debatable. At CNMC, the grid shown in Table 1 serves as a guide to determine the need for a cardiology consultation[1].

**Table 1.** The child with a heart murmur

| *Clinical diagnosis By whom?* | *No heart disease* | *Possible heart disease* | | *Definite heart disease* |
|---|---|---|---|---|
| Anaesthesiologist | Yes | Yes | No | Yes |
| Paediatrician | Yes | No | Yes | Yes |
| Cardiology consult? | No | Yes | Yes | Yes |

A child with a murmur may not require specific preoperative cardiac therapy or even a modification in the selection of anaesthetic agents and technique. Such a child does, however, usually need antibiotic prophylaxis to prevent subacute bacterial endocarditis (SBE). For quick reference, every department of anaesthesiology should have available the most recent American Heart Association's guidelines for prevention of bacterial endocarditis[18]. Children who have innocent heart murmurs do not require SBE prophylaxis. Prophylaxis is also not required for orotracheal intubation and myringotomy. It is generally safe to proceed with surgery if the child has a normal growth and activity pattern, and the murmur is characterized as of low intensity, nonradiating, and early systolic. When in doubt, it is best to consult a cardiologist.

*Congenial or acquired heart disease*

Congenital heart disease occurs in 0.08% of newborn infants. The decision to schedule such a child for ambulatory surgery must be made only after communication with the cardiologist and surgeon. If the cardiac status is stable and a cardiologist has been following the child, ambulatory surgery may be appropriate. Response to four questions should determine the anaesthetic plan[19].

1. Is there a cardiac shunt (e.g. ventricular septal defect)?
2. Is there obstruction to blood flow (e.g. valvular stenosis, coarctation)?
3. What are the consequences of the defect (e.g. congestive heart failure, cyanosis)? and
4. What is the relationship of pulmonary vascular resistance and systemic vascular resistance?

If there is a cardiac shunt, meticulous attention should be paid to eliminating air bubbles from the intravenous lines, and to maintain a left to right shunt flow. Patients with congestive heart failure must continue to receive all medications until the morning of surgery. If the child is cyanotic due to decreased blood flow to lungs secondary to increased pulmonary vascular resistance, hyperventilation and high $FiO_2$ will improve blood flow to the lungs. If pulmonary flow is increased, then ventilation with positive end-expiratory pressure and reducing inspired oxygen concentration will decrease pulmonary blood flow.

If there is any question about the stability of cardiac lesion, hospital admission is advised. Patients requiring routine supplemental oxygen should be hospitalized.

*Asthma*

Asthma is the most common major disease among children. The prevalence of asthma among children in the United States is 7.6%. Most patients have their first attack before their third birthday[20]. The prevalence of asthma is rising, as are hospitalization and mortality rates associated with this condition. Asthma is one of the four most common problems identified during preoperative telephone screening for paediatric ambulatory surgery[2]. The severity of asthma varies greatly in children. Some patients have infrequent attacks, often associated with a cold or with the allergy season. They require minimal medication, and their wheezing is easily controlled by an inhaler or theophylline. Such patients are appropriate candidates for ambulatory surgery. The second group has moderately severe asthma and require continuous therapy. It is important to know their baseline status and communicate directly with their primary physician before scheduling them for ambulatory surgery. Should ambulatory surgery be scheduled, these children must receive their medications until the morning of surgery. A β agonist should be administered in the operating room holding area. If the patient has persistent cough, wheezing, or tachypnoea on the day of surgery, it is best to reschedule surgery. Some children with severe asthma are never completely free of wheezing. If surgery is needed, they usually require admission to the hospital.

*Malignant hyperthermia*

Many children are presumed to be malignant hyperthermia susceptible (MHS) because of a family history suggestive of MH or a previous suspected MH reaction. Few patients actually have biopsy proven MHS. Children otherwise suitable for ambulatory surgery are often hospitalized overnight solely because they are known or suspected to be MHS. Yentis et al.[21] concluded from their retrospective anaysis that postoperative admission to the hospital solely on the basis of the MHS label is not warranted. Intraoperative use of nontriggering agents and 4 h of postoperative observation are, however, recommended.

## Preoperative laboratory testing

Healthy children who are scheduled to undergo surgical procedures that are not associated with the possibility of extensive blood loss require only minimal preoperative laboratory testing. In some instances, such testing is governed by hospital or state policy. Roy et al.[22] studied

2000 patients, aged between 1 month and 18 years, who were scheduled for minor surgery. The incidence of anaemia was 0.5%; approximately 75% of these children underwent anaesthesia without complications. The authors concluded that healthy children, 5 years and older, scheduled for minor surgery do not require routine haemoglobin determination. Hackman et al.[23] prospectively studied the prevalence of anaemia in paediatric day-surgery patients and evaluated the anaesthesiologists' ability to detect preoperative anaemia clinically. Of the 2649 patients, 14 (0.5%) were anaemic. Seven of the anaemic patients were less than 1 year of age. Only five patients were predicted to be anaemic based on clinical examination. The authors concluded that a mild degree of anaemia does not alter the decision to proceed with the ambulatory surgery and that anaesthesiologists cannot reliably detect anaemia clinically.

It has been proposed that routine preoperative haemoglobin testing is necessary only for: (a) children less than 1 year of age; (b) children who have never been tested for sickle cell disease; and (c) children with systemic disease. Most anaesthesiologists now accept haematocrits in the mid-20s for elective surgical procedures, provided there are no other systemic problems.

### *Pregnancy testing*

Testing adolescents for pregnancy is another controversial issue in paediatric ambulatory surgery. The rate of teenage pregnancy is increasing not only in urban populations but also in suburban and rural areas. Some hospitals perform pregnancy tests routinely on every female patient over the age of 12 years; however, most centres first screen patients by obtaining a good history. Accurate history is most often obtained by female personnel, such as the nursing staff in the admission area. Questions about the girl's last menstrual period should be asked in confidence in a private area. A pregnancy test should be ordered if the history suggests that there is a chance of pregnancy.

## Preparing the parents

In the past, the choice of outpatient vs. inpatient care was largely influenced by parents' wishes and the experiences of friends and family. Third-party payors and government regulators are now increasingly reluctant to comply with parents' demands for hospitalization of a healthy child who is scheduled to undergo a minor operation. Parents of children who are scheduled for paediatric outpatient surgery, however, should be capable of understanding and be willing to follow specific instructions related to ambulatory surgery. In most cases, it is up to the physician to educate parents and make them feel secure and comfortable.

## The surgical procedure

The surgical procedure should only be associated with minimal to moderate bleeding and physiological derangements. Most experts believe that almost any operation that does not require a major intervention into the cranial vault, abdomen or thorax can be considered for ambulatory surgery. The five most frequently performed operations at the Children's National Medical Center day surgery unit during the past 2 years were herniorrhaphy, myringotomy, adenoidectomy with or without myringotomy, circumcision, and eye-muscle surgery.

Because of the risk of haemorrhage, there is a debate as to the advisability of performing tonsillectomy as an outpatient procedure. In 1968, Chiang and associates[24] reported performing 40 000 outpatient tonsillectomies and adenoidectomies (T&A) without death. To decrease the risk of haemorrhage, they emphasized that patients must be carefully selected. The preoperative evaluation should seek to eliminate patients with bleeding tendencies and cardiopulmonary disease. As further safeguards, no 'allergic' patient was operated on during the pollen season, and no operation was performed until 4–5 weeks after an acute attack of tonsillitis. More recently, Maniglia and coworkers[25] reported a series of 1428 adenotonsillectomies performed on outpatients. There were two cases (0.14%) of immediate bleeding (within 24 hours) and two of secondary bleeding (after 24 hours). The two incidents of immediate bleeding occurred within the first hour following the surgical procedure. Secondary haemorrhage occurred 1 week after surgery. The authors concluded that outpatient adenotonsillectomy is safe and cost effective, and that there was little benefit in keeping patients in the hospital more than a few hours after surgery.

Recently, there have been reports of postoperative apnoea and/or obstruction in children following tonsillectomy[26]. Many of these patients are young ($< 3$ years) and have a documented history of preoperative sleep apnoea or other obstructive phenomena during sleep. In extreme cases the airway obstruction can result in pulmonary hypertension and cor pulmonale[27]. It is therefore important that the indication for tonsillectomy (repeated infections vs. obstructive symptoms) be carefully reviewed, especially in young patients. Postoperative cardio-respiratory monitoring or even ICU admission for airway support may be necessary in the latter group.

## Conclusion

Growing experience in the past decade has proved that ambulatory surgery is both safe and cost effective. The number of patients undergoing ambulatory surgery has risen to over 50%[28]. Although the growth rate is not likely to be as exponential as the 1980s in the coming years, payors will continue to exert pressure to do more procedures on an ambulatory basis[28]. Performing more complex procedures on sicker patients will be a continuing challenge for ambulatory surgery centres. The keys to success are careful patient selection and meticulous intraoperative and postoperative care.

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# A postanaesthetic discharge scoring system for home readiness after ambulatory surgery

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The assessment of a patient's home readiness is an important element in ambulatory surgery. No objective scoring system exists which systematically determines home readiness. A new postanaesthetic discharge scoring system (PADSS) has been designed and evaluated for reliability and validity against the existing clinical discharge criteria (CDC) in the ambulatory surgery unit of the hospital. Two hundred and forty-seven ambulatory surgery patients undergoing general anaesthesia were studied. Overall, there was a close correlation between the end of anaesthesia to the time patients were fit for discharge using either the PADSS or the CDC (Pearson's correlation coefficient $r = 0.89$). The internal consistency reliability of the PADSS ($\alpha = 0.65$) was superior to that of the CDC ($\alpha = 0.14$). The interobserver reliability coefficients of the PADSS at 1.0 and 1.5 h post surgery was also superior to the CDC for the dilatation and curettage patients. We have validated the PADSS against the CDC and found it to have superior measurement scaling and diagnostic properties.

Key words: Ambulatory surgery, patient discharge, postoperative complications

## Introduction

Ambulatory surgery is becoming more common, and does not only involve simple and short surgical procedures on healthy patients: the trend is towards lengthier procedures in infants, geriatric and debilitated patients[1]. It is predicted that by the end of this decade, 60% of the hospitals' surgical caseload may be performed on an ambulatory basis[2]. The question of how long patients should remain in hospital following ambulatory surgery is crucial to future developments in this area of care[3].

A major concern in the quality of patient care is the safe timing of patient discharge, in relation to recovery from general anaesthesia or conscious sedation. At the time of discharge from the ambulatory surgery unit, the patients should be home ready, meaning that patients are clinically stable and able to rest at home under the care of a responsible adult.

Several discharge criteria have been described but none have been evaluated for their validity and reliability[4–10]. The Aldrete score used for discharging patients from the postanaesthetic care unit cannot be applied to ambulatory surgery patients[11]. The ability to ambulate, the level of hydration and the ability to tolerate oral intake are unique to the ambulatory surgical patient[12]. These factors are not taken into account by the Aldrete scoring system. Though psychomotor impairment may persist hours after a patient has left the unit, this does not mean that the patient cannot be discharged safely[4]. The patient's readiness for discharge needs to be addressed in a simple, clear, reproducible manner. Nursing staff need to be able to evaluate the postoperative course of the patient in a systemic way and meet guidelines to seek physician consultation when necessary[4].

In this study, we have designed a simple cumulative index, the postanaesthetic discharge scoring system (PADSS) – to measure home-readiness of ambulatory surgery patients. We have evaluated its validity and reliability against the existing clinical discharge criteria in the ambulatory surgery unit of the hospital.

## Materials and methods

After obtaining Institutional Human Ethics Committee approval, patients scheduled for outpatient ambulatory surgery were selected at random and informed consent

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**Table 1.** Postanaesthetic discharge scoring system (PADSS) and the clinical discharge criteria used in our ambulatory surgery unit

*Postanaesthetic discharge scoring system (PADSS)*
1. Vital signs
   2 = Within 20% of preoperative value
   1 = 20–40% of preoperative value
   0 = >40% preoperative value
2. Activity and mental status
   2 = Oriented × 3 AND has a steady gait
   1 = Oriented × 3 OR has a steady gait
   0 = Neither
3. Pain, nausea and/or vomiting
   2 = Minimal
   1 = Moderate
   0 = Severe
4. Surgical bleeding
   2 = Minimal
   1 = Moderate
   0 = Severe
5. Intake and output
   2 = Has had PO fluids AND voided
   1 = Has had PO fluids OR voided
   0 = Neither

*Clinical discharge criteria (CDC)*
1. Stable vital signs
2. Patient is alert and oriented
3. Patient is free of nausea and vomiting
4. Steady of gait
5. Patient is not bleeding

Total PADSS score is 10; score ≥9 considered fit for discharge

obtained. Two hundred and forty-seven patients received general anaesthesia and had a variety of operative procedures. After the operation, they were transported to the postanaesthetic care unit. The initial assessment using the PADSS and the CDC was made by an independent investigator not directly involved in the care of the patient 1 h after the operation (Table 1). Subsequently, the evaluation was repeated at 30-min intervals until the patient obtained a postanaesthetic discharge score of at least 9 and until the time the patient fulfilled all clinical discharge criteria, respectively. The scores were not made known to hospital personnel directly involved in the care the patients and the decision to discharge the patients was made independently by hospital personnel according to the CDC. The time that the patients were actually discharged from the ambulatory surgery unit was noted.

To eliminate intraobserver and interobserver bias, another 80 patients for dilatation and curettage were studied. For the elimination of intraobserver bias, two investigators scored 40 patients, one using the PADSS, and the other using the CDC at the same intervals. To determine interobserver agreement, two independent investigators assessed 40 patients separately using both the PADSS and the CDC at the same time intervals.

The PADSS is based on five main criteria:

1. vital signs – blood pressure, heart rate, respiratory rate, and temperature;
2. activity and mental status;
3. pain or nausea/vomiting;
4. surgical bleeding and
5. intake/output.

Qualifications for discharge include: (1) a postoperative discharge score of greater than or equal to 9; and (2) presence of a competent adult to accompany the patient home.

Since each of the three variables (0, 1 and 2) in each category have equal weights in the rating scales, a summated score of 9 or 10 was designed to indicate that the patient is fit for discharge. All patients were interviewed 24 h postoperatively by telephone with a standardized questionnaire to document the postoperative course of the patient and to detect delayed complications after discharge.

The proposed PADSS was validated against the existing clinical discharge guideline in the ambulatory surgery unit by comparing the respective discharge times achieved using the proposed scoring system and the current discharge criteria of the unit.

All data were stored in a computerized database and compared for statistical difference using Student's $t$ tests and $\chi^2$. Pearson's correlation was used to assess the time taken to discharge patients using the PADSS and the CDC.

Computation of Cronbach's alpha was done to assess the internal consistency of the measurement scales in all the data[13,14]. When one combines measurements on distinct items into a single summary score as in the PADSS, statistical evidence that the items form a scale or that the scale is internally cohesive, must be demonstrated[13]. Internal consistency reliability coefficients (Cronbach's alpha) increase directly with the number of items in the scale and with the heterogeneity of the individuals who are measured through the scale[14]. Interobserver agreement was assessed using kappa statistics[15]. The kappa coefficient is a measure of interrater agreement beyond what would be expected by chance alone. Kappa is appropriate when the measurement or rating of individuals is on a categorical or ordinal scale. A kappa of 0 reflects agreement at chance level, while a kappa of 1.0 reflects perfect agreement beyond chance. Data are presented as mean ± SEM. A $P$ value of $<0.05$ was considered statistically significant.

## Results

Two hundred and forty-seven patients were entered into the study. The demographic and clinical characteristics of the patients are summarized in Table 2. The surgical procedures included 151 dilatation and curettage (D&C) (61.1%), 58 arthroscopies (23.5%), 20 laparoscopies (8.1%), and other minor surgical procedures (7.3%). For purpose of analysis, the study population was divided into two main surgical groups – D&C and patients undergoing arthroscopy, laparoscopy and minor surgeries.

At 2.5 h postoperatively, 96% of the patients who had

**Table 2.** Demographic data

| | *D&C* | *Arthroscopy, laparoscopy & others* |
|---|---|---|
| No. of patients | 151 | 96 |
| Gender | 151 F | 43M : 53F |
| Age (yr) | 27 ± 9 | 38 ± 11 |
| ASA class | | |
| I | 141 | 75 |
| II | 9 | 21 |
| III | 1 | 0 |
| Duration of anaesthesia (min) | 20 ± 7 | 62 ± 26 |

Mean ± SEM.

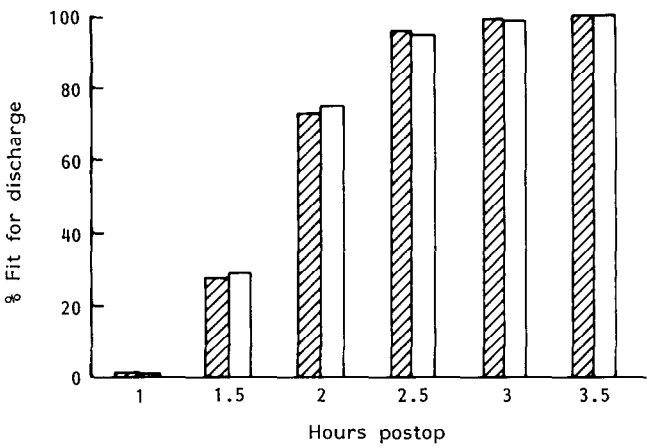


**Figure 1.** Percentage of D&C patients fit for discharge using the PADSS (▨) and the CDC (□).

D&C could have been discharged using the PADSS compared to 94.7% of patients using the CDC (Figure 1). On the other hand, 88.5% of patients who underwent arthroscopy, laparoscopy or other minor surgical procedures were suitable for discharge 3 h postoperatively using the PADSS vs. 86.5% of patients achieving satisfactory clinical discharge criteria (Figure 2).

On average, patients who had D&C required 111 ± 31 min postoperatively to achieve a postanaesthetic discharge score ≥9 as compared to 120 ± 35 min needed to fulfil the clinical discharge criteria satisfactorily ($P<0.001$). Patients who underwent arthrosocopy, laparoscopy or other minor surgeries needed 139 ± 50 min to be discharged using the PADSS vs. 145 ± 53 min needed for satisfactory fulfilment of the CDC ($P<0.001$).

The actual postoperative discharge time for the D&C patients was 177 ± 52 min while for the arthroscopy/laparoscopy/minor surgeries group it was 232 ± 70 min. These results show that patients had stayed significantly longer in the ambulatory surgery unit than the time needed to achieve a safe postanaesthetic discharge score of ≥9 or a satisfactory clinical discharge criteria ($P<0.0001$).

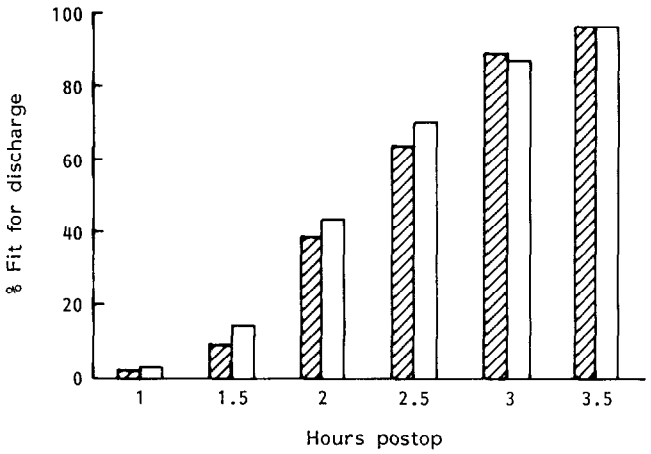


**Figure 2.** Percentage of patients fit for discharge using the PADSS (▨) and the CDC (□) after undergoing arthroscopy, laparoscopy or other minor surgical procedures.

**Table 3.** Times (min)

| | *D&C* | *Arthroscopy, laparoscopy & others* |
|---|---|---|
| End of anaesthesia to PADSS | 111 ± 32 | 139 ± 50 |
| End of anaesthesia to CDC | 120 ± 35 | 145 ± 53 |
| End of anaesthesia to actual discharge | 177 ± 53 | 232 ± 70 |

Note: There are significant differences between and within each surgical group ($P<0.001$) at all levels.

Using the PADSS, patients undergoing D&C and arthroscopy, laparoscopy and other minor surgical procedures could be discharged 66 ± 46 min and 89 ± 65 min earlier, respectively. If the CDC were strictly followed, patients undergoing D&C and arthroscopy, laparoscopy and other minor surgical procedures could be discharged 58 ± 44 and 85 ± 63 min earlier, respectively (Table 3).

Overall, there was a close correlation between the end of anaesthesia to the time patients were fit for discharge using either the PADSS or the CDC (Figure 3) (Pearson's correlation coefficient $r = 0.89$).

The internal consistency reliability coefficients (Cronbach's alpha) of the PADSS reached 0.65 overall for the D&C type surgical group. For the arthroscopy/laparoscopy/minor surgical group, overall internal consistency coefficient reached 0.48 at 150 min post surgery. The largest internal consistency reliability coefficient for the CDC was 0.14 reached at 120 min post surgery for the arthroscopy/laparoscopy/minor surgical group, all other coefficients being close to 0 (Table 4). The Cronbach's alpha is similar to Pearson's coefficient in that the higher the value, the better the internal consistency.

Independent observations were made by two investigators scoring 40 patients, one scoring the PADSS and

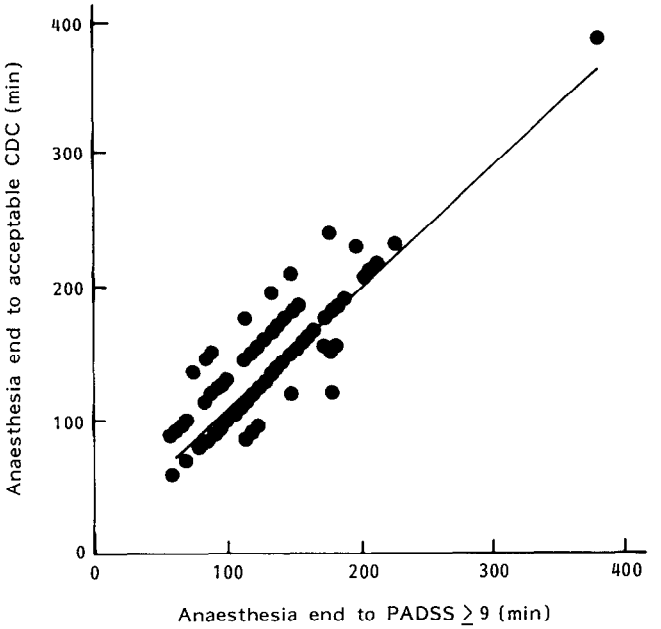


**Figure 3.** Correlation between time from end of anaesthesia to discharge using the PADSS and the CDC (Pearson's correlation coefficient $r = 0.89$).

**Table 4.** Internal consistency reliability coefficient (Cronbach's alpha)

| | *D&C* | *Arthroscopy, laparoscopy & others* |
|---|---|---|
| PADSS | 0.65 | 0.48 |
| CDC | 0.00 | 0.14 |

**Table 5.** Interobserver agreement (kappa agreement coefficient)

| | *1 h postop* | *1.5 h postop* |
|---|---|---|
| PADSS | 0.84 | 0.80 |
| CDC | 0.87 | 0.52 |

$P < 0.001$.

the other the CDC. Pearson's correlation coefficient was high, $r = 0.79$, between the time taken to achieve a discharge score of $\geq 9$ and the time taken to obtain a satisfactory clinical discharge criteria.

The interrater reliability coefficients (kappa agreement coefficients) of the PADSS were high, 0.84 and 0.80, at 1.0 and 1.5 h post surgery respectively. The interrater reliability coefficients of the CDC were 0.87 and 0.52 at 1.0 and 1.5 h post surgery. All kappa were significant at $P < 0.001$ and are substantial according to the Fleiss criteria[15]. Kappa agreement coefficients are similar to Pearson's correlation in that the higher the value, the better the correlation.

There were no hospital readmissions or significant postoperative complications by postoperative follow-up phone call.

## Discussion

There is a growing need to design a discharge scoring system so that home readiness of patients can be addressed in a simple, clear, reproducible manner. It is important to replace subjective clinical impressions as the basis for discharging patients with objective observations which are summarized in a single index with the aim of providing simple and consistent ways of assessing home-readiness. The development of any scale is a multistep process, which is aimed at establishing both its validity and its reliability. A scale is valid if it measures what it intends to measure, while reliability refers to its tendency to produce consistent results when applied to the same individual by different observers, or by one observer at different times[16].

To determine concurrent validity, we compared the discharge time using the PADSS with those achieved using the standard CDC followed in the ambulatory surgery unit of our hospital. Overall, there was a close correlation between the end of anaesthesia to the time patients were fit for discharge using either the PADSS or the CDC (Pearson's correlation coefficient $r = 0.89$). Using independent observers, the correlation coefficient was higher between the time taken to achieve a discharge score of $\geq 9$ and the time taken to obtain a satisfactory clinical discharge criteria ($r = 0.79$). We considered these results as empirical evidence for the diagnostic superiority of the PADSS.

Our results showed that patients stayed longer after the CDC or PADSS were satisfied. The reason being that the health care personnel were not evaluating the patients every 30 min or escorts were not immediately available.

A measurement is perceived to be reliable if it yields essentially the same measure, when it is repeatedly taken under similar conditions on an individual or an object and the state of the individual or an object is assumed to be constant. For the D&C patients the interrater reliability coefficients of the PADSS at 1.0 h and 1.5 h post surgery was 0.84 and 0.80, respectively, as against 0.87 and 0.52 for the CDC, again suggesting the relative superiority of the PADSS.

For any scoring system to be useful it must be practical, simple, easy to remember, and it should be applicable to all postanaesthesia situations. Using only the commonly observed physical signs will avoid any added burden to the postanaesthesia care personnel. By assigning numerical values to parameters indicating patient recovery, progress or lack of it, it becomes more objective and more easily understood. The scoring system that we have designed is a simple way of providing uniform assessment for all patients, and it may have added medicolegal value for assessment of home readiness. It can

determine the optimal length of stay in the ambulatory surgery unit so that it is safe for the patient and also reduce nursing time per patient and increase the efficiency of the nursing staff.

Reduction in the length of stay in the ambulatory surgery unit by the prompt and safe discharge of patients is a cost reduction and labour-efficient strategy. Ambulatory surgery in certain procedures is deemed cheaper even when allowing for treatment failures and readmissions[17]. However discharge of patients should be achieved without compromising the quality of patient care, and the discharge scoring system we developed enabled us to discharge patients safely. We have now discharged 30 000 patients home safely with PADSS.

We recommend using the Aldrete score to evaluate the initial recovery of the patients. Once the Aldrete score is satisfied, home readiness can be evaluated by PADSS. If the PADSS is satisfied twice at 30-min intervals, the patient can be discharged home. PADSS is simple, practical and safe. It establishes a routine of repeated reevaluation of home readiness, and it provides a uniform assessment for all outpatients.

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# Patient survey after inguinal hernia repair in ambulatory surgery

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We studied the patient charts of six women and 41 men who had undergone hernia repair in ambulatory surgery between February 1991 and March 1992, and sent a postal questionnaire to all 47 former patients. No major complications had occurred. The response rate was 92% ($n$ = 43). We discovered that 95% of respondents felt that preoperative instructions had been adequate, but only 38% felt that they had received adequate postoperative information. Postoperative pain was considered to have been severe by 43%. Full activity had been resumed after an average of 28 days. Overall, 86% claimed to be satisfied, and 67% said that they would recommend hernia repair in ambulatory surgery to others. We conclude that hernia repair in ambulatory surgery can be performed safely. Nevertheless, more attention has to be paid to providing information for postoperative life rules and analgesia to enhance patient satisfaction.

Key words: Inguinal hernia repair, patient satisfaction, postoperative pain, postoperative information

Ambulatory surgery means that the patient is admitted and discharged from a facility on the day of operation[1]. The idea of hospital day-case surgery is not new – Nicoll[2] first reported day surgery on paediatric patients in 1909 – but its modern development dates from the 1950s[3]. Although day-case surgery has been routinely practised for nearly 40 years, acceptance has been slow. Recent economic constraints and hospital bed shortages have stimulated the expansion of the practice[4].

At the Maastricht University Hospital we started performing day-case inguinal hernia repair in adults in 1989. Today ambulatory surgery accounts for 26% of the 3027 surgical procedures performed annually in our department. Inguinal hernia repair forms an intermediate general surgical procedure for which a high proportion of patients are eligible for day-case surgery.

A study was carried out to evaluate the efficiency of inguinal hernia repair in ambulatory surgery. Surgical efficacy (concerning complications and readmittance) and the patient efficacy (with regard to postoperative pain, activity resumption and patient satisfaction) were examined.

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## Patients and methods

Between February 1991 and March 1992, 47 adult patients underwent elective inguinal hernia repair by means of a Bassini repair. The procedure was performed under general anaesthesia at the Maastricht University Hospital's day-case centre.

The 47 patients (six women and 41 men) had a mean age of 42 (range 18–73) years. The patients' charts were studied for readmittance rate and complications. We developed a questionnaire consisting of 19 questions.

We included questions about the patients' attitudes towards the information they had been given pre- and postoperatively, any postoperative discomfort they had felt, and analgesia use. We asked them how long it had been before they could go back to work and resume normal activities. The patients had to indicate their general feeling about hernia repair in ambulatory surgery on a scale from 1 (very bad) to 10 (excellent). In addition they were asked whether they would recommend ambulatory surgery to others. The questionnaire was sent to all 47 patients. Non-responders were sent one remainder.

## Results

Anaesthesia and the hernia repair procedure had all been uneventful. All patients had been discharged on the same day as the operation, although one male patient had been readmitted the same night for severe wound pain. Two

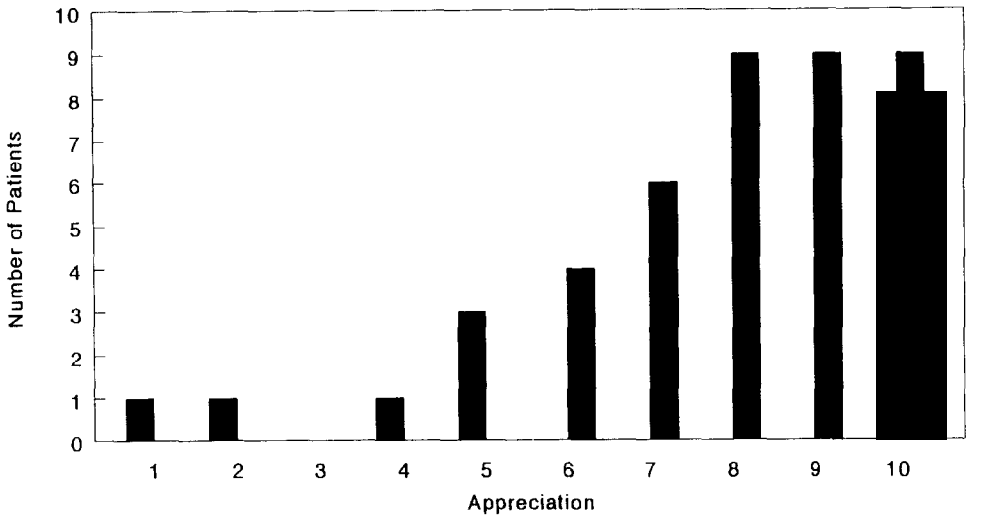


**Figure 1**. Patient satisfaction: ■; score 6 or higher: 86%.

other patients still suffer from mild inguinal haematoma. The follow-up was too short to detect recurrences.

A response rate of 92% (43/47) was obtained from the questionnaire. The preoperative information was reported to have been adequate by 37/43 (86%) of the patients, but the postoperative information was judged to have been sufficient by only 16/43 (38%). In particular, instructions about life rules (what patients may or may not do after the operation) were felt to be insufficient. Postoperative discomfort included wound pain in 35/43 (81%) and headache in 6/43 (14%) patients; and 15/43 (43%) of the patients felt that postoperative pain had been almost unbearable. Oral analgesia was used for an average of 2.5 days by 30/43 (70%) of the patients. 29/43 (67%) patients were active workers with paid jobs, and they resumed work after an average of 30 days. 11/43 (26%) had no paid jobs. Full activity was resumed after an average of 25 days in this group. Full activity resumption in both groups was achieved after an average of 28 days. (Three patients did not respond properly to this question.)

Thirty-seven out of forty-three (86%) patients were satisfied (score 6 or higher) with the hernia repair in ambulatory surgery (Figure 1). 29/43 (67%) of the patients said they would recommend ambulatory surgery to others. Reasons for not recommending it were postoperative pain or complications. Some mentioned that the surgeons had advocated ambulatory surgery and its possible benefits in an over-optimistic manner.

## Discussion

The mere idea of ambulatory hernia surgery softens the emotional impact of the operation. The short hospital stay and temporary disruption of normal daily life can reduce disability and encourage the patient to resume activities after a short time[5]. As reported by Farquharson[6] and Morgan and Beech[3], ambulatory surgery does not increase risks or complications in hernia repair. In this study, only two patients had a postoperative haematoma and one had to be readmitted because of severe pain. However, postoperative pain was found to be a major concern of 43% of the patients, despite the use of oral analgesic by 70%. Postoperative pain affects the patient's appreciation. More attention should therefore be directed to adequate postoperative pain-relief by both surgeons and anaesthetists. Standard analgesia by paracetamol or comparable drugs may be insufficient after hernia repair.

Kirby and Skilton[7] suggested that, apart from pain, uncertainty about the postoperative course was the main reason for the patient being reluctant to go home after a hernia repair. In this study, 62% of the patients were dissatisfied with the postoperative information received: i.e. concerning the expected postoperative discomfort and especially the life rules on what they may or may not do. The surgeon's visit after the operation is usually short and the patient has not recovered from anaesthesia sufficiently to comprehend the instructions fully. More attention has to be focused on this issue. Additional doctors' prescriptions or a phone call the day after the operation can be helpful.

Full activity resumption occurred after an average of 28 days. Cannon et al.[8] found the mean time spent off work to be 52 days in this group of patients, despite the surgeon's advice to resume work within 28 days. Although one might expect that full activity resumption would be earlier after ambulatory surgery than after inpatient surgery, Michaels et al.[9] found no difference in recovery time between inpatients and ambulatory patients. Furthermore, full activity resumption after an operation is possibly influenced more by cultural aspects and social pressures rather than by whether or not the surgery was ambulatory. The persons without paid jobs resumed full activity earlier than those with paid jobs. A possible explanation for this difference is that those with paid jobs can afford to wait until they are ready before resuming all their activities, while those without paid employment are more likely to start all their activities

gradually as their circumstances demand. More detailed questions are necessary to explain a possible difference.

In conclusion this study supports the belief that ambulatory hernia repair is a safe procedure. However, more attention should be directed to postoperative information and pain relief. This will enhance the patient's acceptance of ambulatory hernia repair.

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# Day care in The Netherlands

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In the Autumn of 1992 the Centraal Begeleidings Orgaan voor de Intercollegiale Toetsing (CBO) conducted a survey by questionnaire of hospitals involved in day care. Day care in The Netherlands is defined as surgical or non-surgical treatment, for diagnostic or therapeutic purposes, after which patients require care in a hospital setting for one day. The purpose of the survey was to obtain an adequate view of the current situation of day care in The Netherlands as well as an overview of organizational form, capacity and perceived barriers. All heads of day care units and the management of general and university hospitals received a questionnaire. The overall response rate was 88%. The majority of the responding hospitals reported having a separate unit available for day care, or a unit within a clinical unit. The average admissions per unit was 2947 during 1991. The average number of beds available for day care varied from 7.8 up to 18.1 per unit. Of the responding hospitals 32% intend increasing the number of places available for day care and 61% intend to increase the number of admissions. The results indicate a current interest in the development of day care. However, many respondents perceive barriers to this further development of day care. The main barriers listed by respondents were utilization and planning of care hours, patient logistics, and standardization of working methods.

Key words: Day care, organization, The Netherlands

The CBO* was formed in 1979 by the National Association of Consultants, which forms part of the Dutch Medical Association. The CBO offers assistance and support to professionals in health care for the implementation of structural and systematic quality assurance methods. The CBO day care unit advises hospitals in matters regarding quality of day care.

Day care in The Netherlands is for patients requiring care in a hospital setting after diagnostic and therapeutic treatment. Until recently, these patients have been admitted to the hospital for several days. For surgical interventions, patients arrive at the day surgery facility early in the morning. Shortly after their arrival in the hospital, the necessary operation is performed under general anaesthetic. After recovery, the patients are discharged from the facility at the end of the same day. Therapeutic procedures such as blood transfusions and chemotherapy are the major non-surgical day care treatments. It should be emphasized that, in The Netherlands, outpatient operations are not considered as day care cases, therefore all interventions, mostly performed under local anaesthetic and not requiring postoperative care, have not been included.

Interest in day care has been growing amongst patients, physicians, hospital administrators and health insurance companies. Many hospitals are in the same phase of development of day care facilities and are experiencing similar problems. This study has been carried out to determine the present status and the barriers to further expansion of day care in The Netherlands.

## Survey method

In September 1992, there were 162 day care units in 135 hospitals (general and university) in The Netherlands. The same questionnaire was sent to both the 162 heads of day care units, generally a head nurse, and the management of 135 hospitals. Four questions were related to the unit's internal organization of day care, three questions were related to future plans for day care and one question was concerned with current barriers to the provision of day care programmes. Respondents were requested to indicate on the questionnaire which of the pre-listed responses were appropriate. In case none of the responses were appropriate, respondents were given the

*The CBO (Centraal Begeleidingsorgaan voor de Intercollegiale Toetsing) is the Dutch national organization for quality assurance in hospitals.

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possibility of answering 'other', and were requested to give a brief explanation.

## Results

Two months after the circulation of the questionnaires 185 completed questionnaires were returned to the CBO survey team. Of the responses 98 were from the heads of day care units and 87 were from hospital management. If the responses of both heads of day care units and hospital management are combined, information from 142 out of 162 units (88%) was available.

For most questions the combined responses from the 142 responding units were used. In processing the responses to the first four questions, those from hospital management were used in preference to those from the heads of day care units. When processing the questions relating to future plans, the responses from heads of day care units were used in preference to those from hospital management. Only for the last question were responses from all hospital management and all heads of day care units listed separately.

The total number of responses in Table 1a and Table 2 is over 142, because some hospitals have several day care facilities and therefore gave more than one response. In Table 8 the number of responses is also over 142, because it was possible to experience several barriers.

The responses to the following eight questions are summarized below:

1. How is day care organized in your hospital?

**Table 1a.**

| *Organization of day care* | *Absolute no. of hospitals* |
|---|---|
| Separate unit(s) | 99 |
| Combination of day care and clinical unit (e.g. on surgery ward) | 44 |
| Combination of short stay and day care | 34 |
| Other* | 22 |
| No day care facilities in this hospital | 19 |

*When responding 'Other', the most common other organizational forms of day care were: day care on recovery ward; day care in theatre complex; no special facilities for day care: patients are nursed in the same rooms as clinical patients.

Some hospitals have several day care facilities (e.g. a combination of short stay and day care on the same unit, and a separate day care unit). The two most common combinations of organization models are shown in Table 1b.

**Table 1b.**

| *Different kinds of organization of day care in one hospital* | *Absolute no. of hospitals* |
|---|---|
| A separate unit (e.g. for adults) & a unit for day surgery on a clinical ward (e.g. for children) | 11 |
| A separate unit & a combination of short stay and day surgery on the same ward | 5 |

2. How many places (beds/chairs) are available for day care?

**Table 2.**

| *No. of places (beds & chairs)* | n *no. of respondents* | *Total no. of available places* | *Average no. places per unit* |
|---|---|---|---|
| Separate unit(s) | 96 | 1417 | 14.7 |
| Combination of short stay and day care | 54 | 973 | 18.1 |
| Combination of day care and clinical unit | 50 | 388 | 7.8 |

3. How many patients were admitted for day care treatment in 1991?

Out of 142 responding units, 127 provided information about the number of admissions in day care. The remainder did not maintain detailed enough records in order to report. Of these 127 units, 103 specified the number of admissions for surgical and for non-surgical day care (e.g. chemotherapy and blood transfusions). Three out of the 127 responding units reported providing only day surgery and no non-surgical treatment in day care.

**Table 3.**

| *Admissions in day care* | *Respondents* | *Admissions* | *Average no. of admissions per hospital* |
|---|---|---|---|
| Total admissions in day care | 127 | 374 285 | 2947 |
| Admissions surgical day care | 103 | 207 536 | 2014 |
| Admissions non-surgical day care | 100 | 88 855 | 889 |

4. How many admissions to day care were there in 1991?

**Table 4.**

| *No. of admissions in 1991* | *No. of hospitals* |
|---|---|
| 0–1000 | 32 |
| 1000–2000 | 25 |
| 2000–3000 | 29 |
| 3000–4000 | 29 |
| 4000 or more | 27 |

5. Do you intend to change the number of available beds?

**Table 5.**

| *Plans* | *Absolute no. of hospitals* |
|---|---|
| No expansion, no limitation | 79 |
| Plans for expansion | 46 |
| No response | 16 |
| Plans for limitation | 1 |

6. Do you intend to reorganize your day care facility?

**Table 6.**

| *Plans* | *Absolute no. of hospitals* |
|---|---|
| No plans | 65 |
| To combine day care with short stay | 28 |
| Other* | 24 |
| To start day care unit(s) within clinical unit(s) | 10 |
| To start one or more separate units | 8 |
| No response | 7 |

*When responding 'Other' the most common other reorganization plans were: to start a day care facility outside the hospital; extending opening hours by double use of beds (the first patient is operated early in the morning, and goes home during the afternoon, while the second patient is operated in the afternoon and goes home in the evening).

7. What is your policy regarding the number of admissions?

**Table 7.**

| *Policy* | *Absolute no. of hospitals* |
|---|---|
| To expand the number of admissions | 76 |
| Not yet known | 21 |
| No change in number of admissions | 21 |
| To expand the number of admissions greatly | 11 |
| Other* | 7 |
| No response | 4 |
| To limit the number of admissions | 2 |

*When responding 'Other' the most common other policies were: optimalization of planning by, whenever possible, double use of beds, rather than the provision of additional beds; expansion of beds desired but restricted by space and financial factors; no formal policy in place. Any future demand will be met by increasing the number of available beds on an ad hoc basis; there is sufficient patient demand to consider expansion but the current Dutch tariff for day care does not cover the costs incurred. This makes further expansion unprofitable.

8. What barriers do you experience with regard to day care?

The responses to this question indicate that heads of day care units place more importance on problems relating to their daily work, whilst hospital management attach more importance to planning and organizational problems. Hospital management more often experience problems with operating room (OR) planning, 52%; organization and content of preoperative screening, 33%; and the lack of explicit criteria, 28%; than experienced by the heads of day surgery units (respectively 47%, 18% and 22%). Insufficient change-over of information is a bigger problem for heads of day care units, 32%; than for management, 23%.

In Table 8 we have listed the responses of hospital management separately from the responses of the heads of day care units. As it was possible to indicate more than one barrier, the total number of responses is greater than 176.

## Conclusion

The high response rate to CBO's day care questionnaire, as well as the large number of units intending to change the capacity and organization of day care, indicate a prominent interest in day care in The Netherlands.

The majority of the respondents reported having a separate day care unit or a day care unit on a clinical unit. However, the results of this survey imply that the combination of short stay and day care on the same unit is becoming prevalent. Of the respondents 16% combined day care and short stay on the same unit, whilst almost 20% intend to combine day care and short stay on the same unit. The growing importance of day care is reflected by one third of all responding units intending to

**Table 8.**

| *Barriers* | *Hospital managers (n = 87)* | *Heads of day care units (n = 98)* |
|---|---|---|
| Variable admission (peaks and troughs) | 49 | 65 |
| OR planning related problems | 45 | 46 |
| Long waiting lists for some specialists | 30 | 35 |
| Lack of uniformity in specialists' working practice | 31 | 32 |
| Limited capacity (number of beds, opening hours, personnel/staff) | 28 | 30 |
| Insufficient change-over of information from doctors to nurses | 20 | 31 |
| Insufficient organization and content of preoperative screening | 29 | 18 |
| Lack of explicit selection criteria for day care | 24 | 22 |
| Inverse substitution (ambulatory surgergy in day care units) | 13 | 18 |
| Lack of clarity in discharge procedures | 10 | 10 |
| Other* | 3 | 14 |
| Lack of consistent procedures for patients | 9 | 10 |
| Low capacity utilization | 8 | 9 |
| Lack of formal procedures for reporting and registration | 7 | 7 |
| Lack of cooperation with general practitioners | 3 | 7 |
| No barriers experienced | 7 | 8 |

*'Other' bottlenecks reported by several respondents: patients who do not show up or last minute cancellation; the Dutch tariff for day care is a disincentive for hospital management to promote day care; lack of communication of preoperative information from medical staff to patients; OR and recovery area are not conveniently located; planning of admissions is not optimal; closure of day care unit during summer.

expand the number of places available for day care and almost two thirds intending to increase the number of admissions.

In general, both hospital management and heads of day care units experience the same problems in day care. Capacity utilization is the most commonly reported problem (management 56%, heads of day care units 66%). Long waiting lists and limited capacity are also commonly reported problems. This again indicates significant interest in day care.

It can be concluded that many hospitals are in the same phase of development of day care facilities and are experiencing similar problems during this stage. Considering the barriers experienced and that over 50% of all respondents intend changing the organization of day care, it is clear that day care has not been fully integrated in the hospital setting and process. Therefore it is very important for hospitals to monitor carefully their own day care procedures and to learn from their previous experiences. It also seems relevant for hospitals to exchange experiences and research further this relatively new phenomenon in health care. The CBO intends to continue assisting hospitals in this process in order to improve provision of day care in the future.

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## Case report

# Prolonged mivacurium-induced neuromuscular blockade in patients with reduced plasma cholinesterase activity

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Mivacurium is a recently released short-acting nondepolarizing muscle relaxant, metabolized by plasma cholinesterase. The short duration of action makes mivacurium an increasingly popular choice for muscle relaxation in ambulatory surgery procedures. Individuals with abnormalities of plasma cholinesterase, however, may have longer than expected duration of action of mivacurium, requiring prolonged mechanical ventilation. We present two cases where this occurred.

Key words: Mivacurium, cholinesterase, neuromuscular blockade

Mivacurium is a recently released short-acting nondepolarizing muscle relaxant with a benzylisoquinolium structure. It is known to be metabolized by plasma cholinesterase. As such, its duration of action would be expected to be prolonged in patients with reduced plasma cholinesterase activity[1]. It is also known to be easily antagonized by anticholinesterase drugs.

We report two cases, occurring within 10 days of each other at our institution, where prolonged neuromuscular blockade occurred after mivacurium administration. Both of these patients were subsequently determined to have reduced plasma cholinesterase activity. Contrary to European reports[2], however, the blockade was very difficult to reverse, and these patients required prolonged ventilatory support.

### Case 1

A 68-year-old 84-kg white male presented to the outpatient surgical facility for elective microlaryngoscopy and vocal cord stripping. Past medical history was significant for atherosclerotic heart disease and past surgical history was significant for uncomplicated coronary artery bypass grafting in 1985. Current medications included oral nitrates and angiotensin-converting enzyme inhibitors. There was no other systemic disease noted.

Induction with propofol (1.5 mg $kg^{-1}$), fentanyl (2 μg $kg^{-1}$), and mivacurium (0.15 mg $kg^{-1}$) intravenously was uneventful. Anaesthesia was maintained with nitrous oxide (0.3–0.6 minimum alveolar concentration (MAC)) and isoflurane (0.5 MAC). At the conclusion of a 45-min surgical procedure, the patient had minimal respiratory activity with 2/4 twitches on train-of-four stimulation. The patient was noted to be responding appropriately to questions with eye movement. Reversal was attempted with neostigmine (0.08 mg $kg^{-1}$) and glycopyrrolate (0.03 mg $kg^{-1}$) intravenously. No change in clinical status was noted after 10 min. The reversal drugs were repeated in the same dosage. Again, no change in clinical status was noted. The patient remained responsive with 2/4 twitches on train-of-four stimulation. The situation was explained to the patient and he was transferred to the postanaesthesia care unit with mechanical ventilation.

The patient remained ventilated for approximately 5 h. Spontaneous activity returned very slowly, until the patient was able to make slight purposeful movements with his upper extremities. The patient remained responsive. Respiratory mechanics, however, remained far below minimal criteria for spontaneous ventilation. At this time, reversal was again attempted with neostigmine (0.075 mg $kg^{-1}$) and glycopyrrolate (0.03 mg $kg^{-1}$). Within 3 min, the patient exhibited significant improvement in muscular activity, and was able to sustain head lift for greater than 10 s. He was extubated at that time and was subsequently uneventfully discharged home.

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Follow-up evaluation revealed a plasma cholinesterase level of 242 μu $ml^{-1}$ (normal 1900–3800 μu $ml^{-1}$). Dibucaine number was not available.

### Case 2

A 49-year-old 75-kg white female presented for mastectomy due to localized carcinoma of the breast. She had previously undergone two surgical procedures without complications, although it is known that no muscle relaxant was used in at least one of these operations. Induction with propofol (1.5 mg $kg^{-1}$), midazolam (0.025 mg $kg^{-1}$), fentanyl (1.5 μg $kg^{-1}$) and mivacurium (0.15 mg $kg^{-1}$) was uneventful. Anaesthesia was maintained with nitrous oxide (0.5 MAC) and propofol infusion (120–160 μg $kg^{-1}$ $min^{-1}$). Subsequently, no muscle twitch was detectable with a previously functioning nerve stimulator for 3 h. At that time, she developed a neuromuscular stimulation pattern typical of a dense nondepolarizing blockade. Reversal was attempted with edrophonium (0.5 mg $kg^{-1}$). There was no change in clinical status. One hour later (4 h after mivacurium administration), the reversal was re-attempted with edrophonium (0.5 mg $kg^{-1}$). The patient developed a train-of-four response of 4 twitches with a 25% ratio, but was unable to maintain spontaneous ventilation. One hour later (5 h after mivacurium administration) the patient was again administered edrophonium (0.5 mg $kg^{-1}$) and was able to be successfully extubated.

Follow-up evaluations revealed a normal dibucaine number, but a plasma cholinesterase level of 544 μu $ml^{-1}$ (normal 1900–3800 μu $ml^{-1}$).

### Discussion

Mivacurium is a short-acting, nondepolarizing muscle relaxant which is hydrolyzed by plasma cholinesterase. It is also reversible with anticholinesterase agents. The rate of hydrolysis has been found to be 70–80% of that of succinylcholine[5]. Mivacurium duration of action would be expected to be prolonged in patients with cholinesterase deficiencies. These two case reports confirm that this is indeed true.

The manufacturer states that clinical trials including patients with plasma cholinesterase activities as low as 20% below the lower limit of normal did not reveal significant effects on the mivacurium-induced motor blockade[6]. Our two patients, however, had activity levels more than 70% below the lower normal limit. Many conditions may cause these reductions and these patients will not always be recognized preoperatively.

Whittaker identified a number of causes of decreased plasma cholinesterase activity[7], including: inherited deficiencies; physiologic variances (pregnancy, newborn infants); acquired causes (liver disease, malignancies, collagen diseases, infections, anaemia, uraemia, myocardial infarction, fever, myxoedema, burns); iatrogenic causes (contraceptive pills, MAO inhibitors, cholinesterase inhibitors, chemotherapy).

Ostergaard et al. gave patients homozygous for the atypical plasma cholinesterase gene mivacurium doses of 0.3 mg $kg^{-1}$ [3]. He reported that once recovery from neuromuscular blockade had begun, reversal of residual blockade with neostigmine was effective and safe. He also reported that a correlation was found between cholinesterase activity and duration of mivacurium block in genotypically normal patients.

Basta reported that patients homozygous for the atypical cholinesterase gene given 0.2 mg $kg^{-1}$ mivacurium had 'a markedly prolonged blockade that is readily reversible'[4].

We report that contrary to these findings, when an intubating dose (0.15 mg $kg^{-1}$) of mivacurium is given to patients with low plasma cholinesterase activity, reversal is very difficult and clinically ineffective until significant spontaneous recovery had already occurred.

In conclusion, we report two cases of prolonged neuromuscular blockade following mivacurium administration in patients with reduced plasma cholinesterase activity (70–80% below normal lower limits). Contrary to previous reports, this neuromuscular blockade was difficult to reverse with anticholinesterase agents. It was necessary to wait for almost total spontaneous recovery before reversal and extubation were safely accomplished. We believe that this type of patient will be seen with increased frequency as mivacurium usage becomes more common.

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# Evaluating ambulatory surgery: how it affects all surgeons

## Extended Abstracts from a Session of the Postgraduate Programme at the Spring Meeting of the American College of Surgeons, Montreal, April 25–28, 1993

### Introduction

At the spring meeting of the American College of Surgeons in Montreal a postgraduate course entitled 'Evaluating ambulatory surgery: how it affects all surgeons' was presented. This course described the types of ambulatory surgery units in the USA and Canada and suggested how they could be initiated. The scope of surgery, standards of care, accreditation and credentialling procedures, certification requirements, OSHA regulations, current legislation and education of house staff and medical students in ambulatory surgery were covered by this programme.

The rationale for this postgraduate programme was predicated on the enormous and increased importance of ambulatory surgery to patients, surgeons, hospitals and the economics of health care. In the USA in 1990 the volume of ambulatory surgery exceeded that of inpatient surgery for the first time, and at present constitutes 60% of all surgical procedures performed. Plastic surgery, otolaryngology, orthopaedics, gynaecology, hand and oral surgery have led the way in the movement from inpatient to ambulatory surgery. Only now are general surgeons recognizing the advantages of utilizing ambulatory surgery to reduce the costs of health care and maximize the convenience and satisfaction of their patients.

The participants in this postgraduate course have provided us with a summary of their presentations which describe the USA and Canada's experience in ambulatory surgery, which includes surgeries performed in hospital-affiliated surgical ambulatory care facilities, surgical free-standing ambulatory care facilities, multidisciplinary ambulatory surgical facilities, unispecial ambulatory surgical facilities, and office-based surgeries.

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# Standards for ambulatory and office-based surgery

In an era of major change in health care delivery, the issue of standards of care emerges almost immediately because standards provide a means of measuring both utilization and quality of care. How and by whom standards are defined, as well as evaluation of adherence to them is an important issue. How and by whom they can be modified is yet another concern. Finally, the whole question of whether standards are necessary has been raised.

Implicit in any discussion of standards in health care is the assumption of their communal good; this is a difficult value to refute. Moreover, standards are an integral part of quality, an obviously desirable communal objective. The issue of who defines and evaluates compliance with established standards at once assumes some degree of urgency. One could argue that standards, once established, lead to a more algorithmic medical practice, obviating creativity and limiting physician choice. The apparent trade-off of individual freedom for community benefit with quality as the outcome measure is, for now perhaps, a more philosophical than real threat. In any case, this issue must be considered lest the quality of care revert to a mean rather than an ongoing pursuit of excellence.

Standards are established so that facilities can achieve accreditation or quality of care is assured. For the former, certifying bodies exist; each has similar points covered often with interpretation differences. Not infrequently, these differences are predicated on the population served (e.g. ASA 1 or 2, young, healthy elective cases) and not on a universal total population standard. Clearly, an assessment of patient risk is an integral part of any standard-setting exercise along with appropriateness of site and indications for the procedure. Preoperative evaluation and preparation for, and type of, anaesthesia are important issues. Age and the presence of chronic illness are factors to consider for both could increase risk. It is reasonable to match necessary preoperative testing to type of anaesthesia proposed and patient's health status. Such relationships have been established and variance from them could result in an unnecessarily poor outcome.

Standards are established to recognize or screen for a risk, allowing for preemptive management. The effectiveness of this risk assessment can be determined from the number of patients admitted after ambulatory surgery because of problems with preexisting disease conditions. Risk, complexity of procedure and anatomic site should be considered when deciding where a procedure should be done. Despite the growth of ambulatory surgery it is not appropriate for all cases. Some procedures require inpatient facilities, while others can be done in offices. Whether a procedure can be done in a specific site is different from whether it should be done there. This is a quality issue related to standards, and disagreements are frequently contentious.

Indications for the procedure should be documented in the medical record. Physicians as a group can define indications and adherence to them is expected. Lack of documentation – a critical problem – raises issues of quality of care.

Standards should be relevant to decreasing risk and minimizing cost without sacrificing quality or patient safety. Institution- and site-specific standards related to physiologic assessment, intra- and post-procedure monitoring, discharge criteria and postoperative instructions are clearly part of quality care and need to be in place and available for evaluation. Standards must be designed to give the highest yield of useful data to assure a quality outcome that can be identified and measured. The objective of standard setting is the assurance of quality care. When standards are implemented a high quality outcome is more likely.

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# Ambulatory surgery: effects on education of surgical housestaff and medical students in Canada

## Factors governing trend to ambulatory surgery

In Canada, there has been a strong move toward short stay and ambulatory surgery. The prime motivation for this trend has been financial. Canadian hospitals are financed by global budgets, based on a flat dollar amount allocated by the provincial governments. Spending of this budget is mostly determined by the hospital itself. Decreasing global hospital budgets have led to bed closures and a strong impetus for increased efficiency. As a result, waiting lists have grown and elective procedures have at times been cancelled at the last minute.

Costs of health care delivery are to a great extent related to salaries of employees in the hospital, and the costs of providing 'hotel services' such as room and board not directly influencing patient outcome. Furthermore, inpatients have their usual medications provided at no cost to them, financed out of the hospital global budget. Inpatients, particularly in a teaching hospital, tend to have more tests done than outpatients, again consuming a portion of the hospital global budget.

Ambulatory surgery patients do not require nurses for evening and night shift, make fewer demands on housekeeping and laundry staff, have much of the testing done outside of the hospital, and have no medication provided once they are beyond the recovery room. All these issues result in lowering the cost for patient care by shifting the costs away from the hospital to the private sector.

At the same time, less invasive surgical procedures have resulted in more rapid patient recovery and less need for intensive nursing care after surgery. These procedures allow the patient to care for him or herself, without nursing supervision in the majority of cases.

## Procedures done in ambulatory surgery

Currently a multitude of general surgical procedures are performed in an ambulatory surgery setting. Some of these have always been done in such an environment, while others have moved to ambulatory surgery with the evolution of less invasive techniques and better patient education. Such procedures include: endoscopy (diagnostic and therapeutic); skin (melanoma, basal and squamous carcinoma, benign lesions); breast (biopsy, partial or modified radical mastectomy, axillary node dissection); hernia (open or laparoscopic); lumps and bumps (lipomas, sebaceous cysts, abscesses); diagnostic laparoscopy; gall bladder (laparoscopic, mini-cholecystectomy); gastrostomy (PEG); vascular access; lymph node biopsy; pilonidal sinus; anorectal (haemorrhoids, abscess, fissure, fistulas, polyps); oropharyngeal tumours; minor amputations.

## Potential problems

As a result of the increasing trend to day surgery, several problems have been identified, with an impact on training of residents and medical students in surgery. There is a conflict between activities in the main operating room (OR) with those in day surgery, often scheduled simultaneously. Usually ambulatory procedures are considered less exciting and residents gravitate to the main OR.

Residents often arrive in day surgery with no knowledge of the patient. The preop work-up is usually done by someone else. The residents are there to do a technical procedure in isolation from pre- and postoperative care. This is 'the itinerant surgeon' of the residency programme. They have been excluded from the preoperative process of making a diagnosis, evaluation of the patient's risk for surgery, selection of the appropriate surgical procedure, selection of the best environment for the operation (inpatient vs. outpatient), and education of the patient about the procedure about to be performed. Furthermore, there is a shift in the role of the housestaff from direct care of the patient to onlooker-assistant. This results in loss of patient-physician interaction. Postoperatively, the resident is usually excluded from patient care. The process of evaluation of patient complaints, the wound healing process, evaluation of postoperative fever, diagnosis and treatment of wound infection, appreciation of normal postoperative pain and its treatment are missed. The result is a surgeon who will be inexperienced in the most common areas of general surgery when he/she goes out in practice.

The medical student has less teaching material in hospital, performs fewer physical examinations to appreciate normal findings (e.g. rectal exams, breast exams,

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hernias, etc.) and has less opportunity to be exposed to abnormal physical findings in the preop patient. There is less time for discussion of the patient and the patient's clinical problem in the setting of rounds on a clinical teaching unit. Failure to be exposed to the postoperative patient implies that the student will be less familiar with the appearance of the healing wound and with the normal postoperative course.

**Advantages**

There are definite advantages to ambulatory surgery from the point of view of residents and students. The number of operative procedures will increase. The operating room will not be held hostage to bed unavailability, and patients requiring major surgical procedures will have easier access to hospital. As a result there will be fewer routine cases in hospital, making rounds more expedient and hospitals/wards more efficient. The housestaff will be asked to do less 'SCUT' work and perhaps more time will be available for reading and educational activities. Being involved with ambulatory surgery will give housestaff a glimpse of common surgical practice. Residents might have an opportunity to learn to do their own anaesthesia, since many of these procedures are done under local or regional anaesthesia, blocks, or intravenous sedation, administered by the surgeon.

As a bonus, hospitals will save money which may then be better channelled to purchasing new equipment, upgrading facilities, purchasing teaching aids for medical students, or perhaps hiring ancillary help to lighten the workload of the residents.

**Answers**

After appreciating the problems and potential benefits resulting from an inevitable move to increasing ambulatory surgery, we must develop an approach that will maximize the educational benefits to residents and medical students. We can establish ambulatory surgery clinics which involve residents/students in performing the history and physical examination, the diagnostic work-up, and operative decisions made prior to surgery. Ambulatory surgery clinics would be an excellent environment for demonstration of physical signs to students.

It is possible to have designated 'staff' patients with residents as the primary surgeon involved in their care, much as is done with inpatients. The resident would be responsible, under the supervision of the attending surgeon, for preparation of the patient for surgery, for patient education and obtaining informed consent, and for being available to the patient for any problems that arise after surgery. The patients would be asked to return to the same clinic postoperatively, where their course can be monitored. Junior residents should have an important role in these clinics and in the day surgery procedures, while senior residents would have primary responsibility for inpatient care. Ambulatory surgery would allow an improved caseload for junior residents. The increased operative experience and responsibility will undoubtedly result in improved morale among junior residents.

Ambulatory surgery may be taught as a separate rotation rather than within the setting of a traditional rotation through a surgical clinical teaching unit. In that way ambulatory surgery clinics and duties would not compete for the residents' time with demands imposed by inpatient care. This rotation might be particularly attractive to junior residents, and perhaps residents rotating through surgery from family medicine.

In summary, ambulatory surgery is increasing, driven by financial and social pressures. We have the opportunity to anticipate potential problems and develop a plan that will improve education of residents and students and ultimately turn out surgeons better qualified to deal with the realities of future surgical practice, in a programme where the morale and enthusiasm of residents will be high.

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# Evolution in ambulatory surgery: unispeciality perspective

When establishing an office-based outpatient surgical unit, the unispeciality practitioner should be cognizant that constraining himself to performing only minimally invasive surgery is probably unrealistic. The surgeon must determine the full range of the procedures that are safely performed by members of his speciality in the outpatient setting, and gear his facility accordingly. Otherwise, the temptation will be to expand to accommodate these procedures without the proper policies and procedures in place.

There are pros, cons and issues to be faced when one contemplates construction of an ambulatory surgery unit. The issues and relative advantages and disadvantages impact the unispeciality practitioner in a much more personal way than they impact participants in a multispeciality unit.

## Pros

Factors in favour of establishing a unispeciality unit include:

1. Greater surgeon control of the atmosphere and the ambience of the facility;
2. Greater surgeon control of the logistics of the care delivered, instrumentation, supplies, etc.;
3. Patient privacy and confidentiality (this may be speciality-dependent and is particularly meaningful relative to aesthetic surgery); and
4. As a potential profit centre – to enhance overall practice revenue.

## Cons

The disadvantages of a unispeciality centre include:

1. Greater responsibility accrues to the owner/surgeon for all aspects of care – including anaesthesia and the nursing activities surrounding the surgical procedure;
2. An increase in liability relative to the increase in responsibility;
3. An increase in financial risk resulting from an era of patchy reimbursement of unispeciality facility services, lack of economies of scale that are inherent in multispeciality and large group-owned units and the need to meet high fixed costs, thus limiting discretionary time away from the practice;
4. A decrease in 'visibility' of the surgeon at hospitals and other health care facilities where other practitioners meet and see one another on a day-to-day basis. This may adversely impact the physician's referral sources: 'Out of sight, out of mind'.

## Issues

The issues confronting the unispeciality surgical unit are really no different from the issues confronting the multispeciality unit or the hospital-based unit. It is simply that there are often fewer resources available to the solo unispeciality practitioner and less manpower with which to address the following issues:

1. Physical plant setup (meeting stringent building codes for surgery centres);
2. Capital for equipment;
3. Staffing and personnel;
4. Regulatory issues, including Occupational Safety and Health Agency (OSHA) and toxic waste management;
5. Credentialling;
6. Ongoing quality control and quality assurance;
7. Accreditation and certification;
8. Licensing.

The primary issue to be addressed by any practitioner, administrator or management team in any surgical centre setting should be continuous quality assessment and quality control (QA/QC). The concept of total quality management serves as a platform from which to address all issues that may impact a patient care delivery system. A well written policy and procedure manual serves as a template for the ambulatory surgery centre. Established policies and procedures become the bases for invoking controls, verification procedures and validations that carry out the QA/QC mission. This is a fluid exercise and never ceases.

All outpatient surgery centres should be subject to peer review and accreditation. These controls on utilization and standards serve the best interests of patients and providers alike.

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**Potential solutions to pros, cons, issues, etc.**

The solo practitioner is probably ill advised in today's practice climate to implement an outpatient surgery unit. However, for large single-speciality groups and multispeciality groups, the prospect of incorporating an ambulatory surgery unit into the practice setting becomes more attractive. The formula for establishing a successful outpatient surgery centre begins with shared risk.

Another group concept that is only now beginning to surface as a viable sponsor of the ambulatory surgery centre is the 'similar speciality' consortium – for example, plastic surgery, ear, nose and throat and ophthalmology or orthopaedics, hand surgery and neurosurgery or general surgery, gynaecology and urology. Hospital/physician joint ventures in outpatient surgery units are not applicable to unispeciality or 'similar speciality' modes, and, given the tenuous nature of these relationships – both from a regulatory and practical perspective – I believe they should not be recommended to individual practitioners.

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# Types of ambulatory surgery centres and how to initiate them: Canadian system

The chronic financial deficit of Canadian hospitals has forced the closure of inpatient beds mainly at the expense of departments of surgery. One-day surgery has been shown to be a safe and satisfactory alternative to inpatient care for several surgical procedures, although studies do not demonstrate major cost savings. One of the few randomized clinical trials performed in Canada[1] has shown that tubal ligation and hernia repair were cost efficient and averaged hospital savings of $86.00 and $115.00 more than inpatient care. However, meniscectomy deviated from this trend in that treatment costs were significantly higher for one-day surgery patients. Moreover a significantly higher proportion of one-day patients than their hospitalized counterparts found their stay to be too short and would prefer hospitalization as an alternative. As advances in technology and in surgical and anaesthetic expertise allow more complex procedures to be performed in an outpatient setting, the aging of the population might prevent the evolution of this approach. Moreover, the sophistication of new technology has increased the price of instrumentation to a level which prevents public hospitals affording them. In the Canadian system, we cannot yet pass this new burden to the patients.

The volume of day surgery in the Province of Quebec has been growing at the rate of 3–4% annually, since 1984. By 1989, day surgery accounted for less than 30% of surgical procedures in Quebec[2] and for 42% in British Columbia[3]. There is now more governmental pressure to increase the numbers of outpatient procedures.

In Canada, facilities used for outpatient surgery are mainly hospital-integrated units. Usually the attending surgeon mixes some day-surgery cases with his inpatient elective surgery cases. Such units are more prone to operative delays and cancellations when major procedures are prolonged or urgent procedures must be performed. To avoid these problems, new hospital surgical units independent from the inpatient surgical facilities are emerging. These units remain inside the hospital under the legal jurisdiction of the board of directors. Satellite units or free-standing units are still prohibited by the Canadian Hospital Act. Some specialists have tried to challenge that issue recently without success.

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The list of procedures to be performed in these units remains vague. The American College of Surgeons opposes a definitive classification of operative procedures. Canadian surgeons also prefer to consider each case individually. In each hospital, there should be an agreement between surgeons and anaesthetists for acceptable procedures and patient risk factors. The ideal procedure should be short (less than 90 min) with a short postoperative recovery, with few anticipated postoperative complications and easily controlled postoperative pain. The patient should live within 50 km (30 miles) of the hospital and have help at home for the first 24 h.

Establishing a programme of outpatient surgery is a challenging task in the Canadian system[4]. Three main issues have to be settled:

1. Patient: As the patient has access to free services, he wants what he considers to be the best treatment and in-hospital recovery remains the standard with minimal burden on the family and the maximal feeling of security. Moreover certain insurance companies give better benefits for an inpatient procedure which is considered more 'serious'. However, as the waiting time for minor surgery has increased dramatically recently, some patients are now considering alternatives. Certain rules have to be changed and better education of the consumer has to be established.
2. Surgeon: As inpatient facilities are regularly reduced, the surgeon still wants to maintain good patient care and a short waiting list: two incentives for day surgery. The criteria for the selection of patients, although relatively clear in the literature, needs consideration by surgical judgement. Good support from the hospital facilities and a proper back-up system for the first 24 h, as well as the collaboration of consultants (cardiologists, pneumologists and endocrinologists) for preoperative evaluation, are required.
3. Hospital: With a chronic deficit and no hope of reducing costs, the establishment of day surgery needs new funding. The reallocation of funds and personnel is severely impaired by collective agreements and delays the settling of the new system.

## Conclusion

In Canada, surgeons consider outpatient surgery as a very sensible way to solve certain problems but settling the issue will need political and societal choices.

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# Education of surgical house staff and medical students – opportunities and problems

There is a growing realization in educational circles of the importance of all forms of education in ambulatory settings. As ambulatory medicine begins to receive greater emphasis in our medical schools, the nature and degree of exposure of medical students to ambulatory surgery will undoubtedly change. At the moment, medical students are rarely exposed to ambulatory surgery in an explicit and organized way. Ambulatory surgery, if it is offered at all to the medical student, is usually offered as an appendage to the inpatient surgical activities. Students are generally not taught the basic principles of ambulatory surgical procedures. Students should be exposed in an organized fashion to the principles and techniques of ambulatory surgery, including the principles of local and regional anaesthesia. The basic elements of planning and performing an operative procedure and the basic elements of tissue handling techniques can be taught in an ambulatory setting. Students should be taught and should have experience in the care of injuries requiring surgical repair, such as lacerations and soft tissue injuries. Opportunities should be presented for the students to have sufficient follow-up on patients so that they can become familiar with the management of complications that may occur. A curriculum, with clearly stated educational objectives, is also essential.

At the resident level, the educational issues become somewhat more complex. Residents also need to have a basic grounding in fundamental elements of ambulatory surgery. These principles are at the present time not well taught in many medical schools and they are not well taught in many surgical residencies. There is a tendency for surgical residents to focus on the inpatient surgical procedures, and the ambulatory activities are often given a position of secondary importance. The academic structure of each residency programme should provide the opportunity for residents to be exposed to and involved in ambulatory surgical procedures in an organized fashion under adequate and appropriate supervision. Surgical faculty should be assigned to the ambulatory surgical centre as well as to the inpatient units. Surgical residents generally get experience in ambulatory surgery in one of two organizational frameworks. One system is to assign the resident to a team which is responsible both for inpatient and outpatient activities. The drawback of this system is that the pressure of the inpatient activities often dominates the residents' activities. Another system is to assign the residents directly to an ambulatory centre in which they have no inpatient responsibilities. That system has the advantage of providing appropriate emphasis on ambulatory surgical activities, but participation of residents in preoperative and postoperative care may be more difficult to achieve in this setting. Whichever assignment system is used, residents should have protected time to participate in the ambulatory surgery programme.

From an educational standpoint, residents should be involved not only in the performance of an operative procedure, but also in preoperative care so that they may participate in establishing a diagnosis and in planning an appropriate operative procedure. They should be responsible for significant portions of the operative procedure itself and should also be involved in the postoperative care of the patient so that they may become familiar with outcomes of the operation as well as with complications. Continuity of care is just as important in ambulatory surgery as it is in inpatient surgery. Facilities should be made available to the residents so that the continuity of care is maintained.

We are still at a relatively rudimentary level of development of educational programmes in ambulatory settings. Excellence in ambulatory surgical education will require organization and the commitment and dedication of surgical faculty as well as residents and students, but there is no reason it cannot be achieved.

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# Ambulatory surgery and the government: an evolving partnership

As ambulatory surgery evolves, so does the interests of the federal government. Ambulatory surgery is not a recent phenomenon of modern surgery. The true phenomenon is the significant attention it has received from federal policymakers in the past decade.

Times have changed since 1909, when the *British Medical Journal* reported that James Nicoll MD performed more than 7000 operations on an ambulatory basis. The number of operations performed in hospital outpatient settings increased over threefold between 1980 and 1990. According to the unpublished data from the American Hospital Association Annual Survey Files, in 1982 there were 4.2 million operations conducted in outpatient hospital settings, while in 1990 the number increased to over 11.6 million. In contrast, the number of inpatient operations decreased from 16.1 to 11.4 million over the same period of time.

In 1990, nearly three-quarters of all ambulatory surgical procedures were performed in hospital outpatient departments. That year, 72.1% of all ambulatory surgical procedures were conducted in hospital outpatient facilities, 16.3% were performed in ambulatory surgical centres (ASCs) and 11.6% were performed in doctor's offices. Even with the smaller percentage, the number of freestanding ASCs has increased 651%, from 239 centres in 1983, to 1555 centres in 1991. The number of procedures performed in ASCs has increased accordingly.

As surgical care is shifting its venue, the government is working to keep pace with the changes. From the legislative perspective, United States Representative Ron Wyden, a Democrat from the state of Oregon, introduced the bill, HR 6096, the Ambulatory Care Quality Improvement Act of 1992. The purpose of the bill was to establish a programme under which certain ambulatory health care facilities would be regulated to ensure that the health care services they provide are rendered safely and effectively. The bill did not pass. Prior to introducing this bill, he had developed many draft proposals on the topic. Rep. Wyden often consulted with the American College of Surgeons as he reviewed and revised those drafts.

Two years ago, Rep. Wyden, as Chairman of the US House of Representatives Small Business Subcommittee on Regulation, Business Opportunities and Energy, held a hearing on safety and quality of care problems at unlicensed, non-certified or under-monitored surgical, diagnostic and immediate care facilities. At that hearing, the US General Accounting Office concluded that unless the Department of Health and Human Services or a reputable private accrediting organization is monitoring an unlicensed freestanding facility, patients do not have adequate assurance that quality care can be provided.

On February 4, 1993, the College submitted to Rep. Wyden several suggestions for modifying his bill before it is reintroduced in the 103rd Congress. These recommendations were a compilation of the comments solicited from the Governors' Committee on Ambulatory Surgical Care and from representatives of the College's Advisory Council for Plastic and Maxillofacial Surgery and the Advisory Council for Otorhinolaryngology.

Starting from September 7, 1982, the federal government has paid Medicare benefits for the facility costs of certain operations performed in ASCs. Freestanding ASCs are reimbursed on the basis of a prospective fee schedule for certain operations, whereas hospital outpatient departments are paid rates determined by a blended payment amount of 42% of hospital-specific costs and 58% of the ASC payment rate.

Some ASC proponents have expressed concern that Medicare's policy of paying hospital outpatient departments on the basis of reasonable costs rather than on the basis of a fixed, prospective rate has resulted in hospitals being paid more than Medicare-certified ASCs for performing the same surgical procedure. Others contend that there are justifiable differences in the costs of furnishing services in hospital outpatient settings. In its March 1992 report to Congress, the Prospective Payment Assessment Commission (ProPAC) recommended that payments for ambulatory surgery performed in the hospital outpatient setting be fully prospective based on national rates adjusted for area wage differences. ProPAC believes that the payment rate should be computed using average hospital costs and freestanding ASC payments in a budget neutral fashion where overall spending would neither increase nor decrease.

On December 31, 1991, payment rates for ASC services were divided into eight payment groups ranging from $285 to $905, an increase of 5.1% from the rates that had been in effect since July 1, 1990. A ninth payment group of $1150 was added to cover the cost of renal extracorporeal shock wave lithotripsy. The inclusion of lithotripsy on the ASC list had been enjoined by federal courts pending review of the Health Care Financing Administration's (HCFA) rate setting procedures. The court has stayed the rate and HCFA is in the process of implementing it.

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As mandated by the Omnibus Budget Reconciliation Act of 1986, HCFA publishes a list of surgical procedures for which facility services are covered when performed in an ASC. HCFA is required to update this list every two years. A new updated list is expected this year.

Although the College has made successful recommendations to HCFA regarding the inclusion and exclusion of certain surgical procedures on the list, it is concerned that the development of such lists may lead to categorizing certain procedures unequivocally as 'ambulatory' without taking into account the patient's unique medical, social, and psychological needs, or giving proper weight to the surgeon's judgement.

HCFA has entered into contracts with groups outside the government for specific projects. The Center for Health Policy Studies (CHIPS) has been retained by HCFA to conduct a study of outpatient resource costs. The primary purpose of the study is to provide data on resource use and costs for a wide variety of surgical procedures, medical visits, and diagnostic tests. These data will be used to test the equity and adequacy of the relative weights and payment levels to be used in HCFA's outpatient prospective payment system.

Also in the area of contracts, HCFA asked the College to work with them on the Medicare Ambulatory Surgical Center Payment Rate Survey. The College will convene a panel of expert consultants to review the payment classifications for nearly 2300 procedures.

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# Standards of care for unispeciality ambulatory surgery centres: the plastic surgery model

The American Association for Accreditation of Ambulatory Plastic Surgery Facilities, Inc. (AAAAPSF) was formed in 1980 to assure the safety of patients undergoing operative procedures in office-based ambulatory surgery units. Standards formulated by the AAAAPSF address issues of patient care, quality assurance, personnel, equipment, safety and administrative support. Adherence to these standards is assured through a voluntary accreditation process.

Accreditation by the AAAAPSF identifies the facility as one which:

1. Is owned/directed by an ABMS board certified plastic surgeon holding comparable hospital privileges for the procedures done in the outpatient centre and who adheres to the ethical principles of the American Society of Plastic and Reconstructive Surgery.
2. Has successfully completed a quality assurance programme and participates in peer review through a PRO organization.
3. Adheres to the laws and regulations affecting the operation of the facility (i.e. OSHA bloodborne pathogens, Americans with Disabilities Act, etc.)
4. Meets the standards set forth by the AAAAPSF.

Accreditation consists of a two-fold review which includes a self evaluation and a site visit by voluntary inspectors who are certified by the American Board of Plastic Surgery and who own and or direct an AAAAPSF accredited facility. To promote objectivity no inspector may review a facility within his/her own community. The inspectee may select from amongst three potential inspectors nominated by the AAAAPSF. Reciprocal inspections are not permitted.

The inspector reviews every aspect of the surgery centre, including but not limited to: patient charts, personnel records and qualifications, safety procedures and patient selection criteria. Also assessed are the scope of procedures performed, to assure that the surgeon has comparable hospital privileges. Findings are processed by computer and are provided to the facility to allow for correction of deficiencies. The data, including correction of deficiencies, are evaluated by the credentialling committee and then go to the Board of Directors who may issue full accreditation (3 years), provisional accreditation (minor deficiencies which must be corrected within 90 days) or denial of accreditation.

Centres are classified and accredited according to differing levels of capability as follows:

Class A: Centres performing minor plastic surgery procedures using local, regional or topical anaesthesia.

Class AB: Centres performing minor or major plastic surgery procedures using intravenous or parenteral sedation, analgesia, or dissociative drugs not requiring intubation of the airway.

Class ABC: Centres performing major plastic surgery procedures using intravenous, parenteral sedation, analgesia, or dissociative drugs requiring intubation or using general anaesthesia.

This classification was developed to assure the highest quality of safe patient care. These categories are listed in the site visitors checklist and adherence to the standard established for a particular class is carefully assessed by the site visitor.

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# Letter to the Editors

### The reinforced laryngeal mask in dental day surgery

We read with interest the paper by Goodwin et al. (*Ambulatory Surgery* 1993; **1**: 31–35) which compared the reinforced laryngeal mask airway (RLMA) with nasotracheal intubation (NTI) for dental day surgery. Whilst concurring with the authors that the RLMA provides a reliable method of airway management for removal of impacted wisdom teeth, we feel that if total intravenous anaesthesia (TIVA) had been employed for both groups, a more useful comparison of the two techniques would have been possible. The NTI technique involved the use of suxamethonium followed by inhalational anaesthesia; whereas TIVA with propofol was used in the RLMA group. The statistically significant differences between the two groups were that recovery times were longer and there was a greater incidence of myalgia with the NTI group. It would seem likely that these differences were due to the use of a volatile agent and suxamethonium rather than the choice of airway, and a short-acting non-depolarizing agent followed by TIVA may have produced different results. Interestingly, the study does demonstrate a higher incidence of technical anaesthetic difficulty with NTI when compared with the RLMA (26% vs. 14%), and also a significantly higher incidence of postoperative bleeding.

In addition we would like to make two further points. The reinforced laryngeal mask airway is not made from latex, but silicone tubing reinforced with wire. Finally, Figure 1b, whilst illustrating that the RLMA is kink-proof probably overemphasizes the ease with which a conventional LMA can be occluded. Kinking was a problem in an early production model of the size 2 LMA[1] and this has since been corrected by the manufacturer[2]. It is important that a kink test is performed prior to insertion of a conventional LMA by bending the tubing upon itself to 180°, as any kinking will imply a defective LMA, probably from overuse, which should then be discarded. Bending the tube beyond 180° will, however, produce a 'remembered' kink and should be avoided.


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# Literature review

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### Laparoscopy explosion – hazards with nitrous oxide

George G Neuman, George Sidebotham, Edward Negoianu, Jeffrey Bernstein, Aaron F Kopman, Robert G Hicks, Stanley T West, Laurence Haring

*Anesthesiology* 1993; **78**: 875–9

The use of laparoscopic surgical techniques for various gynaecologic procedures has increased over the last 20 years, as well as their use in general surgery. The report of an intraabdominal explosion causing the death of a patient undergoing laparoscopic surgery, in which nitrous oxide was used as the insufflating gas, as well as other reports of less severe episodes of intraperitoneal combustion, has led to the gradual abandonment of nitrous oxide as an insufflating agent in favour of carbon dioxide.

The composition of intestinal gas is nitrogen, oxygen, carbon dioxide, hydrogen and methane. The maximum measured concentration of hydrogen and methane in bowel gas has been reported as 69% and 56% respectively. During laparoscopic surgery utilizing carbon dioxide as the insufflating agent, nitrous oxide will diffuse into the peritoneal cavity if it is used as part of the anaesthetic. Bowel perforation and the subsequent release of volatile bowel gas could create an explosion hazard.

This paper was divided into two parts. It quantified the transfer of nitrous oxide, over time, in 19 female patients undergoing laparoscopy. The second part established the lower limits of flammability of a range of concentrations of methane and hydrogen diluted with nitrogen (simulated bowel gas) in a range of concentrations of nitrous oxide diluted with carbon dioxide (simulated peritoneal gas).

The mean concentrations of $N_2O$ at 10, 20 and 30 min from the time of insufflation were 19.9 ± 4.8%, 30.3 ± 6.8% and 36.1 ± 6.9% respectively. The maximum reported concentrations of methane and hydrogen in bowel gas are 56% and 69%, respectively. The concentration of nitrous oxide necessary to support combustion of 56% methane is approximately 47%. By contrast, the concentration of nitrous oxide needed to support combustion of 69% hydrogen is approximately 29%. Therefore, it is possible for nitrous oxide to reach concentrations in the peritoneal cavity that can support combustion of bowel gas.

This paper points out the possibility for nitrous oxide to reach concentrations in the peritoneal cavity that can support combustion of clinically observed concentrations of methane and especially, hydrogen. As laparoscopic surgical techniques become more complex, the chance of intentional or unintentional perforation becomes more likely. The authors recommend that if a bowel perforation is recognized, the peritoneal cavity should be vented and purged with carbon dioxide, and the nitrous oxide removed from the anaesthetic mixture. The hazard of explosion can then be reduced.

FC

### Improved postoperative analgesia with morphine added to axillary block solution

Denis L Bourke, William R Furman

*J Clin Anesth* 1993; **5**: 114–17

This study determined whether the addition of morphine to the axillary block local anaesthesia solution provided improved or prolonged postoperative analgesia. Patients in the treatment group were given intravenous saline and had morphine 0.1 mg $kg^{-1}$ added to their axillary block solution. Control subjects received morphine 0.1 mg $kg^{-1}$ iv and had saline added to their axillary block solution. All axillary blocks were performed using 0.55 ml $kg^{-1}$ of 1.5% lidocaine with epinephrine 1 : 200 000.

Both groups had similar visual analogue scale pain scores in the postanaesthesia care unit, 6 h, 12 h and 24 h postoperatively. In the 24 h postoperative study period, the treatment group required approximately half as many doses of supplemental analgesic as control subjects. There were no major complications in either group. It was concluded that morphine 0.1 mg $kg^{-1}$ added to the axillary block solution resulted in comparable pain scores, and patients required approximately half as much supplemental analgesic.

The mechanism responsible for enhanced postoperative analgesia when morphine was injected into the brachial plexus neurovascular sheath remains unknown. The addition of morphine to an axillary block solution is simple and safe and the technique offers patients the possibility of improved postoperative analgesia without an increased frequency of side effects or complications.

FC