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Editorial

Patient focused management: cost versus value

Stocker and Houghton's article in this issue of Ambulatory Surgery (pages 87–89), 'Anaesthetic drug costs in a district general hospital day surgery unit' concludes that cost should not be the only factor determining availability and use of an anaesthetic drug or technique. Although the study is day surgery and anaesthesia specialty specific, it has wide reaching implications for all aspects of patient care. Value to the patient and the facility must be factored in when assessing real cost. It is therefore, incumbent upon every day surgery center to develop a facility specific economic model that addresses all aspects of patient care.

During the last two decades of the past century, 'quality care' used to describe physician–patient–facility relationships evolved into 'cost-effective quality care'. The definition of cost-effective quality care is dependent upon the differing perspectives of the three major players in health care: payers, consumers or providers.

- The payers (government, industry, health care plans) want the lowest possible cost for 'safe care' (a yet undefined term).
- The consumers (patients) want the best available care. Cost is never the issue as long as the patient is not responsible for the payment.
- The providers (physicians and facilities) have finally moved from the 1970s where neither bothered thinking about cost to the present where both realize cost must enter into the decision making process.

It was not that long ago that patient care generated revenue proportional to the time and resources consumed. Cost was not a factor. The more anaesthesiologists (for that matter other physicians and facilities) utilized in providing care, the more the facility charged. Anaesthesiologists could embrace every new drug, new agent or technique; if it was new it had to be better. The way it was, is not the way it is, or the way it will be. Emphasis is now placed upon minimizing resources expended, decreasing costs and maximizing revenues, the perceived elements of survival.

Anaesthetic drugs in current use (and for that matter every new drug) in day surgery must be assessed from the standpoint of intensity of care required post anaesthesia (morbidity, time to arousal, time to discharge, recovery staffing needs) and anaesthesia related costs. Anaesthetic drugs and agents must offer unique and important benefits. As anaesthesiologists we have to learn to ask the following regarding any new agent, drug or technique:

- Is it sufficiently better than what is currently available to warrant widespread incorporation into clinical practice?
- Are there added costs associated with it's use (cost of product, equipment needed to administer, waste)?
- Are there cost savings that result from a decrease in patient morbidity and length of recovery stay?

Having a procedure performed in a day surgery facility creates savings compared to the patient staying overnight in a hospital. Day surgery plus value based anaesthesia management multiplied by the number of patients cared for each year can result in significant savings to the facility or health care system. Value based anaesthesia management refers to: Drugs, devices and medical procedures that anaesthesiologists use in and outside the operating room; Administrative and organizational support needed to improve turnaround time between cases; Reduction or possible elimination of the labor intensive phase one recovery room stay by the use of specific anaesthetic techniques that limit the duration of post-procedure anaesthetic effect.

Although today, patient care is being driven by cost, ultimately the relationships among patient outcome and satisfaction, efficiencies and cost will define a value based management system. Physicians and facilities

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have to embrace the concept of patient focused management: Helping the patient in and out of the system as efficiently and cost effectively as possible without compromising care.

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Review

Combination therapy for postoperative nausea and vomiting — a more effective prophylaxis?

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Abstract

The problem of postoperative nausea and vomiting (PONV) remains far from being resolved. Despite the introduction of new classes of antiemetics and a vast amount of published research, there is a general impression that there has been little progress in this area. The multifactorial etiology of PONV might be better addressed using a combination of drugs acting at different receptor sites. This approach of balanced antiemesis may be the answer towards achieving a significant improvement in the management of PONV. This article will cover the different strategies used to prevent PONV with particular emphasis on combination antiemetics. A review of the currently available methods to manage PONV as well as the physiological and pharmacological basis of combination therapy is presented.

Keywords: Antiemetics; Combination therapy; Nausea; Vomiting

The last decade has seen a dramatic increase in day-case surgery. Up to 80% of patients in the US are currently admitted on the day of surgery [1]. Adequate control of postoperative pain, postoperative nausea and vomiting (PONV), and early return to normal activity are important anesthetic goals in the context of ambulatory surgery. Major advances have been achieved in the field of acute pain and in the availability of short acting anesthetic agents. However, despite the availability of new antiemetic agents, the incidence of PONV has remained largely unchanged, although its severity has decreased [2]. Presently, the overall incidence of PONV for all surgeries and patient populations is estimated to be 25–30% [3]. Furthermore, it is estimated that approximately 0.18% of all patients may experience intractable PONV, leading to a delay in postanesthesia care unit (PACU) recovery room discharge and/or unanticipated hospital admission, thereby increasing medical costs [4]. Chung and colleagues [8] recently reported that PONV were responsible for increasing the duration of postoperative stay by 25 and 79% in patients undergoing ambulatory surgery, who received general anesthesia (GA) and monitored anesthesia care (MAC) respectively [5].

Nausea and vomiting are among the most unpleasant experiences associated with surgery and one of the most common reasons for poor patient satisfaction rating in the postoperative period [6]. Macario et al. [7] quantified patients' preferences for postoperative outcomes before surgery. Postoperative nausea and vomiting were among the ten most undesirable outcomes following surgery. Indeed, patients allocated the highest amount (about $30) to avoid PONV out of a total of $100 they were allowed to spend to avoid all complications. In a recent study, Gan and colleagues demonstrated that surgical patients were willing to pay up to $100 to avoid PONV (8). PONV may also be associated with serious complications, such as wound dehiscence, pulmonary aspiration of gastric contents, hematoma formation beneath skin flaps, dehydration, electrolyte disturbances, Mallory Weis tear and esophageal rupture [9–11].

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1. Who should get prophylaxis?

Since, overall, only 25–30% of the surgical patient population will experience PONV, not all patients will require antiemetic prophylaxis [12]. Systematic reviews suggest that prophylaxis might have limited efficacy, be associated with adverse drug reactions and treatment may be more cost effective than prophylaxis [13].

Patient-, anesthesia- and surgery related risk factors should be evaluated to identify patients who may benefit from prophylactic antiemetics. Anesthetic related risk factors include the type of intravenous and volatile anesthetic agents, the use of nitrous oxide in certain patient populations, the use of higher doses of neostigmine for the reversal of neuromuscular blockade, the use of opioids and experience of the anesthesiologist. Female gender, obesity, history of PONV or motion sickness and high levels of anxiety are also associated with a higher risk of PONV. Long surgical procedures and certain types of surgery carry a greater risk of PONV [14]. In adults, high incidences of PONV are found in intra-abdominal surgery (70%), major gynecological surgery (58%), laparoscopic surgery (40–77%), breast surgery (50–65%), eye and ENT surgery (71%). Pediatric operations at high risk for PONV include strabismus (up to 85%), tonsillectomy and middle ear procedures [15]. Various PONV risk scores corresponding to the above mentioned risk factors have been devised. Recently, Apfel et al. [16] developed a simplified risk score consisting of four predictors: female gender, history of motion sickness or PONV, nonsmoker and the use of postoperative opioids. If none, one, two, three, or four of these risk factors were present, the incidences of PONV were 10, 21, 39, 61 and 79% respectively. Prophylactic use of antiemetics is therefore only warranted in high-risk patients and should be part of a multimodal approach to the management of PONV.

2. Multimodal strategies for the management of PONV

As PONV are multifactorial, a multimodal strategy should be adopted to successfully reduce the incidence. Evidence suggests that the use of anxiolytic premedication [17], avoidance of intra- and post- operative opioids [3], use of a NG tube in GI surgery, oro- or naso-gastric suction prior to extubation [18], adequate intravenous hydration [19], avoidance of hypotension [20], ensuring good pain relief [21], gentle handling of patients, smooth ambulation, and avoiding overuse of oral airways and oro–pharyngeal suction [3], can affect the incidence of PONV. There is evidence from systematic reviews of randomized controlled trials, that certain interventions may help keep the baseline risk of PONV low: the use of propofol for induction and maintenance of anesthesia, omitting the use of nitrous oxide and avoiding reversal of neuromuscular blockade [13].

The use of prophylactic antiemetics should be reserved for the high-risk patient and is best achieved using a combination of drugs (balanced antiemesis). Prophylactic antiemetic therapy is cost–effective for operations with a high frequency of emesis, whereas treatment of established symptoms is more cost–effective when the frequency is lower [22]. Recently, Hill and colleagues [23] reported that the use of prophylactic antiemetic therapy in high-risk ambulatory surgical patients (women with previous history of PONV or motion sickness undergoing emetogenic procedures) was more effective in preventing PONV and achieved greater patient satisfaction at a lower cost compared with placebo.

Most published studies show that the combination of antiemetics acting at different receptors provide significantly better efficacy in preventing PONV than a single antiemetic acting at one receptor site. Knowledge of the physiology of the vomiting reflex and an understanding of the different neurotransmitters and receptors involved as well as the pharmacology and site of action of individual antiemetics are important when using combination therapy.

3. Physiology

The complex act of vomiting involves coordination of the respiratory, gastrointestinal and abdominal musculature. It is controlled by the vomiting center, which is located in the lateral reticular formation of the medulla oblongata in close proximity to the nucleus of the solitary tract in the brain stem and has access to the motor pathways that are responsible for the visceral and somatic output involved in vomiting [24]. The vomiting reflex has two main detectors of the need to vomit: the gastrointestinal tract (GIT) and the chemoreceptor trigger zone (CTZ) in the area postrema [25]. The vagus is the major nerve involved in the detection of emetic stimuli from the GIT and has two types of afferent fibers involved in the emetic response: mechanoreceptors, located in the muscular wall of the gut, that are activated by contraction and distension of the gut as well as chemoreceptors, located in the mucosa of the upper gut, that are sensitive to noxious chemicals [26,27]. Stimulation of the vagal afferents leads to activation of the CTZ in the area postrema. The latter is a U-shaped structure a few millimeters long located on the dorsal surface of the medulla oblongata at the caudal end of the fourth ventricle. It is one of the circumventricular organs of the brain and is outside the blood–brain barrier and the cerebrospinal fluid barrier, and thus can be activated by chemical stimuli received through the blood as well as the cere-

brospinal fluid [28]. Several other stimuli can affect the vomiting center including afferents from the oropharynx, mediastinum, peritoneum and genitalia as well as afferents from the CNS (cerebral cortex, labyrinthine, visual, vestibular apparatus) [24].

Different types of receptors are involved in the transmission of impulses to the vomiting center. Cholinergic receptors are found in the vomiting center and vestibular nuclei. The area postrema is rich in dopamine (D2), opioid and serotonin (5HT3) receptors [29,30]. The nucleus tractus solitarius is rich in enkephalins and in histaminergic (H1), muscarinic cholinergic and NK-1 receptors, the latter are also found in the dorsal motor nucleus of the vagus nerve [31–33]. Antiemetics may act at the dopaminergic (D2), cholinergic, histaminergic (H1), 5HT-3 and NK1 receptors and, when deciding upon a combination, it is logical to choose drugs acting at different receptors.

4. Currently used antiemetics

4.1. Older generation antiemetics

4.1.1. Phenothiazines

The antiemetic effect of phenothiazines has been attributed to blockade of D2 receptors in the CTZ. They also have moderate antihistaminergic and anticholinergic actions. The phenothiazines have an aliphatic or heterocyclic ring attached to the tenth position of a tricyclic nucleus. The aliphatic phenothiazines (promethazine, chlorpromazine) have less antiemetic potency and more sedative effects than the heterocyclic phenothiazines (perphenazine, prochlorperazine) [34,35]. They have been used for many years in the prevention and treatment of postoperative emesis, particularly if opioids have been administered. However, they are usually ineffective against motion sickness and have no effect on gastric emptying [36]. Phenothiazines can produce significant sedation (e.g. promethazine) and some have been shown to prolong recovery from anesthesia and delay discharge. Other side effects include extrapyramidal symptoms (particularly with the heterocyclic phenothiazines), hypotension, restlessness, anticholinergic side effects and the neuroleptic malignant syndrome (NMS) [15].

4.1.2. Butyrophenones

The neuroleptic drugs haloperidol and droperidol have significant antiemetic effects. They are strong D2 receptor antagonists that act at the CTZ and area postrema. Droperidol is the only drug in this class that has been extensively used in anesthesia. It has a long duration of action (as long as 24 h following administration) probably due to its strong binding affinity to the emetic receptors [3], even though its half-life is relatively short (3 h) [37]. In a recently published meta analysis, Henzi et al. [38], reported that the anti-nausea efficacy of Droperidol was superior to its anti-vomiting efficacy. However the anti- nausea effect was short lived and not dose-dependent; the number-needed-to-treat (NNT) to prevent early nausea was five with 0.25–0.30 mg. For both early and late anti-vomiting efficacy there appeared to be dose–responsiveness; the best efficacy was with 1.5–2.5 mg (NNT 7). In children there was also a dose–response relationship, with best efficacy at 75 mcg/kg (NNT 4). Sedation and drowsiness are important side effects of droperidol and are dose dependent. Studies using low doses of droperidol (0.25–1.25) did not find any increased sedation associated with its use. Extrapyramidal reactions are recognized side effects of Droperidol, but these are rare in the doses used to treat PONV and are more likely to occur in children. Anxiety and restlessness developing after discharge have been reported, suggesting that droperidol may not be an appropriate antiemetic for ambulatory anesthesia [39]. Other side effects may include hypotension due to alpha-receptor blockade, NMS, visual disturbances, nightmares and urinary retention [40,41].

4.1.3. Antihistamines

Antihistamines (dimenhydrinate, diphenhydramine, cyclizine, hydroxyzine) act by blocking acetylcholine receptors in the vestibular apparatus and histamine H1 receptors in the nucleus of the solitary tract [3]. They are effective for the prophylaxis and treatment of motion sickness and for the control of emesis following middle ear surgery. The piperazine derivative cyclizine has been used extensively for PONV. It has similar effectiveness to promethazine in preventing and treating PONV. Side effects include sedation and a dry mouth [15].

4.1.4. Anticholinergics

Anticholinergics are a first generation class of antiemetics. They block muscarinic and cholinergic CNS emetic receptors in the cerebral cortex and pons [42]. Atropine and scopolamine are tertiary amines that cross the blood–brain barrier and have efficacy against motion sickness and PONV [43,44]. The addition of these anticholinergic agents to opioid premedication decreases emesis [45]. Transdermal scopolamine is effective in controlling motion sickness and PONV following outpatient laparoscopy [46]. Side effects include sedation, dry mouth, blurred vision, mydriasis, urinary retention, hallucinations, central cholinergic syndrome, confusion and disorientation [36,47].

4.1.5. Benzamides

Metoclopramide is the most commonly used antiemetic in this group. It is a prokinetic agent that blocks D2 receptors in the GI tract and centrally at the

CTZ and area postrema. It also increases lower esophageal sphincter tone and enhances gastric motility, which may prevent the delayed gastric emptying caused by opioids [48]. At high concentrations, it has been shown to have weak serotonin receptor antagonistic effect [49]. However, the efficacy of metoclopramide in preventing PONV is uncertain, with approximately 50% of studies showing it to be no more effective than placebo [15]. In a systematic review of randomized placebo-controlled studies involving metoclopramide, Henzi et al. [50] reported that there was no significant anti nausea effect. The numbers needed to treat to prevent early (0–6 h) and late (within 48 h) vomiting were 9.1 and 10, respectively. In children the NNT to prevent early vomiting was 5.8. There was no evidence of dose–responsiveness, the best-documented dose for adults and children being 10 mg IV and 0.25mg/kg IV respectively. Metoclopramide has a short duration of action (1-2 h) and should be administered at the end of surgery or after admission to the PACU to have a reliable antiemetic effect in the early postoperative period [9]. Side effects include sedation, restlessness and extrapyramidal symptoms. Rapid intravenous administration may also be associated with cardiovascular side effects (hypotension, bradycardia or tachycardia). However the incidence of adverse events is relatively low in the doses used for the management of PONV [15].

Domperidone is a benzimidazole derivative pharmacologically similar to metoclopramide. However, it appears to be more effective than metoclopramide for the treatment of active PONV and is associated with a lower incidence of extrapyramidal symptoms [51]. It is only available as an oral or rectal preparation. The parenteral formulation was withdrawn following several reports of serious cardiac arrhythmias after intravenous administration [52–54].

4.2. Newer generation antiemetics

4.2.1. Serotonin receptor antagonists

The serotonin 5-HT3 receptor is highly specific and selective for nausea and vomiting. Members of this group exert their effects by binding to the serotonin 5-HT3 receptor in the CTZ and at vagal afferents in the gastrointestinal tract. Serotonin receptor antagonists were first used in the management of radiotherapy and chemotherapy induced nausea and vomiting. They proved to be superior to other antiemetics in this respect and were then investigated for the treatment of PONV.

Ondansetron was the first member of this group to be evaluated and approved for PONV. The optimal effective dose was found to be 4 mg intravenously at induction or 8 mg orally 1–2 h before anesthesia [55,56]. For children the optimal effective dose was found to be 0.1 mg/kg [57]. In a quantitative systematic review of randomized placebo controlled trials involving Ondansetron, Tramer reported that the best NNT to prevent PONV with the best-documented regimes was between 5 and 6. This was achieved with an intravenous dose of 8 mg and an oral dose of 16 mg. In all published studies, the antiemesis efficacy of Ondansetron was consistently better than antinausea efficacy [58]. In 1997 Sun et al. suggested that the efficacy of Ondansetron may be improved by administration at the end of the surgical procedure compared with at induction of anesthesia. This was confirmed in another study by Tang and colleagues, [59,60].

Three other serotonin receptor antagonists (Tropisetron, Granisetron and Dolasetron) have been studied for the prevention and treatment of PONV. Dolasetron is available in intravenous and oral forms. The recommended intravenous dose for prophylaxis and treatment of PONV is 12.5 mg. The prophylactic dose should be given 15–30 min before the end of anesthesia, as the active compound is hydro-dolasetron, a metabolite of the parent drug. The oral prophylactic dose is 100 mg [3]. In a multicenter trial it was demonstrated that 2 mg tropisetron intravenously had similar efficacy and side effect profiles to those of 4 Ondansetron mg [61]. The longer half-life of Tropisetron (7–30 h) compared with Ondansetron (3.5 h) did not result in a clinically beneficial effect in clinical studies. The recommended prophylactic dose is 5 mg given at induction of anesthesia [62]. The optimum effective dose of intravenous Granisetron was found to be 1mg and 40 mcg/kg in different studies [63,64].

The reported side effects of serotonin receptor antagonists include headache (3:100), dizziness, flushing and elevated liver enzymes (3:100) [58].

4.2.2. NK-1 receptor antagonists

NK-1 receptor antagonists demonstrated broad spectrum antiemetic activity in animals and have recently been found to be effective in the treatment of established PONV and superior to ondansetron for the prophylaxis of PONV in females undergoing major gynecological surgery under general anesthesia [65,66].

4.3. Non-traditional antiemetics

4.3.1. Steroids

The mechanism of the antiemetic action of corticosteroids is not well understood. An anti-inflammatory and/or membrane stabilizing effect may play a role [3]. The release of endorphins resulting in mood elevation, a sense of well-being and appetite stimulation may also underlie the antiemetic properties of corticosteroids [67]. Following the successful use of dexamethasone in the prevention and treatment of chemotherapy induced nausea and vomiting, this agent has been evaluated for

the management of PONV. A single prophylactic dose of Dexamethasone was found to be superior to placebo [68,69]. The most commonly used dose regimen is 8–10 mg in adults and 1–1.5 mg/kg in children. A dose–response relationship for dexamethasone could not be established. In a meta-analysis, Henzi and colleagues reported that dexamethasone is particularly effective against late PONV. The NNT in children to prevent early (0–6 h) and late (0–24 h) vomiting was 7.1 and 3.8 respectively. In adults the NNT to prevent late nausea was 4.3. The combination of dexamethasone with 5-HT3 receptor antagonists further increases its efficacy. There are no reports on dexamethasone related adverse effects in the doses used for the management of PONV [70].

4.3.2. Propofol

The possible antiemetic effects of propofol have been the focus of much interest. Propofol-based anesthetics were associated with a lower incidence of PONV compared with enflurane [71], isoflurane [72] or desflurane anesthesia [73]. The findings from these studies show a low incidence of PONV only when propofol was used throughout the procedure. Intraoperative propofol anesthetics have been shown to be as efficacious in the reduction of postoperative nausea as ondansetron 4 mg [74]. The beneficial effect on PONV, however, is likely to be of short duration after surgery. The protective effect of propofol against PONV was not evident when it was used as an induction drug only [75]. More recently, continuous subhypnotic propofol infusion has been shown to be effective in the prophylactic treatment of PONV [76]. The use of patient-controlled antiemesis (PCAE) with propofol has also been investigated. Patients self-administered 20 mg (2 ml) of propofol with a lockout interval of 5 min. This technique was found to be effective in the treatment of PONV and associated with great degree of patient satisfaction, oversedation did not appear to be a problem in this dose range [77].

The effective plasma concentrations of propofol for the 50% reduction in nausea scores has been found to be 343 ng/ml [78]. This is much lower than the range required for sedation (900–1300 ng/ml) and anesthesia (3000–10 000 ng/ml).

The mechanism of the antiemetic action of propofol is not known. It is not due to the intralipid emulsion in the formulation and propofol appears to have direct antiemetic property [79]. It has been postulated that propofol may act via an antidopaminergic pathway [80]. However, two recent studies have not substantiated this claim [81,82]. Several other mechanisms have been postulated including a depressant effect on the CTZ, the vagal nuclei and a decreased concentration of serotonin in the area postrema following prolonged infusion of propofol [78].

4.3.3. Other therapies

Two studies have shown that intramuscular ephedrine was superior to placebo and had similar antiemetic effectiveness to droperidol and propofol following outpatient gynecological laparoscopy [83,84]. Recently, Grief and colleagues [85] have shown that, after colonic resection, supplemental oxygen reduced the incidence of PONV nearly twofold. A number of studies have shown a reduction in PONV associated with the use of benzodiazepines [86,87]. They do not appear to show true antiemetic receptor binding affinity, but decrease the production of catecholamines, thereby decreasing anxiety.

4.4. Nonpharmacologic techniques

Nonpharmacologic techniques that have been used to prevent PONV include acupuncture, electroacupuncture, laser stimulation of the P6 point, transcutaneous electrical nerve stimulation, acupoint stimulation and acupressure. Acupuncture has been used as a medical modality for over 3000 years in China. In 1996, the FDA reclassified acupuncture needles from class III (experimental) medical devices to class II (nonexperimental, but regulated) [88]. Several investigators have shown a useful effect of these nonpharmacological methods in the management of PONV. A few studies, however, failed to demonstrate a beneficial effect. Lee and Done in 1999 performed a meta-analysis to assess the efficacy of nonpharmacologic techniques in the prevention of PONV. Their main findings were that there was a significant reduction in early PONV in adults using nonpharmacologic methods compared with placebo and that antiemetics (metoclopramide, cyclizine, droperidol, prochlorperazine) versus nonpharmacologic techniques were comparable in preventing early or late PONV in adults. In children, however, no benefit was found. There were no studies comparing nonpharmacologic techniques with 5-HT3 receptor antagonists [89].

4.5. Combination antiemetics

None of the available antiemetics is entirely effective for preventing PONV, especially in high-risk patients, probably because most of them act through blockade of mainly one receptor. The etiology of PONV is multifactorial and a better prophylaxis might be achieved using a combination approach. The concept of combination therapy was introduced by Parikh in chemotherapy induced vomiting [90]. The use of a combination of antiemetics from different pharmacological classes might provide enhanced antiemetic efficacy with a reduced side-effect profile. A number of combinations have been studied.

A summary of the published papers comparing combination therapy versus monotherapy is shown in Tables 1–3.

4.5.1. Ondansetron and droperidol

This was the most commonly studied combination. This combination is theoretically attractive for several reasons. Both agents proved to be superior to placebo for the prevention and treatment of PONV while acting at different receptor sites. Droperidol has greater antinausea efficacy, whereas ondansetron has better effect on preventing vomiting [38]. The protective effect of droperidol against postoperative headache combined with an increased risk of headache with 5-HT3 receptor

Table 1
Efficacies of combination of 5-HT3 receptor antagonists and droperidol versus single agent studies[a,b]

Reference	Surgery	Regimen	Complete response (%)[c]	No ponv 24h	Result
Pueyo et al. [92]	Abdominal	P		28	O+D>O=D>P
		D2.5mg+D1.25mg		60*	
		O4mg		56*	
		O4mg+D2.5mg+D1.25mg		92	
Bugendo et al. [93]	Gyn&bilary	P		77	O+D>D>P
		D2.5mg		83	O+D=O>P
		O4mg		91	
		O4mg+D2.5mg		95*	
Wu et al. [94]	Gyn laparoscopy	O4mg+D1.2		77*	O+D>O=D>P
		O4mg		54*	
		D1.25mg		39*	
		P		29	
McKenzie et al. [95]	Tubal banding	D1.25mg+O4mg	91.6*		O+D>D
		D1.25mg	78.3		
Riley et al. [96]	Major Gyn	D1.25mg+O4mg	45		O+D=D
		D1.25mg	38		
Peixoto et al. [97]	Major Gyn	D1.25mg		67	O+D=O=D
		O4mg		60	
		O4mg+D1.25mg		57	
Wrench et al. [98]	Major Gyn	O4mg+8mg/60ml/PCA		65	O+D=O=D
		D1.25mg+3mg/60ml/PCA		85	
		O+D		80	
Warrick et al. [99]	Gyn laparoscopy	D1.25mg then P		59	O+D=D
		D1.25mg then D1.25mg		48	
		D1.25mg+O4mg then P		65	
		D1.25mg+O4mg then P		69	
		D1.25mg+O4mg then D1.25mg+O4mg			
Klockgether-Radke et al. [100]	Strabismus	D75mcg/kg		73.5*	O+D=O=D>P
		O0.1mg/kg		60*	
		D75mcg/kg+O0.1mg/kg		55*	
		P		5	
Fujii et al. [106]	Laparoscopic cholecystectomy	G3mg	86		G+D>G,D
		D1.25mg	64		
		G3mg+D1.25mg	98*		
Fujii et al. [107]	Breast surgery	G3mg	82		G+D>G,D
		D1.25mg	62		
		G3mg+D1.25mg	96*		
Fujii et al. [108]	Tonsillectomy	G40mcg/kg	83*		G+D>G>D
		D50mcg/kg	55		
		G40mcg/kg+D50mcg/kg	97*		
Fujii et al. [109]	Strabismus	G40mcg/kg	78*		G+D>G>D
		D50mcg/kg	38		
		G40mcg/kg+D50mcg/kg	98*		

[a] P, placebo; D, droperidol; O, ondansetron; G, granisetron
[b] = indicates no difference; > indicates significantly ($P<0.05$) more effective; * indicates $P<0.05$ versus other group or placebo.
[c] Complete response = no PONV and no rescue.

Table 2
Efficacies of combination of 5-HT3 receptor antagonists and dexamethasone versus single agent studies[a,b]

Reference	Surgery	Regimen	Complete response (%)[c]	No PONV 24 h (%)	Result
Fujii	Major Gyn	D1.25mg	49		G+Dex>G>D=D+Dex=M=M+Dex
et al. [68]		D1.25mg+Dex8mg	60		
		M10mg	51		
		M10mg+Dex8mg	62		
		G40mcg/kg	80*		
		G40mcg/kg+Dex8mg	96*		
Rajeeva	Gyn	O4mg+Dex8mg		92*	
et al. [101]	laparoscopy	O4mg		65	O+Dex>Dex
McKenzie	Major Gyn	O4mg	37.5		O+Dex=O
et al. [102]		O4mg+Dex20mg	52.5		
Lopez-Orlando	Major Gyn	P		20	O+Dex>O=Dex>P
et al. [103]		O4mg		52	
		Dex8mg		60	
		O4mg+Dex8mg		84*	
McKenzie	Major Gyn	O4mg	38		O+Dex>O
et al. [105]		O4mg+Dex8mg	52*		
Splinter	Strabismus	O150mcg/kg		72	O+Dex>O
et al. [104]		O50mcg/kg +Dex150mcg/kg		91*	
Fujii	Major Gyn	P		77	G+D>G=Dex=P
et al. [110]		G20mcg/kg		77	
		Dex8mg		77	
		G20mcg/kg+Dex8mg		95*	
Fujii	Breast	P	56		G+Dex>G>P
et al. [111]		G40mcg/kg	84		
		G40mcg/kg+Dex8mg	98*		
Fujii	Middle ear	G3mg	80*		G+Dex>G>Dex
et al. [112]		Dex8mg	55		
		G3mg+Dex8mg	98*		
Fujii	Laparoscopic	G40mcg/kg	83		G+Dex>G
et al. [113]	cholecystectomy	G40mcg/kg+Dex8mg	98*		
Fujii	Thyroidectomy	G40mcg/kg	86		G+Dex>G
et al. [114]		G40mcg/kg+Dex8mg	98*		
Fujii	Cesarean section	G3mg	85		G+Dex>G
et al. [115]		G3mg+Dex8mg	98*		
Janknegt	Abdominal/Gyn	D1.25mg		58	G+Dex=G>D>P
et al. [116]	Breast/ENT	G1mg		78*	
		G1mg+Dex5mg		82*	
		P		5	
Holt	Tonsillectomy	T0.1mg/kg		39	T+Dex>T
et al. [127]		T0.1mg/kg +Dex0.5mg/kg		61*	

[a] O, ondansetron; Dex, dexamethasone; P, placebo; G, granisetron; D, droperidol; T, tropisetron.
[b] = indicates no difference; > indicates significantly ($P<0.05$) more effective; * indicates $P<0.05$ versus other group or placebo.
[c] Complete response = no PONV and no rescue.

antagonists provides another reason for this combination [58,91]. Pueyo et al. [92] studied the intravenous combination of 4 mg ondansetron and 2.5 mg droperidol at induction of anesthesia followed by 1.25 mg droperidol 12 h later for the prevention of PONV in elective abdominal surgery. The combination was more effective than each individual drug or placebo with a complete response (no PONV in 48 h) of 92% compared with 28, 60 and 56% in the placebo, droperidol and ondansetron groups respectively. However sedation was greater in patients receiving droperidol.

The combination of 4 mg ondansetron and 2.5 mg droperidol was also studied by Bugedo et al. [93] in patients undergoing biliary or gynecological surgery. The combination was better than placebo and droperidol but not ondansetron. Sedation scores were also higher in patients receiving droperidol or the combination. These studies suggest that droperidol in doses above 1.25 mg should be avoided. In another study, a combination of 4 mg ondansetron and 1.25 mg droperidol was found to be superior to each drug alone especially in the first 3.5 postoperative hours following

outpatient gynecological laparoscopy. Drowsiness was more severe in the group receiving droperidol alone, but not in the combination group [94]. The same doses were used by Mckenzie et al. in two studies comparing the combination with droperidol in females undergoing laparoscopic tubal banding and abdominal hysterectomy. The combination was significantly superior to droperidol in achieving a complete response (no emesis, no rescue) and in reducing the incidence and severity of nausea in the tubal banding study, but not in the hysterectomy study. However, in both studies the combination was significantly better that droperidol in reducing the time to and the number of emetic episodes [95,96]. Similar doses were used by Peixoto and colleagues in females undergoing major gynecological surgery. The combination was significantly better than either drug alone in the first 2 h, the incidence of PONV was, however similar in all groups over the 24 h period [97].

This combination was also studied during patient-controlled analgesia (PCA) using morphine. Ondansetron (4 mg bolus) followed by 0.13 mg/ml mixed in the morphine solution was compared to droperidol (1.25 mg bolus) and 0.05 mg/ml in the morphine solution and with the combination of ondansetron and droperidol. The combination provided better control of nausea in the first 12 h postoperatively, however there was no difference in vomiting or in nausea beyond 12 h. There was no increased sedation in patients receiving droperidol [98].

These results were not confirmed by Warrick et al. who compared a single dose of 1.25 mg droperidol with and without 4 mg ondansetron and two doses of 1.25 mg droperidol with and without 4 mg ondansetron. The first dose of droperidol was given at induction followed by a second dose 4 h later. Although the combination regimen did not show greater efficacy in reducing the incidence of PONV, a reduction in the severity of nausea was noted up to 24 h postoperatively in the

Table 3
Efficacies of other combination antiemetic studies for PONV prophylaxis[a]

Reference	Surgery	Regimen	No PONV 24h (%)	Result
Michaloudis et al. [117]	Laparoscopy	D0.5mg + M5mg + H0.1mg	53	D + M + H = D
		D1.25mg	37	
Kymer et al. [118]	Strabismus	D300mcg/kg	73*	D + M = D > M,P
		M0.15mg/kg	38	
		D300mcg/kg + M0.15mg/kg	78*	
		P	44	
Pendeville et al. [119]	Strabismus	P		D + M = D = M = P
		D10mcg/kg		
		M0.1mg/kg		
		D10mcg/kg + M0.1mg/kg		
Kathirvel et al. [120]	Strabismus	P	28	O + M = O > M,P
		M250mcg/kg	40	
		O150mcg/kg	60*	
		O100mcg/kg + M150mcg/kg	56*	
Steinbrook et al. [121]	Laparoscopic cholecystectomy	O4mg	55.2	D + M > O(nausea)
		D0.625mg + M10mg	75.6*	
Eberhart et al. [122]	Nasal	P	62.9	Di + D > D,Di,P
		Di1mg/kg	77.1	
		D15mcg/kg	82.9	
		Di1mg/kg + D15mcg/kg	94.3*	
Khalil et al. [123]	Middle ear	O4mg	52	O + PR = PR > O,P
		PR25mg	61*	
		O2mg + PR12.5mg	71*	
		P	26	
Eberhart et al. [124]	Endonasal	P	62.5	Di + M > P(not Di, M)
		M0.3mg/kg	72.5	
		Di1mg/kg	75	
		M + Di0.3mg/kg + 1mg/kg	85*	
Barst et al. [125]	Tonsillectomy	O0.1mg/kg + PRO120–140mcg/kg/min	93.3*	O + PRO + > PRO
		P + Pro120-140mcg/kg/min	77.8	
Ahmed et al. [126]	Gyn laparoscopy	O4mg	15	O + C > O > P
		O4mg + C50mg	27*	
		P	2	

[a] D, droperidol, M, metoclopramide; H, hyoscine; P, placebo; O, ondansetron; Di, dimenhydrinate; PR, promethazine; PRO, propofol; = indicates no difference; > indicates significantly ($P < 0.05$) more effective; * indicates $P < 0.05$ versus other group or placebo.

combination groups versus the droperidol groups [99]. However, in children undergoing surgery for strabismus, ondansetron and droperidol combination did not provide any advantage over either agent alone [100].

4.5.2. Ondansetron and dexamethasone

Rajeeva et al. [101] reported better control of delayed vomiting using a combination of 4 mg ondansetron and 8 mg dexamethasone when compared with ondansetron alone, in females having a diagnostic laparoscopy. Patients in the combination group also had significantly lower nausea scores. Similar results were obtained by McKenzie and colleagues [102] in women undergoing major gynecologic procedures using the same dosage. Lopez and colleagues [103] used similar doses and reported that the combination was more effective than ondansetron for nausea and vomiting, and better than dexamethasone for vomiting but not for nausea in females undergoing major gynecologic surgery. The incidence of vomiting was also significantly lower in the combination group compared with ondansetron alone in children undergoing strabismus surgery [104].

A study by McKenzie et al. [105] however, did not find a reduction in PONV when 20 mg dexamethasone was added to 4 mg ondansetron in patients undergoing major gynecologic surgery. Patients in this study had a low incidence of vomiting (17.5 and 12.5% in the ondansetron and combination groups, respectively). The use of droperidol with the first complaint of nausea in about 50% of patients may have contributed to this reduction in vomiting and the lack of a difference between the groups. These studies did not report any difference in adverse events when using a combination or each agent alone, headache being the most commonly reported side effect.

4.5.3. Granisetron and droperidol

Fujii et al. compared a combination of 3 mg granisetron plus 1.25 mg droperidol with each agent alone in patients undergoing laparoscopic cholecystectomy and breast surgery.

In both studies, the combination was found to be superior to each agent alone in achieving a complete response (no PONV and no rescue antiemetic during the 24 h study period) and better than droperidol when nausea and vomiting are analyzed separately [106,107]. The same group found similar results in children undergoing tonsillectomy and strabismus surgery [108,109]. Excessive sedation was not observed in these studies and there was no difference in adverse events between the groups.

4.5.4. Granisetron and dexamethasone

This combination was studied extensively by one group from Japan. Fujii et al. published six papers comparing the combination with either agent alone. The doses of granisetron were 20 mcg/kg in one study, 40 mcg/kg in three studies and 3 mg in two studies. Eight milligrams of dexamethasone were used in all studies. They included patients undergoing breast surgery, thyroidectomy, middle ear surgery, laparoscopic cholecystectomy, cesarean section and major gynecological procedures. In all these studies they reported that the combination was superior to each agent alone with a complete response (no PONV and no rescue for 24 h) of 98% compared with 50% in the dexamethasone group and 83–86% in the granisetron group. They postulated that dexamethasone enhances the efficacy of granisetron by inhibiting stimulation of 5-HT3 receptors where granisetron exerts its effects. There was no difference in adverse events between the combination and either agent alone [110–115].

Janknegt et al. also compared the combination of 1 mg granisetron plus 5 mg dexamethasone with 1 mg granisetron and 1.25 mg droperidol in patients undergoing gynecological, breast, abdominal and ENT surgery. Both granisetron and the granisetron/dexamethasone combination performed better than droperidol alone in reducing the incidence of vomiting and combined nausea and vomiting. The combination was also more effective than the other groups against nausea [116].

4.5.5. Combinations involving metoclopramide

Three studies involving a combination of metoclopramide with droperidol did not show an improved outcome over droperidol alone [117–119]. The combination of metoclopramide with ondansetron was also not superior to ondansetron alone in children undergoing surgery for strabismus [120], however a combination of droperidol and metoclopramide was found to be more effective than ondansetron in preventing postoperative nausea in patients undergoing laparoscopic cholecystectomy [121]. Eberhart et al., found that the incidence of patients free from PONV, in males undergoing endonasal surgery, was significantly higher compared with placebo using a combination of dimenhydrinate and metoclopramide but not with each agent alone [122].

4.5.6. Other combinations

In a study comparing the ondansetron plus promethazine combination versus each agent alone in adult patients undergoing middle ear surgery, Khalil et al. reported that the combination and promethazine alone, but not ondansetron reduced the incidence of PONV compared with placebo; the combination was also superior to individual antiemetic groups in reducing the severity of vomiting [123]. In male patients undergoing nasal surgery, Eberhart et al. found that a complete response (no PONV for 24 h) was significantly greater (94%) using a combination of droperidol

and dimenhydrinate, compared with each agent alone and with placebo [124]. A combination of ondansetron and propofol infusion was also superior to propofol alone in reducing the incidence of emesis in children following tonsillectomy [125]. Recently, Ahmed and colleagues have shown that a combination of ondansetron and cyclizine was significantly better than ondansetron alone in reducing the incidence of vomiting, the incidence and severity of nausea as well as the need for rescue [126]. Holt and colleagues have also found that a combination of tropisetron and dexamethasone was more effective than tropisetron alone in reducing the incidence of PONV following pediatric tonsillectomy [127]. More recently, a combination of Ondansetron and the NK-1 receptor antagonist [CP-122,721] was shown to significantly prolong the time of the first administration of the first rescue antiemetic, compared with either drug alone, and almost completely prevented the occurrence of emesis (2% of patients vomited) when used as a prophylaxis in patients undergoing abdominal hysterectomy [66].

4.6. Multiple antiemetic combination

Scuderi et al., investigated a multimodal approach to the management of PONV in female patients undergoing outpatient laparoscopy. Their multimodal clinical care algorithm consisted of total intravenous anesthesia (propofol and remifentanil), no nitrous oxide, no neuromuscular blockade, aggressive intravenous hydration (25 ml/kg), triple prophylactic antiemetics (ondansetron 1 mg, droperidol 0.625 mg and dexamethasone 10 mg), and 30 mg ketorolac. Control groups included standard balanced outpatient anesthetic with or without 4 mg ondansetron prophylaxis. Multimodal management demonstrated superior efficacy in preventing symptomatic PONV compared to routine monotherapy prophylaxis; no patients in the multimodal group vomited prior to discharge and time to readiness for discharge was significantly shorter in this group compared to the other groups [128].

Recently, a triple antiemetic combination with ondansetron and droperidol in the presence of propofol maintained anesthetic was also associated with a lower incidence of PONV and greater patient satisfaction compared with similar antiemetic combination without propofol [129].

5. Conclusion

There is a strong evidence from published work that a much better prophylaxis against PONV may be achieved by using a combination of antiemetic agents acting at different receptor sites. Such prophylaxis should be considered for patients at high risk for PONV. There is, however, a striking lack of data on the efficacy of combination therapy for the treatment of established PONV. Further work is required to identify the optimal combination of antiemetic drugs that is most efficacious, least likely to be associated with adverse effects and cost–effective. Minimal effective doses of these combinations need to be established. More studies are needed to explore the potential of additional benefit of combining more than two antiemetics.

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Hernia surgery for the third millennium. Does classical herniorraphy still play a role?

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Abstract

The steadily increasing use of prosthetic grafts in hernia repairs can be said to play down the classical approach for repairing groin hernia. We retrospectively report on 894 patients operated on for groin hernia at our out-patient surgery clinic from June 1992 to May 1998. Herniorraphy was widely performed (96.3%). The recurrence rate was of 1.6% (overall). For patients younger than 45 yr with no systemic concurrent disease, as few as 0.1% relapsed after a 58-month average follow-up. According to our results, ambulatory herniorraphy can provide an excellent degree of efficiency in selected young patients suffering from indirect unilateral primary groin hernia. Likewise, we regard the prosthetic repair as the gold standard technique in those patients with a weakened posterior inguinal wall.

Keywords: Groin hernia; Tension-free mesh repair; Herniorraphy; Recurrence; Day case; Hernia repair

1. Introduction

Given the excellent results the prosthetic materials have recently offered in terms of complications and rate of recurrence, no wonder the classical approach to hernia repair has given way to the former [1,2].

In order to pinpoint the most suitable indications for these techniques, we have reviewed our long-term results in retrospect to dispel whether the classical techniques can still play a role.

2. Patients and methods

We report on 894 patients operated on for groin hernia at our Day Surgery Unit (DSU) from June 1992 to May 1998. For the patient to be treated as a day case, ASA I–II status and a suitable social and family environment were required. Age was not a benchmark for exclusion, nor was the hernia size.

We have collected data with regard to the past medical records, the clinical picture and type of hernia (according to Nyhus' classification), surgical procedures and anaesthetic techniques. Complications both in the short- and long-term have also been analyzed. We have sifted through several standard clinical indications of quality for ambulatory surgery.

Once the patients undergo operation, they remain in the DSU up to 6 h, after which we would consider their stay as an unplanned delay in discharge. Decision with regard to the anaesthetic and surgical options were left to the physician in charge. Antibiotic prophylaxis was only indicated when the use of prosthetic material was foreseeable (amoxicillin + clavulanic acid intravenously 2 g, single dose).

Once the patients were discharged, our Home Care Unit (HCU) specially trained and skilled in postoperative care followed their recovery until skin staples were removed, so that complications were fully reported and treated and patients could be sent back to hospital if needed.

Regarding the follow-up, the patients were visited and appraised at the outpatient clinic within the first month, and then once yearly.

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3. Results

The mean age of our series was 40.52 yr (6–76), the bulk of whom were men (88.48%). Clinical picture included groin lump in 91.8% of patients (53.47% on the right side and 46.53% to the left), as well as local pain in 25.84% of patients. Some 28% had suffered from at least one episode of incarceration, and 13.26% had undergone previous hernia surgery to the opposite side.

According to Nyhus' classification, type I (indirect inguinal hernia with normal internal abdominal ring) accounted for 59.73% (534 patients); type II (indirect inguinal hernia with internal abdominal ring dilated, but an intact posterior abdominal wall) accounted for 28.07% (251 patients). As for type III (posterior wall defects whether with an associated large indirect hernia or not), it represented 12.20% of patients (109). Those patients aged more than 40 yr or obese were much more likely to present with type III hernia.

With regard to anaesthetic techniques, general anesthesia, was the procedure of choice upon setting up the pilot study and so it remained during the first year of the DSU functioning as an independent unit. More recently, it has given way to spinal and local techniques, the latter accounting for more than 90% at present. On the whole, the three of them more or less represented one third each (31.54%, 35.01% and 33.45%, respectively).

As for the surgery, herniorraphies represented 96.3% of patients, the Bassini operation strikingly standing out (86.4% of patients), the Mc. Vay operation having been performed in the remaining group. Prosthetic repair was performed in as few as 33 patients (3.7%). Herniorraphy was basically sewn with multifilament non-absorbable material in 77.05% and continuous suture was placed in 97.58% of patients.

Relaxing incisions were used in 3.02% of cases only as we no longer consider this manouver as being useful. Resection of the cremaster muscle was moderately performed (34.45%), whereas ligation and resection of the hernial sac was widely rendered (66.7%).

The mean postoperative spell at the DSU was 193.59 min (90–360). Immediate complications included slight local pain (15.44%), nausea (4.14%), and vagal syndrome (0.7%).

Our DSU's staff took over the home care for a mean period of 7.23 days. Local complications developed during either this period or the follow-up as shown in Table 1. The rate of complications was slightly higher in comparison to that of the prosthetic group, yet no statistical differences were found.

The mean follow-up period was 58 months (12–82). The overall rate of recurrence was of 1.5% (13 patients) for herniorraphies, and 0.33% for prosthetic repair (1 patient). Regarding the former, 10 patients presented with large direct defects, and two were older than 45 yr and presented with internal defects along with obesity.

Table 1
Immediate complications

Complications	Number of patients	Rate (%)
Slight pain (first 48 h)	82	9.2
Severe pain (first 48 h)	37	4.14
Seroma	18	2.07
Haematoma-ecchymosis	36	4.07
Wound infection	8	0.9
Hydrocoele	18	2.1
Neuralgia	3	0.33
Intolerance to suture	1	0.1
Mortality	0	0

We have analyzed several clinical indications of quality for day surgery, and found 6.4% overall unplanned admissions (Table 2), 5.9% unplanned overnight admissions, 0.45% unplanned return to the operating room, 0.45% delayed admissions (longer than 24 h after discharge), and 0.9% unplanned delay in discharge (longer than 6 h).

4. Discussion

Hernia surgery can be said to account for approximately 15% of surgical procedures carried out in a General Surgery Department in Spain. Its incidence varies widely in different countries – 10/10 000 inhabitants/yr in the UK to 28/10 000 inhabitants/yr in the USA [3].

Our study ties in with other multicentric studies in Spain, in terms of population data and distribution [4], with male adamantly setting against female and indirect defects against direct ones. Criteria such as age and concurrent diseases were different, for our patients had been picked out according to day surgery criteria [1]. This must be the reason why our patients developed a lower rate of complications both in the short and in the long-term in comparison to other series [5].

Table 2
Overall unplanned admissions

Grounds for unplanned admission	Number of patients	Rate (%)
Anaesthetic advice	19	2.1
Hernia size	14	1.6
Surgical complications	6	0.67
Associated surgery	6	0.67
Social or familiar	8	0.90
Systemic complications	4	0.45

According to some recent studies, local anesthesia plus sedation has been proved to result in higher degrees of acceptance and satisfaction, while cutting down on complications in comparison to general anesthesia, that in addition requires a longer stay in hospital [6–8].

We have reviewed the available literature regarding the clinical indicators of quality for day surgery. These are comparable to ours, with unplanned admissions due to surgical complications, as well as delayed admissions and unplanned return to operating room remaining lower than 1% [9].

Long-term studies have shown inconsistent rates of recurrence (0–30%) even though the same technique was performed [10]. That might well be due to a poor technique, which depends on the surgeon [11], or to inadequate selection [12].

Studies with only prosthetic repairs having been performed have resulted in a lower rate of recurrence ($< 1\%$) and complications, for these techniques are to some extent more independent of the surgeon and easier to perform [13–15]. According to other authors, morbidity can be said to be similar [16], the main downside being the presence of prosthetic material that could lead to several problems, such as intolerance or infection which increase cost [17].

The point is whether we should routinely use the prosthetic repair for groin hernia.

Further study in depth shows that specialized surgeons still recommend classical herniorraphies on the basis of good results, provided the surgery is flawlessly performed by skilled personnel in selected young patients with no associated morbidity [18–20]. We have reported on a satisfactory outcome for selected patients in our DSU, who underwent herniorraphy, with results comparable to prosthetic studies in terms of morbidity and rate of recurrence.

Those older than 40 yr and obese [21], who presented with direct defects [22] were more likely to develop complications and relapse.

To summarize, we can make out no significant difference on behalf of prosthetic repair in comparison to the classical techniques, as long as the patient is properly selected (primary indirect defects in young patients with no concurrent disease), and both surgery and postoperative home care are painstakingly carried out. Likewise, we regard the prosthetic repair as the gold standard technique in those patients with a weakened posterior inguinal wall.

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Two percent lidocaine spinal anaesthesia compared with sevoflurane anaesthesia in ambulatory knee surgery – cost-effectiveness, home readiness and recovery profiles

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Abstract

A total of 60 patients scheduled for elective knee arthroscopy were randomized to receive spinal anaesthesia (SA) with 2% lidocaine ($n = 30$) or general anaesthesia with sevoflurane (SE) ($n = 30$). SA and SE were compared in terms of the total costs of anaesthesia. The time to reach home readiness and the total time spent in the recovery unit (RU) were assessed. The early postoperative period and recovery at 24 h and 1 week were evaluated in terms of the incidence of pain, sedation, nausea and general satisfaction with the method of anaesthesia and postoperative instructions. The total costs of anaesthetic materials in the operation theatre (OT) and anaesthetic materials and personnel costs until home readiness was achieved in the RU were 160.7 FIM (1 FIM = 0.17 EUR) for SA and 171.0 FIM for SE (not significant). The corresponding sums were 197.2 FIM for SA and 224.4 FIM for SE ($P = 0.001$) when the total stay in RU was considered. The time to reach home readiness was 140.8 min (S.D. 52) in the SA group and 96.4 min (S.D. 62) in the SE group ($P = 0.02$). There were no differences in the total RU time (224.0 min (S.D. 67) for SA and 218.0 min (S.D. 59) for SE). The level of postoperative pain was generally low, as all the SA patients and 86.7% of the SE patients had VAS < 4 2 h postoperatively. Six SA patients (20.0%) had postoperative headache and two of them also had headache in the supine position. There were no headaches in the SE group ($P = 0.024$). None of the patients in the SA group and six SE patients (20.0%) had nausea (needed treatment) in the RU ($P = 0.024$). Four patients (13.3%) in the SE group and 1 patient (3.3%) in the SA group had nausea during the first 24 h postoperatively. All the patients were alert 60 min postoperatively with no difference between the groups and they were very satisfied during the first 24 h. All patients would have liked to have a similar operation done on an ambulatory basis. 93.3% said they would choose the same kind of anaesthesia. 91.7% were satisfied with the first week.

General anaesthesia with SE is more cost-effective than SA with 2% lidocaine in ambulatory knee surgery if a short RU time is needed. The patients do generally well, but the incidence of postspinal headache with SA, adequate postoperative pain treatment and the possibility to have nausea with SE must be kept in mind.

Keywords: Ambulatory anaesthesia; Cost-effectiveness; Home readiness; Knee arthroscopy; Recovery; Sevoflurane; Spinal anaesthesia

1. Introduction

During the last decade, there has been an exponential growth in ambulatory anaesthesia facilitated, in part, by the introduction of new drugs and the development of anaesthetic techniques which provide rapid and predictable recovery. Although the influence of specific anaesthetic drugs on both early and late recovery times has been evaluated in a number of studies, the cost-benefit characteristics of many techniques have not been clearly established [1–3].

Spinal anaesthesia (SA) with lidocaine has been very popular in Finland among anaesthesiologists, and it has also been adopted for ambulatory surgery. During recent years, the use of lidocaine has declined because of the fear of the transient neurologic syndrome (TNS) [4]. It has been recommended that a lower dose i.e. 60 mg of lidocaine, can still be used as a spinal anaesthetic [5,6]. Previous studies [3,7,8] have shown that patients anaesthetized with 5% lidocaine have to stay in the

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recovery unit (RU) over three times as long as patients anaesthetized with general anaesthesia (GA). That makes SA with lidocaine less cost-effective than GA [3].

The aim of this study was to compare a low-concentration (2%) lidocaine SA and general anaesthesia with sevoflurane (SE) in terms of the total costs of anaesthesia in elective ambulatory knee arthroscopy. A further purpose was to evaluate the recovery characteristics of both anaesthesias (early recovery, recovery at 24 h and recovery during the first postoperative week).

2. Methods

2.1. Patients and methods of anaesthesia

A total of 60 patients (ASA I or ASA II, age 18–65 yr) scheduled for elective knee arthroscopy were randomized to receive SA with 2% lidocaine or general anaesthesia with SE. Informed consent was obtained from each participant and the protocol was approved by the Ethics Committee of the Medical Faculty, University of Oulu.

SA ($n = 30$) was administered with 60 mg of lidocaine (1.2 ml lidocaine 50 mg/ml in 7.5% glucose) diluted with 1.8 ml of 0.9% NaCl to get 3 ml of 2% lidocaine solution. The block was induced laterally via a 27 gauge sharp-point needle inserted through the lumbar III/IV space with the patient lying on the side to be operated.

SE ($n = 30$) was anaesthetized with SE after a propofol bolus of 2 mg/kg i.v. Alfentanil 1 mg i.v. was given and the patient was relaxed with a single bolus of mivacurine 0.3 mg/kg and intubated. After that, the anaesthesia was maintained with 8% SE inhalation with a fresh gas flow of 5 l/min for 3 min. After this, the SE inhalation was lowered and the fresh gas flow was reduced to 1 l/min for all patients. The goal was to reach 1 MAC before the skin incision and to continue at that level during the operation. The patients were normoventilated ($EtCO_2$ 4.5–5.5%) with 30% oxygen in air. Alfentanil (0.5 mg) was administered for pain when needed (systolic blood pressure or heart rate rise over 20% over the baseline value). Before the operation, 100 mg of ketoprofen diluted in 20 ml of 0.9% NaCl was given to both groups. Postoperatively, all patients received 100 mg of ketoprofen i.v. or p.o. three times in 24 h and 0.05 mg of fentanyl i.v. when necessary for postoperative pain.

2.2. Postoperative period

The protocol to study the postoperative period was the same as in our previous studies [7,8]. The time of extubation, the patient's ability to open his/her eyes when asked, the ability to obey orders ('squeeze my hand') and orientation ('name and date of birth') were recorded. In the RU, vital signs were monitored regularly (HR, BP, SaO_2, alertness) at intervals of 30 min after arrival until discharge from the RU. The following parameters were recorded: degree of pain as estimated by VAS (0–10), degree of alertness (on a scale 1 = fully awake; 2 = sleepy, mostly awake; 3 = sleeps, wakeable by words; 4 = sleeps, wakeable; 5 = in coma), postoperative nausea and vomiting (PONV) (on a scale 0 = no PONV; 1 = mild PONV, no medical treatment; 2 = PONV with medical treatment; 3 = serious PONV, medical treatment ineffective). If the patient vomited or the nausea lasted for over 15 min, the patient was given metoclopramide 10 mg i.v. If the patient felt nausea after the metoclopramide dose, 4 mg of ondancetrone was given i.v. Digit Symbol Substitution Test (DSST) [9] was administered preoperatively and 60 min after the end of anaesthesia to evaluate home readiness. The following criteria for discharge were applied in both groups: alert, stable vital signs, able to ambulate, able to take oral fluids, no nausea, pain controllable by oral medication and SA patients able to void [10].

2.3. Recovery profile (after 24 h and 1 week)

On the day following discharge, the patients were asked to ascertain their nausea on an 11-point rating scale (0 no nausea, 10 worst possible nausea). The intensity of pain was evaluated as an average during the 24-h period on an 11-point rating scale (0 no pain, 10 worst pain imaginable). The patients were also asked whether they had had headache (in a supine or upright position), difficulties in voiding or abnormal sleepiness after their discharge. The patients' overall satisfaction with their general condition during the first 24 h after surgery, the timing of discharge, the anaesthesia and the postoperative pain treatment as well as their satisfaction with the staff (surgeon, anaesthesiologist and nurses) were all evaluated on an 11-point rating scale. The patients were also asked if they would be willing to have a similar procedure done in the future in an ambulatory setting and if they would have the same type of anaesthesia. The patients were asked how many hours it took postoperatively to feel as alert as they normally feel in their daily life.

After one week, the patients were asked to complete a questionnaire. They were asked about the pain during the first week, the number of days for which they needed pain medication, or if the instructions for pain treatment were adequate or inadequate. The number of readmission was recorded. The patients were also asked about discomfort during the first week (nausea, headache, backache and leg pain) and about heir overall satisfaction during the first week (0 dissatisfied, 10 totally satisfied).

2.4. Cost accounting

The direct costs [11] of the materials needed for both types of anaesthesia and the work in the operation theatre (OT) and the RU were calculated. We used the same formula for cost accounting as in our previous study in Oulu University Hospital [12]. The fixed costs [11] that remain unchanged regardless of the number of operations were ignored. The time spent in the OT and in postoperative care in the RU before discharge was recorded. The surgical team in the OT consisted of two doctors and three nurses. During the postoperative period, one nurse was able to take care of three patients. The average OT and RU salary costs per minute were calculated by dividing the total salaries with the OT and RU working hours.

The price for liquid drugs was calculated as per quantity of each drug used in millilitre. The cost of SE was calculated from the formula [12]:

$$\text{Cost in Finnish marks (FIM)} = PFTMC/2412d,$$

where P is the vaporizer concentration (Fi%), F is the fresh gas flow (l/min), T is the duration of anaesthesia (min), M is molecular weight (g), C is the cost of anaesthetic (FIM/ml), d is density (g/l).

This method of calculation assumes that the gases are delivered from the machine at an atmospheric density corresponding to 21°C, which explains the factor 2412 in the formula. M, C and d are agent-specific and are defined for SE as $M = 200$ g, $C = 3.4$ FIM/ml and $d = 1.53$ g/l.

2.5. Statistical analysis

The summary statistics for continuous variables were expressed as mean and standard deviation. The comparison between the groups was done by Student's t-test or, in a non-normal situation, by the Mann–Whitney U-test. The χ^2 or Fisher's exact test was utilized for categorical variables. The longitudinal data was analysed by analysis of variance for repeated measurements, where the preoperative value was considered as a baseline value. Significance levels are reported for comparisons with $P < 0.05$. The analyses were performed using a standard statistical program (SPSS 9.0).

3. Results

The demographic data of the groups are shown in Table 1. The variance of age was considerable and there was a tendency for the SA patients to be older than the SE patients. The study groups were comparable with regard to sex and body mass index. The duration of operation was equal, and there were no differences in the quality of operation between the two groups. The patients had similar blood-free times in the legs to be operated in both groups. The groups were also comparable with regard to the ASA risk.

3.1. Early recovery

Haemodynamically the patients did well and were stable (Table 2). There was a slight drop of both systolic and diastolic blood pressure in the SE group 5 min after the start of the operation, but this was not statististically significant. Both groups oxidized equally during the operation and postoperatively.

The SE patients were more sedated than the SA patients 30 min ($P = 0.01$) and 60 min ($P = 0.012$) postoperatively. 90 and 120 min postoperatively, there were no differences between the groups. Most of the patients were alert at that time. DSST values were equal in both groups preoperatively and at 60 min postoperatively.

The level of pain was generally low. During the first 90 min postoperatively, the median VAS was 1 for SA and 2.5 for SE. At 120 min, the median VAS for both groups was 1. All of the SA patients and 86.7% of the SE patients had VAS < 4. The need for fentanyl in the RU was 20.0% in the SA and 36.7% in the SE group.

No patients within the SA group had nausea in the RU. Six SE patients (20%) had nausea (needed treatment) in the RU ($P = 0.024$). Five patients of the SE group needed ondancetrone after metoclopramide had been given.

The time to reach home readiness was 140.8 min (S.D. 52) in the SA group and 96.4 min (S.D. 62) in the SE group ($P = 0.02$). There were no differences in the total RU time (224.0 min (S.D. 67) for SA and 218.0 min (S.D. 59) for SE).

3.2. Twenty-four hour recovery profile

All the 60 patients were contacted by phone the next day. Four patients (13.3%) in the SE group and one (3.3%) in the SA group had nausea during the first 24 h postoperatively. The overall frequency of vomiting was 3/30 in the SE group and 0/30 in the SA group.

The level of pain was generally low in both groups. 96.7% of the SA patients and 80.0% of the SE patients

Table 1
Demographic characteristics[a]

	Spinal	Sevoflurane
Number of patients (n)	30	30
Men/women (%)	50/50	60/40
Age (yr)	44.9 (11.5)	35.7 (11.8)
BMI	26.9 (3.4)	25.6 (4.4)

[a] The values are presented as means and standard deviation.

Table 2
Haemodynamic parameters (mean)[a]

		BPsyst	S.D.	Min	Max	*P*	S.D.	Min	Max	SaO_2	S.D.	Min	Max
Before operation	SA	143	19	111	191	67	13	45	103				
	SE	139	20	85	165	67	9	52	85				
5 min after anaesthesia induction	SA	134	16	100	166	64	9	48	86				
	SE	109	9	85	128	61	9	46	79				
Mean during operation	SA	133	15	104	167	64	8	50	87	98	1	95	100
	SE	109	11	85	135	62	8	50	77	98	1	96	99
Immediately postoperatively	SA	137	16	100	174	63	12	48	103	98	2	94	100
	SE	130	15	92	156	75	12	56	101	98	2	93	100
30 min postoperatively	SA	131	17	96	162	61	10	45	81	98	2	93	100
	SE	128	14	105	151	69	13	44	91	99	1	95	100
60 min postoperatively	SA	130	16	107	164	63	9	48	78	98	1	93	100
	SE	131	15	107	165	66	13	41	95	99	1	96	100
90 min postoperatively	SA	132	16	100	158	64	9	45	82	98	1	95	99
	SE	130	14	105	155	63	11	42	88	98	1	94	100
120 min postoperatively	SA	133	15	114	165	65	10	45	83	98	2	93	99
	SE	131	14	100	170	66	12	48	100	98	1	95	100

[a] Bpsyst – systolic blood pressure in mmHg, *P* – pulse beat/min, SaO_2 – oxygen saturation%.

had VAS < 4. Six patients (20.0%) in the SA group had postoperative headache, and two of them also had headache in the supine position. There were no headaches in the SE group ($P = 0.024$). The incidence of backache was 6/30 in the SA and 3/30 in the SE group. The frequencies of numbness in the lower extremities (2/30 in SA and 3/30 in SE) and pain in the thigh (3/30 in SA and 4/30 in SE) or buttock (1/30 in SA and 1/30 in SE) were very low.

The patients were very satisfied during the first 24 h. Everybody would have liked to have a similar operation done on an ambulatory basis. 93.3% would have liked to choose the same kind of anaesthesia.

3.3. Recovery during the first week

Fifty-six patients (93.3%) returned the questionnaire. 4.3% felt severe pain and the mean need for analgesics was 3.3 days. All of those who felt severe pain belonged to the SE group. 96.4% were satisfied with the pain treatment instructions. There was one readmission because of pain and swelling of the operated knee. Four SA patients had symptoms of postspinal headache (13.3%), but none of them needed a blood patch. One SE patient called the doctor about inadequate pain treatment. Three SA patients and one SE patient had pain in the contralateral leg. One SA patient and three SE patients had back pain during the first week.

The level of satisfaction was high: 91.7% felt that they were satisfied with the first postoperative week.

3.4. Costs

The costs of anaesthetic materials and RU care (material and personnel) are shown in Table 3.

4. Discussion

This study showed that it takes a significantly longer time for spinal patients to reach home readiness than SE patients. This means that SA patients need RU services for almost 45 min longer than patients given general anaesthesia with SE. In this study, we tried to reduce the amount of lidocaine to give more exactly defined anaesthesia, hoping to cut down the RU time. Although the lidocaine dose was small, but still adequate to give satisfactory anaesthesia, the effect on reducing RU time was minimal compared to our previous studies [7]. The total duration of stay in the RU in both groups (mean 221 min) was long compared to the home readiness time. The most common reason for the long stay in the RU was that the patient had to wait to be escorted from the hospital. One reason for the long RU stay may be the habit of keeping the patients in the RU for some hours to play it safe, although home readiness has been achieved.

SA is cheaper than SE, but the main cost-saving effect of SE is that SE requires a significantly shorter postoperative period, and more patients per day can

Table 3
Total anaesthetic material costs in OT and anaesthetic material and personal costs in RU

	Anaesthesia	Mean (FIM)	S.D.
Until home readiness achieved	SA	160.7	23.0
	SE	171.0	31.1
Until total discharged from RU	SA	197.2*	29.5
	SE	224.4*	29.6

* $P = 0.001$.

therefore be operated on. In previous studies, the costs of anaesthetic medication were estimated to account for less than 10% of the overall costs, while the salaries of the staff accounted for more than 85% of the total costs of anaesthesia [13]. While staff costs are difficult to reduce, overall savings may be achieved by increasing the number of cases operated per day. The cost of special anaesthetic drugs may then not be so important [14].

Some patient in the SA group had symptoms suggestive of TNS, but the number of patients was far too low to warrant any conclusion. On the other hand, the SE group had similar symptoms in the lower extremities as the SA group. One reason for this might be the patient's position during the operation and the blood-free limb. The incidence of postspinal headache was high, although none of the patients needed blood patching. The possibility to get postspinal headache and the consequent absences from work must be taken into account when calculating the total costs of different methods of anaesthesia. This aspect was not considered here.

There was a slight tendency for SE patients to have more pain than SA patients during the first postoperative week. One reason for this might be the pre-emptive analgesia caused by SA. Although the patients were generally satisfied with the postoperative pain instructions and pain management, there were too many patients in the SE group who felt severe pain. Special attention should be paid to those ambulatory patients who have had GA with short-acting opioids.

Sedation is not a problem with these patients. Nausea was moderate in the SE group, because five patients needed ondancetrone after metoclopramide had been given. Ondancetrone is an expensive drug compared to metoclopramide, which must be kept in mind when calculating the total costs.

We conclude that general anaesthesia with SE is more cost-effective than SA with 2% lidocaine in ambulatory knee surgery if a short RU time is needed. The patients are haemodynamically stable postoperatively, and the need to monitor vital parameters in the RU is short. SE anaesthesia is therefore suitable for busy units where the patient turnover is high. SA with 2% lidocaine is more cost-effective than SE then when the time spent in the RU is not important. In this series we were unable to show any connection between 2% lidocaine SA and TNS. Postspinal headache is an important side effect of SA. Adequate postoperative pain treatment and the possibility of nausea must be kept in mind when anesthetizing patients with SE.

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Outpatient laparoscopic cholecystectomy. A prospective study with 100 consecutive patients

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Abstract

One hundred patients with cholelithiasis were included in a prospective consecutive follow-up study to evaluate laparoscopic cholecystectomy in a day surgical setting. The median operating time was 70 min. In 96% of the patients, it was possible to perform peroperative cholangiography. The median time off work was 7 days and the median time to full recovery was 14 days. Five patients were admitted due to weakness/nausea. Six patients were admitted due to conversion to open surgery or choledocholithiasis. Eighty-nine patients were treated in ambulatory surgery. We conclude that laparoscopic outpatient cholecystectomy can be performed safely with a low unplanned admission rate.

Keywords: Laparoscopic; Cholecystectomy; Outpatient; Ambulatory surgery; Admission; Complications; Recovery

1. Introduction

Outpatient or day case laparoscopic cholecystectomy has been undertaken in several centres in the world and is reported in series both from North America [1–3] and Europe [4,5], but has not yet been introduced as a routine in Scandinavia. It has been shown to be less expensive than inpatient surgery [1,6] and it can be performed with high patient satisfaction [5,7,8].

In our department we have a tradition of day surgery in herniorraphy, proctology, etc. Laparoscopic cholecystectomy has been our standard treatment for cholelithiasis but the patients have traditionally been admitted routinely for at least 1 day postoperatively. As a preparation for outpatient surgery we made a prospective evaluation of a series of 48 admitted laparoscopic cholecystectomies in 1996. The patients were treated as if they were outpatients but they were all admitted. Forty-two patients stayed one night and six patients stayed two nights due to pain. We found that no major complications occurred after 6 h postoperatively. According to that experience we designed a protocol for outpatient laparoscopic cholecystectomies. In our department the mean hospital stay after a planned inpatient laparoscopic cholecystectomy is 1.5 days (36 h).

2. Materials and methods

From January 1998 to April 1999, 100 consecutive patients with cholelithiasis documented by ultrasonography who were scheduled for planned outpatient laparoscopic cholecystectomy were included in the study and were prospectively registered in a protocol. The mean age was 41 yr (18–61) and mean body mass index 27 (17–39). Another 255 patients underwent laparoscopic cholecystectomy as inpatients in our department during the same period.

To be eligible to participate in the study the patients should be able to communicate without interpretation and have a responsible adult at home. They should not have had a history of choledocholithiasis or pancreatitis

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and the liver enzymes and amylase preoperatively should be normal. On ultrasonography there should not be a dilatation of the bile ducts. Only American Society of Anesthesidogists Physical Status Classification System I–II patients were included.

Thorough written and oral information of the procedure was given to all patients. One week ahead of the operation the patients were seen at the day surgical clinic by the surgeon, the anaesthetist and a day surgical nurse on a short outpatient visit.

Preoperatively, 1 g Paracetamol suppository and 8 mg Ondansetron i.v. was given as the only premedication. All patients were intubated and received standardised i.v. anaesthesia with Propofol/Alfentanil/Rocuronium.

A standard four trocar laparoscopic cholecystectomy with as low intra-abdominal pressure as possible was performed by experienced laparoscopic surgeons. Peroperative cholangiography was performed as a routine. By the end of the procedure all patients received 75 mg Diclofenac i.m. and 100 mg Tramadol i.v. Bupivacaine 5 mg/ml was given in the wound edges.

Postoperative pain was evaluated with visual analogue scale (VAS, 0–10) after 2 and 4 h in the clinic, by telephone in the evening and on the following morning. Tablets of Diclofenac, Tramadol and Paracetamol for 24 h of treatment were sent home with the patients. They were encouraged to take the prescribed medication. They also received three suppositories of Ketobemidon to use in case of severe pain. A relative picked the patient up in the hospital and stayed with the patient at home until the next morning.

The nurse who was responsible for the postoperative period at the day surgical clinic was on-call via a cellular phone during the first evening and night. She called the patients in the evening and on the following morning. If she needed advice, she called the surgeon on-call.

Follow-up was also done via questionnaire, which was given to the patients when discharged. Eighty patients returned the questionnaire. Ten patients were reached by telephone and 10 were lost to follow-up. These patients were checked against the computerised patient booking system in the county. No one had been visiting a hospital or doctor's office in the county due to postoperative problems. According to the answers the patients were seen selectively at the clinic.

3. Results

Thirty patients had chronic cholecystitis and five acute cholecystitis. The median intra-abdominal pressure was 9 mmHg (8–14). Peroperative cholangiography was performed in 96 patients. The median operating time was 70 min.

Median VAS regarding pain was 2 or lower during the first postoperative 24 h (Fig. 1). Sixty patients needed extra analgesics during the first postoperative hours and four in the first postoperative evening. The next morning, nine patients needed extra analgesics.

The nurse on-call did not receive any extra phone calls from the patients but she called everyone in the evening and on the following morning. There was no need to consult a surgeon during the first evening or on the postoperative morning.

The mean postoperative stay at the day surgical unit was 6 h for 89 patients. Eleven patients were admitted (Table 1). Three of those were converted to open cholecystectomy because of technical difficulties in pa-

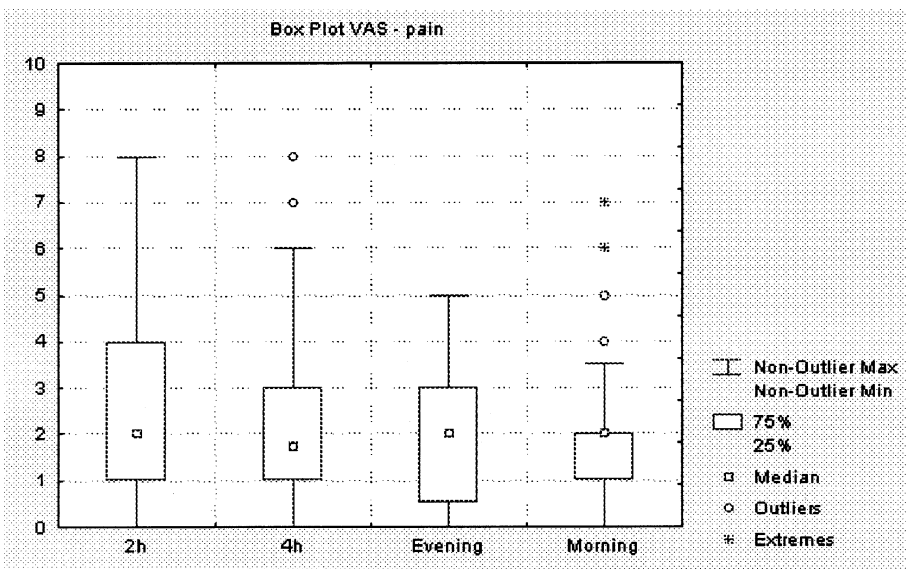

Fig. 1. Postoperative pain (VAS)

Table 1
Admitted Patients

Reasons for admittance	Number	Hospital stay (days; mean)
Chronic cholecystitis (conversion to open surgery)	4	2.2
Choledocholithiasis – ERCP postop.	2	4
Weakness/nausea	4	1
Pain	1	1
Total	11	

tients with severe chronic cholecystitis. One was converted to open choledocholithectomy because of severe chronic cholecystitis with the neck of the gall bladder adherent to the Common Bile Duct and multiple choledocholithiasis. Two patients had choledocholithiasis and had an Endoscopic Retrograde Cholangio Pancreaticography done postoperatively. Four patients were admitted due to weakness/nausea and one due to pain. One patient was admitted 30 h after surgery because of nausea and weakness. She was discharged the next morning.

No major complications occurred. Eight minor complications were recorded: two wound infections in trocar sites, two cases of urinary retention in women who needed a urinary catheter for 2 days, one trocar site hernia and three patients had nausea and could not take anything orally on the first postoperative morning. The latter returned to the day surgical department and were treated with antiemetic drugs and i.v. fluids and returned home after a few hours with no further problems. The median time off work was 7 days (0–46) and the median time to full recovery was 14 days (0–60).

4. Discussion

With reductions in real terms healthcare funding and hospital beds, a transference from inpatient surgery to outpatient surgery is needed if hospitals are to be able to provide care for all patients and diagnoses [6]. A large group of patients that could be transferred from inpatient to outpatient surgery are patients with cholelithiasis. If outpatient laparoscopic cholecystectomy could be done safely with a low admittance rate it would reduce cost [1–3] and it could be performed with a high patient satisfaction [4,5].

Postoperative pain needs particular attention in a day surgery setting. The pain after laparoscopy can be reduced by keeping the intra-abdominal pressure low, injection of local anaesthesia in the port sites, by evacuation of all CO_2, and by thorough patient information [9–11]. There is controversy as to whether i.p. administration of local analgesics should be done. Some authors have shown effect [12–14] while others have not shown any significant effect [15,16] in pain reduction after i.p. administration of Bupivacaine. In our study we used low intra-abdominal pressure, local Bupivacaine infiltration in the port sites and thorough patient information with a close follow-up in an effort to reduce the postoperative pain.

Residual CBD stones is one of the reasons for readmission after outpatient laparoscopic cholecystectomy [3]. By the routine use of perioperative cholangiography (96%) we did not have any case of residual CBD stones.

In 1998 the mean postoperative hospital stay for admitted patients after laparoscopic cholecystectomy was 1.5 days in our department. Eighty-nine of the 100 patients planned for ambulatory surgery could return home as planned, thereby saving an estimated 130 days of hospital stay.

Our results indicate that it is possible to perform laparoscopic cholecystectomy as an ambulatory surgical procedure with a low morbidity and a low unplanned admission rate.

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Anaesthetic drug costs in a district general hospital day surgery unit

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Abstract

Propofol infusions for the induction and maintenance of anaesthesia are associated with many advantages. In some units their cost is thought to be prohibitive and limits their use. We have analysed the drug costs within a Day Surgery Unit over a 4-year period in order to quantify the cost of the increased use of these infusions. In our unit this has not resulted in increased anaesthetic drug costs. We therefore advocate the continued use and development of these techniques which have been shown to have many advantages both to patients and to the smooth and efficient running of theatre units.

Keywords: Drug costs; TIVA; Day surgery

1. Introduction

Recent advances within anaesthesia have included the introduction of newer anaesthetic agents and methods of delivery. In particular, the use of propofol infusions for the induction and maintenance of anaesthesia, and remifentanil infusions for intra-operative analgesia and reduction in propofol requirements. These agents are associated with a low incidence of nausea and vomiting [1–4] decreased antiemetic requirements, [2] rapid ability to alter depth of anaesthesia which is not linked to ventilation, rapid emergence and hence short recovery time [3,4] earlier discharge from day-area units and decreased admission rates [2] earlier return to work and hence decreased sick leave requirement with its associated cost [3,5]. However despite convincing arguments to the contrary [6–8] in many units the cost of these drugs is thought to be prohibitive and hence limits their use. Previous work has shown that the cost of anaesthetic drugs contributes $<4\%$ of the total cost of a day surgery procedure [6] and that there is little variability in drug costs between anaesthetists using total intravenous anaesthesia and those using volatile techniques [7]. When the costs of consumables and theatre staff are included, those patients receiving a cheaper anaesthetic when measured in terms of drug costs, in fact occurred a higher total cost [6]. The same author has also shown that the majority of anaesthetic drug cost occurs at induction and that it costs relatively little to maintain anaesthesia even when using propofol infusions [9].

We have analysed the drug costs within the Day Surgery Unit of a District General Hospital over a 4-year period during which the use of these drugs was increasing, in order to quantify the cost of this increase. The unit is self contained, treats no inpatients and is able to identify its own expenditure and workload.

2. Methods

A list of the top one hundred drugs (total cost) used in the unit within a 4-year time period (1996–2000) was obtained from the hospital pharmacy computer system. Any drugs not used by anaesthetists were excluded. The cost of each drug for each year being studied was recorded. Information about total numbers of cases performed in this time period, length of cases, how

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Table 1
Summary of drug costs during the period studied

	1996/97	1997/98	1998/99	1999/00
Total anaesthetic drug costs	£56 894	£64 654	£73 249	£74 652
GA cases	4492	4933	4916	4843
Anaesthetic drug costs/GA	£12.67	£13.11	£14.90	£15.41
TIVA (% of GA)	2587 (58%)	3063 (62%)	3022 (61%)	3232 (67%)
Hours/Case	0.47	0.47	0.48	0.52
Total hours GA	1805	1870.4	2092	2228.5
Anaesthetic drug costs/h GA	£31.52	£34.57	£35.02	£33.50

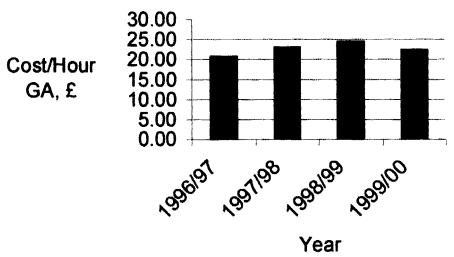

Fig. 1. Cost of anaesthetic agents per hour of general anaesthesia time.

many of these were under general anaesthesia and, of these, what percentage were anaesthetised using total intravenous anaesthesia was retrieved from the unit database. In addition, we were provided with data for total cost per case and hours of theatre activity for the unit for each year being studied. Drug costs per case and per hour of theatre time for general anaesthesia cases were then calculated.

3. Results

The results of our study are summarised in Table 1.

Within the time period studied total theatre activity in terms of cases performed increased by 22.7%. Cases performed using Total Intravenous Anaesthesia (TIVA) increased by 25%. This was associated with an increased cost of general anaesthetic drugs per general anaesthesia case, but this was only an increase of 17.8%. It will be noted that during this time period the time per case has increased. This is due to a change in case mix within the day surgery unit resulting in longer cases being performed. During this time the termination of pregnancy service was transferred elsewhere, resulting in the removal of these short procedures from our lists. They have been replaced by longer procedures. In common with other units, the scope of day surgery is being constantly extended resulting in longer and more complex procedures now being carried out in day surgery units. When account is taken of procedure time within our calculations, it can be seen that the cost of anaesthetic drugs when measured per hour of theatre time has actually reduced over this period.

More detailed analysis of drug costs showed that, as expected, the majority of the drug costs of anaesthesia are due to the cost of intravenous and volatile anaesthetic agents. However, the cost of this group of agents has increased only marginally. (Fig. 1).

When looking at the costs of other anaesthetic drugs over the period studied, Fig. 2, it can be seen that most have not varied greatly. The reduction in cost of muscle relaxants reflects both decreased cost and decreased use within our unit. The reduction in cost of anti-emetic medication, which is not used routinely, is partly due to switching brands of 5-HT_3 antagonists. Introduction of remifentanil in 1998/1999 was associated with a slight increase in opiate costs. The increase in cost of simple analgesic agents is mainly due to the use of diclofenac eye drops which occurred when we incorporated ophthalmic surgery into our unit.

4. Discussion

We have shown that the increasing use of agents often classed as expensive, has not resulted in increased

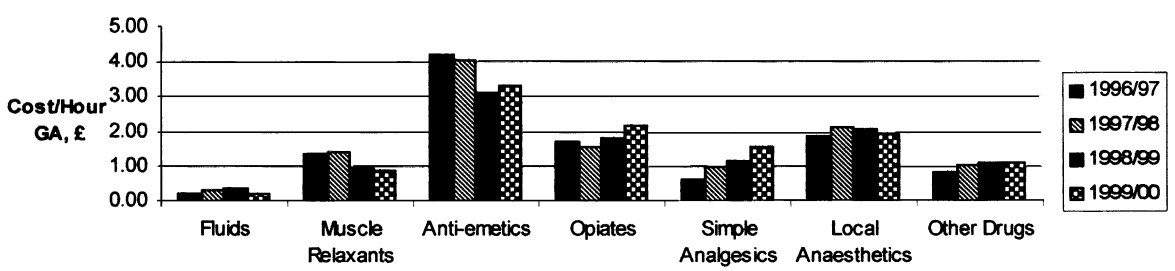

Fig. 2. Costs per hour of general anaesthesia of drugs used during anaesthesia.

anaesthetic drug costs when measured per hour of general anaesthesia. These drugs constitute a small percentage of the total cost of a day surgery procedure within our unit. It would therefore appear that the most effective way to reduce the actual cost per case would be to achieve more cases with the same overhead and staff costs. Using drugs, which aid faster, complication free recovery may contribute to an increased throughput of cases. Previous work has shown that use of TIVA is associated with decreased anaesthetic time and increased throughput of cases [6]. Other factors often not considered when discussing drug costs are the cost to the patient, their employer and the state if their return to work is delayed. It has been shown that patients return to work earlier following anaesthesia with propofol infusions [3]. Our work has shown that within our day surgery unit increased use of total intravenous anaesthesia is not associated with increased drug costs. We would therefore advocate the continued use and development of these techniques which have been shown to have many advantages both to the patients and to the smooth and efficient running of theatre units.

Acknowledgements

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Is pain prophylaxis in minor gynaecological surgery of clinical value? a double-blind placebo controlled study of paracetamol 1 g versus lornoxicam 8 mg given orally

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Abstract

Methods: In a prospective randomised placebo controlled double-blind study 210 ASA I–II women scheduled for elective termination of pregnancy received 1 g paracetamol, 8 mg lornoxicam or placebo orally 60 min before anaesthesia which was standardised with propofol, fentanyl and oxygen in nitrous oxide 1:2. Postoperative pain was assessed by VAS-score at 30 and 60 min after end of surgery and at discharge as primary endpoints. Need for rescue medication and time to discharge were secondary endpoints. *Results:* All patients had an uncomplicated course. Overall pain intensity was low, however, the patients pretreated with lornoxicam had significantly less pain after surgery, no difference could however, be seen in need for rescue medication or time to discharge between the three groups. *Conclusion:* General pain prophylaxis may be argued in minor gynaecological surgical procedures where postoperative pain is of low intensity. If general prophylaxis is to be given in minor gynaecological surgery, a non steroidal anti-inflammatory (NSAID) such as lornoxicam, seems more efficacious as compared to a standard dose of 1 g paracetamol.

Keywords: Analgesics; Paracetamol; Lornoxicam; Ambulatory surgery; Postoperative pain

1. Introduction

Postoperative pain is one of major complaints after ambulatory surgery [1]. Paracetamol is widely used for prophylactic postoperative pain relief because it is well tolerated and not expensive. In previous studies we found prophylactic paracetamol 1 g given rectally at the end of minor gynaecological surgery not efficacious in reducing postoperative pain, however, prophylactic non steroidal anti-inflammatory therapy (NSAID) with ketoralac or diclofenac given parenteral just before surgery decreased pain and the need for postoperative analgesics [2,3]. In the present study we wanted to evaluate the effects of prophylactic paracetamol 1 g or lornoxicam 8 mg given orally 1 h prior to anaesthesia on postoperative pain. Lornoxicam is a new non steroidal anti-inflammatory drug, non selective with a tolerability profile similar to diclofenac but superior to indometacin [4,5].

2. Methods

The Ethics Committee of the Karolinska Institute approved the study and the patients were included after informed consent. Two hundred and ten ASA I–II women scheduled for elective termination of pregnancy under general anaesthesia were randomly assigned to one of three groups: paracetamol 1 g, lornoxicam 8 mg or placebo given orally 60 min before anaesthesia in a prospective, double-blind randomised fashion. Randomisation was done by an envelope technique by a nurse not otherwise involved in the study while another nurse, also not otherwise involved in the study, gave the pretreatment. No other premedication was given.

Anaesthesia was induced with 0.1 mg fentanyl and 2–2.5 mg/kg propofol and maintained with oxygen in

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nitrous oxide 1:2 and additional small doses (20–30 mg) of propofol when needed. The patients breathed spontaneously and ventilation was assisted only when necessary.

Patients received uterine cervical pretreatment with laminaria tab, at the discretion of the gynaecologist. Cervical dilatation and vacuum aspiration was done in accordance with routines at the gynaecological department All patients were given 5 U oxytocin i.v. at the end of the surgery. After surgery all patients were transferred to the recovery unit and observed by the nurses on duty who as well as the patients were blinded to the randomisation.

The patients were asked to quantify their postoperative pain on a 100 mm baseline visual analogue scale (VAS) where 0 = no pain and 100 = unbearable pain. This was done 30 and 60 min after surgery and at discharge. Patients with a VAS pain score of >45 or who requested an analgesic were given paracetamol 1 g rectally. If this was insufficient to alleviate pain, morphine 2–3 mg at the time was administered intravenously. Persistent nausea or vomiting was treated with 10 mg metoclopramide intravenously. Patients were defined as street fit when awake, oriented and able to drink and eat and to void and walk unassisted without pain or nausea. For statistical evaluation pain less than or equal to 30 was transformed to no pain, pain >30 at any time during the observation period was transformed to pain.

3. Statistics

All values are given as mean and standard deviation (SD) unless stated otherwise. The groups were compared with analysis of variance (ANOVA) for continuous data, to identify differences between the three groups Scheffe F-test was used. The χ^2-test was used for the analysis of class data. A P value of less than 0.05 was considered statistically significant. A sample size of 70 for each group was determined adequate by power analysis prior to the study to create a power of 80% at an α of 0.05. The power analysis assumed that: (a) the incidence of patients needing postoperative analgesics in the control group would be 25–30%; (b) a reduction of approximately 50% in the incidence of patients needing analgesics would be considered a clinically valuable treatment.

4. Results

Demographic data and preoperative observations are presented in Table 1. The groups were comparable in terms of age and weight. There were more first pregnancies and number of females without previous childbirth in the group receiving lornoxicam and therefore as well more patients given cervical pretreatment in that group. All procedures were uneventful and no complications were noted.

Overall pain intensity was low and pain decreased over time in all three groups, VAS-evaluation of pain is shown in Fig. 1. There were significantly fewer patients that experienced pain in the lornoxicam group $P<0.016$. No differences in need for rescue analgesics or time to discharge were noticed (Table 2). The uneven distribution of females with no prior childbirth did not influence the frequency of patients experience postoperative pain.

5. Discussion

There are three major findings in the present study. First; overall quite low postoperative pain intensity. Second; paracetamol 1 given orally was not more effective than placebo in this patient population. Third; lornoxicam 8 mg orally did have a significant pain reducing effect. Taking the overall low pain intensity into perspective one may argue, however, about the clinical value of this effect and to question whether pain prophylaxis have a place in such procedures.

Table 1
Patients characteristics and preoperative observations

	Paracetamol ($n=70$)	Lornoxicam ($n=70$)	Placebo ($n=70$)
Age (mean ± SD)	29 ± 6	29 ± 6	29 ± 6
Weight (kg) (mean ± SD)	62.8 ± 9.3	63.2 ± 8.4	62.0 ± 7.8
No prior childbirth (no. of patients)	33	42[a]	32
Gestational week (mean ± SD)	8.9 ± 1.6	8.6 ± 1.2	9.0 ± 1.4
Laminaria pretreatment (no. of patients)	32	43	35
Oral pretreatement (min) (mean ± SD)	65.7 ± 31.5	61.3 ± 32.3	63.7 ± 30.2
Propofol (mg/kg) (mean ± SD)	3.5 ± 0.8	3.5 ± 0.7	3.5 ± 0.7
Hegar 9/11 (no. of patients)	56/14	60/10	52/18
Spiral (no. of patients)	19	13	19

[a] $P<0.05$ χ^2-test lornoxicam versus placebo or paracetamol.

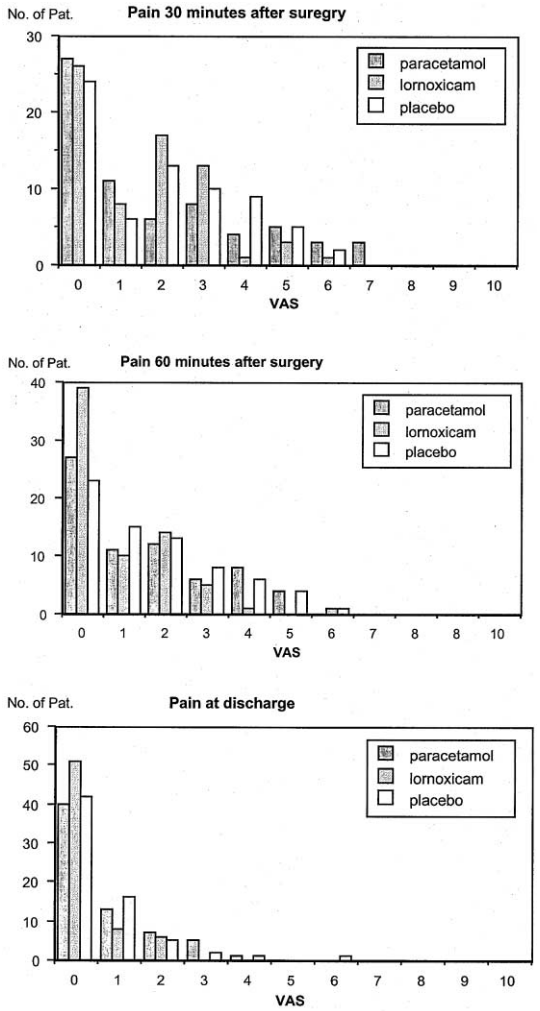

Fig. 1. Pain after surgery: (a) 30 min; (b) 60 min; (c) at discharge.

Pain and emesis are the most common complaints after minor out patient surgery and is also known to be one of most important factors for delayed discharge and to increase unanticipated hospital admission [1,6]. Minimising postoperative pain is an important part of optimising recovery process, however, it is also of great interest to evaluate treatments, to show that they are efficacious and cost effective. The knowledge about pain mechanisms and of the pharmacology for pain treatment has grown tremendously during recent years [7]. Meta-analytic comparisons of oral pain therapy have shown NSAIDs as well as paracetamol to be most effective in reducing acute pain [8]. In a previous study we were unable to show any beneficial effects from 1 g paracetamol given rectally at the end of surgery [2]. Oral administration is easier and paracetamol is also better absorbed when administered orally as compared to rectally [9]. In the present study we could however not see any major impact of pretreatment with paracetamol 1 g given orally approximately 1 h before surgery. This is a finding in agreement with Cade and Ashley also studying patients scheduled for termination of pregnancy [10]. Bjune et al. studying postcaesarean pain, which most certainly has a more complex pathophysiology than pain after termination of pregnancy, found paracetamol effective only in severe pain but not in moderate pain [11].

The bioavailability of paracetamol, given orally, has been shown to be higher and more stable than with rectal administration [12,13]. Our patients, in the paracetamol group, received an average of 16 mg/kg. This is a dose that has been shown ineffective in some studies where doses of more than 20 mg/kg have been shown effective [14,15]. Maybe the frequently used dose of 1 g orally, is insufficient to change the postoperative course, especially in mild to moderate baseline pain.

The surgical procedure may have an impact. In a study by Beaver and McMillan on postpartum pain paracetamol seemed less effective in uterine cramp pain than in pain associated with episiotomy [16]. Pain induced by termination of pregnancy is probably related to prostaglandin release, producing painful contractions of myosalpinx and the myometrium. In pain associated with contractions of the uterus NSAID's has been shown to be more effective than paracetamol [17].

We have, in a previous study, shown a positive effect from pretreatment with intramuscular diclofenac and ketorolac [3]. In a recent meta-analytic comparison Tramer et al. have shown that, concerning NSAID's, the oral route is comparable to intravenous injections and as well preferable in pain conditions other than renal [18]. Pretreatment with oral lornoxicam reduced postoperative pain, however, the clinical relevance of this may be argued in a patient population with low pain ratings. Furthermore, we could find no difference

Table 2
Postoperative observations

	Paracetamol ($n = 70$)	Lornoxicam ($n = 70$)	Placebo ($n = 70$)
No pain (no. of patients)	47	60[a]	47
Pain (no. of patients)	23	10	23
Analgesics postoperative (no. of patients)	19	12	18
Antiemetics (no. of patients)	7	2	4
Time to discharge (min) (mean $\pm$ SD)	99 ± 30	91 ± 20	93 ± 27

[a] $P < 0.016$ χ^2-test lornoxicam versus placebo.

in need for rescue analgesia or time to discharge. The overall low pain intensity may be explained by the use of fentanyl as preoperative opioid. We have in previous studies looked at the effects of the anaesthetic technique on postoperative pain after termination of pregnancy [19,20]. A combination of propofol with an opioid did decrease postoperative pain [19].

Our results should be put into the perspective of the over all low pain intensity during the postoperative period. That makes the assessment of the analgesic drugs more difficult because it is harder to point out differences between groups with low pain intensity [11]. Still, the present study clearly shows that pain intensity after minor gynaecological surgery is overall low, thus general use of analgesics given prophylactically should be weighed against the potential risks and costs. If a prophylaxis is to be given the routine use of preoperative paracetamol 1 g given orally is not effective while preoperative administration of an NSAID orally seems to have a significant impact on pain perception.

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The effects of lowering fresh gas flow during sevoflurane anaesthesia: a clinical study in patients having elective knee arthroscopy

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Abstract

The potential for minimising anaesthetic gas consumption with a circle absorber system is related to fresh gas flow. This study measured the actual sevoflurane consumption during elective arthroscopy of the knee in 75 ASA I–II patients randomised to three fresh gas flow rates (6, 3, and 1.5 l/min) using sevoflurane and O_2:N_2O (1:2) after intravenous induction with fentanyl and propofol. A circle absorber system was used with a laryngeal mask airway. Anaesthetic duration, discharge time and postoperative pain did not differ between groups. Sevoflurane consumption was more than doubled with each doubling of fresh gas flow (0.07 ± 0.03; 0.16 ± 0.05; 0.41 ± 0.12 ml sevoflurane/min; for gas flow 1.5, 3, 6 l/min; $P < 0.01$). The hourly sevoflurane related cost decreased from 15.5 to 2.8 US$ when reducing the fresh gas flow from 6 to 1.5 l/min. Decreasing the fresh gas flow from 6 to 1.5 l/min provides good anaesthetic depth with effective reduction in anaesthetic consumption, cost and environmental burden.

Keywords: Volatile anaesthetics; Sevoflurane; Fresh gas flow; Health economy

1. Introduction

Day surgery has evolved under the continuing pressure of achieving good anaesthesia, no awareness, short emergence times and cost effectiveness. Lowered consumption of anaesthetic gases, in addition to reducing costs, is also of environmental concern both locally for personnel in the operating room and globally.

We have in a series of earlier studies looked at the consumption of anaesthetics associated with various standardised anaesthetic techniques used in day surgical procedures and found both clinical differences in emergence time and considerable differences in direct drug related costs [1–3]. The present study investigated the consumption of sevoflurane and clinical outcome when using three different rates of gas flow.

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2. Methods

Seventy-five ASA I–II patients scheduled for elective knee arthroscopy were studied after approval from the hospital ethical committee and informed consent. Cyclozine 50 mg was given orally prior to anaesthesia; no other premedication was given. Routine monitoring included ECG, pulsoximetry, heart rate (HR) and non-invasive systemic blood pressure.

2.1. Induction study protocol

Patients were preoxygenated ($FiO_2 = 0.7$) via a face-mask 3 min prior to induction with bolus doses of propofol and standardised dose of 0.1 mg fentanyl. Muscle relaxants were not used and a laryngeal mask airway was easily introduced in all patients and then connected to a circle absorber system (Q-2 system, Anmedic AB, Valentuna, Sweden). All patients received intra-articular lidocaine (5 mg/ml) with adrenaline and fentanyl (0.05 mg) at the end of surgery.

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Table 1
Patient characteristics and preoperative observations for three levels of fresh gas flow in patients anaesthetised with sevoflurane for arthroscopy of the knee[a]

	Group A (0.5:1 l/min)	Group B (1:2 l/min)	Group C (2:4 l/min)
Age (years)	53 ± 14	47 ± 10	46 ± 12 ns
Weight (kg)	77 ± 11	75 ± 12	81 ± 19 ns
Duration of anaesthesia (min)	24 ± 7	24 ± 12	22 ± 8 ns
Duration of surgery (min)	20 ± 7	17 ± 8	18 ± 7 ns
Sevoflurane consumed (g)	2.6 ± 1.0	5.7 ± 3.6	13.9 ± 5.4[b]
Sevoflurane consumed (ml/min) [range]	0.07 ± 0.03 [0.03–0.16]	0.16 ± 0.05 [0.04–0.24]	0.41 ± 0.12[b] [0.24–0.61]

[a] $N = 25$ in each group; mean ± S.D. ANOVA: ns, no significance.
[b] Indicates $P < 0.001$ between the three groups.

Maintenance anaesthesia consisted of an oxygen:nitrous oxide mixture (1:2) and sevoflurane. Patients were randomised (Table 1) to three different fresh gas flow rates from the start and maintained throughout the procedure. Group C received 6 l/min, Group B received 3 l/min, and Group A received 1.5 l/min fresh gas flow.[1] Sevoflurane concentration was varied according to clinical judgement. The anaesthetist was not blinded to gas flow. At the end of surgery, nitrous oxide and sevoflurane were discontinued and a fresh gas flow of 6 l/min of oxygen was used until removal of the laryngeal mask airway.

2.2. Gas consumption determination

The sevoflurane vaporiser was filled and weighed (scale type) prior to induction. The vaporiser was disconnected and re-weighed when anaesthesia was complete. Sevoflurane consumption per min was calculated individually for each patient.

2.3. Postoperative care

All patients received lornoxicam 8 mg and paracetamol 2 g orally as postoperative analgesia. Pain was assessed at 30 and 60 min after emergence according to the visual analogue scale (VAS). Criteria for discharge were standard hospital routines: ability to drink, ambulate, void and pain less than 3 on the VAS scale.

Cost for sevoflurane was taken from the Swedish pharmacopoeia, 1 581 SEK for 250 ml and the exchange rate 1 US$ = 9.6 SEK.

2.4. Statistics

All values are given as means and standard deviation unless otherwise stated. Assuming an alpha risk of 0.05, a beta risk of 0.20, and the sevoflurane consumption reduced by half by each reduction of the fresh gas flow, we calculated that 75 patients should be included in this study. Differences between groups, for weights before and after anaesthesia were studied by means of ANOVA, whenever appropriate, followed by Scheffe F-test. $P < 0.05$ was considered statistically significant.

3. Results

Patient data is shown in Table 1. The groups did not differ in age, weight, or duration of either surgery or anaesthesia. All surgery was uneventful, haemodynamics were well controlled in all patients and there were no clinical signs of inadequate anaesthesia nor was any awareness reported.

Pain was overall low and VAS at 30 and 60 min postoperatively did not vary with gas flow (Table 2). Emesis was only infrequently seen, and time to discharge as well did not differ between the groups.

The sevoflurane consumption more than doubled with each doubling of fresh gas flow rate. Huge individual differences were noticed in anaesthetic consumption and the range increased with increasing fresh gas flow (Table 2 and Fig. 1). The coefficient of variation for the sevoflurane consumption was 43, 31 and 29, respectively for the 1.5, 3 and 6 l/min group of patients.

The average cost associated with sevoflurane consumed during each procedure was totally 10, 22 and 54 SEK, respectively for the 1.5, 3 and 6 l/min fresh gas flow. The estimated cost per h being 5.5 times higher for the 6 compared with the 1.5 l/min patients (Table 2).

4. Discussion

This study has shown that by reducing fresh gas flow to low levels in a semi-closed ventilator system, equivalently good anaesthesia is provided but with a more than proportional decrease in the volatile anaesthetic. Our results are to some extent different from those of Weiskopf and Eger, who found that 'background flows'

[1] Under sevoflurane's labeling, a fresh gas flow rate as low as 1 l/m is permissible for short cases (2 MAC h or less).

Table 2
Postoperative observations and direct cost associated to sevoflurane consumed for three levels of fresh gas flow in patients anaesthetised for arthroscopy of the knee[a]

	Group A (0.5:1 l/min)	Group B (1:2 l/min)	Group C (2:4 l/min)
VAS 30′	1.3 ± 2.0	1.4 ± 2.2	1.4 ± 1.9 ns
VAS 60′	1.6 ± 2.3	1.2 ± 1.4	1.1 ± 1.4 ns
Rescue analgesia (no. of patients)	3	3	2 ns
PONV (no. of patients)	1	3	0 ns
Time to discharge (min)	61 ± 23	72 ± 23	68 ± 17 ns
Cost/h (sevo) SEK (US$)	27 (2.8)	57 (5.9)	149 (15.5)

[a] $N = 25$ in each group; mean $\pm$ S.D. ANOVA: ns, no significance.

from 1 to 2 and to 4.0 l/min changed desflurane consumption by only 68–82%. In that study, a fixed 1 MAC concentration was the end-point whereas in our study 'adequate anaesthesia' was the end-point used [4]. The sevoflurane concentration in the present study was adjusted according to clinical needs. Our results are, however, very similar to those of Pedersen et al. who looked at isoflurane consumption during clinical anaesthesia for longer in-hospital procedures [5].

In this study, each reduction by half of the fresh gas flow resulted in a somewhat greater reduction in total sevoflurane consumed. It is hard to give any absolute explanation for this finding. Our study is, as far as we know, the first investigating the actual sevoflurane consumption during clinical anaesthesia. One possible explanation could be that during the higher fresh gas flow, a somewhat deeper anaesthesia was established. The somewhat bigger individual variation of sevoflurane consumption in the higher fresh gas flow group may be an indication in that direction. The stability of the haemodynamics and equivalent anaesthesia times and time to discharge all suggest that the depth, and therefore quality, of anaesthesia in each group was more or less equivalent. An explanation in the same direction would be that the vaporiser is not entirely accurate at the lower fresh gas flows and therefore, a smaller quantity of sevoflurane than anticipated has been administered to the patients. The use of a more objective method for determination of anaesthetic depth, such as the BIS monitor or something similar may have been of value.

Cost effectiveness, particularly crucial in rapid day surgery, is a complex equation of many factors, of which drug cost is only one [6]. Induction/preparation time, duration of anaesthesia/surgery, time to discharge, factors influencing personnel related costs are at least as important [7]. We found a cost saving of a multiple of 2–5 by decreasing the fresh gas flow, however, put into the financial perspective the saving per patient was not more than 2–3 US$. Even if accounting for only a very minor part of the total cost associated with each surgical procedure, drug-related cost reductions should be seen in the perspective of the multiple of procedures performed. Even if cost saving may be rather small for an individual patient, the savings should be put into the perspective of number of procedures carried out. Patient-related factors such as postoperative pain and satisfaction should of course not be neglected or overruled by cost constraints. We could, however, see no differences between the three fresh gas flows studied regarding clinical outcome. The number of patients is of course low for the determination of more delicate differences in the clinical course. Whether our findings are applicable to longer procedures is hard to tell. Saturation of the patient and the circle system during the initial phase may make a difference.

Environmental concerns for local and global effects of both halogenated anaesthetic gases and nitrous oxide are in this case congruent with cost considerations. Even with effective exhaust systems, leakage of anaesthetic gases locally into the surgical theatre are unavoidable and can plausibly be argued to increase with increased fresh gas flow [8,9]. Not even the most modern exhaust systems do more than remove the anaesthetic gases from the local to the regional environment. While probably not a significant contributor to the

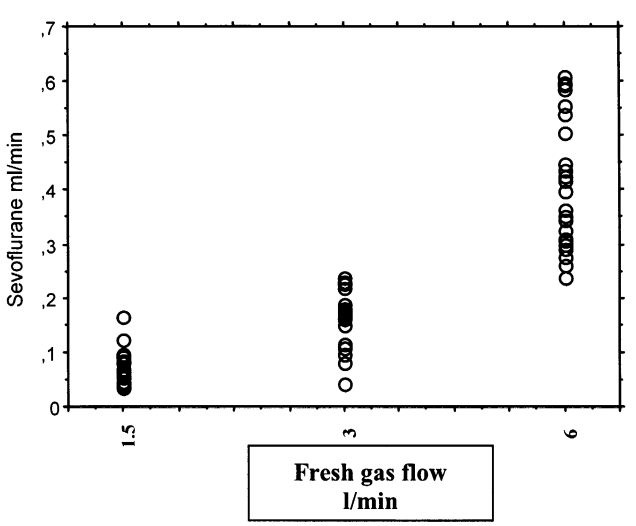

Fig. 1. The effect of fresh gas flow (l/min) on sevoflurane consumption (ml/min) in 75 patients undergoing knee arthroscopy ($r^2 = 0.7$).

total amount of halogenated gases released into the environment [10], our responsibility as health providers requires us to take those steps available to us. By reducing the fresh gas flow it is obvious that not only the amount of nitrous oxide is considerably lower but also the sevoflurane burden.

In conclusion, the simple reduction of fresh gas flow results in a slightly more than proportional decrease in sevoflurane consumption with a maintained standard of anaesthesia. The lowering of the fresh gas flow in the range between 6 and 1.5 l/min during ambulatory procedures such as arthroscopy of the knee is an effective cost-minimisation strategy.

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Introduction of a hand trauma day surgery operating list

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Abstract

Due to a huge increase in hand trauma referrals to our busy plastic surgical unit, we introduced a dedicated half-day hand trauma day surgery (HTDS) list to try and reduce the pressure on inpatient beds and length of wait for surgery. We reviewed the first 101 cases treated on the HTDS list to determine whether this allowed adequate specialist treatment of these injuries and to assess outcome and complications rates. Only one patient needed admission following surgery and our complication rate compared favourably with that of patients admitted and treated in the standard manner. We conclude that a HTDS list is both an effective and efficient method of treating a wide range of hand injuries.

Keywords: Day surgery; Hand trauma; Consultant led service

1. Introduction

The Queen Victoria Hospital is a regional referral centre for plastic surgery, burns and hand trauma for the South East region of England with a catchment population close to 4 million people and serviced by 21 referring Accident and Emergency departments and Minor Injuries Units. There are nine plastic surgery consultants at the hospital, of which two are specialist hand surgeons.

An audit of the workload of trauma patients performed in 1992 and again in 1998 by our clinical audit department showed that approximately 50% of all trauma referrals were for hand injuries and this proportion had remained essentially constant over the time period. The absolute number of referrals had tripled over the 6 years. This increase in workload had major implications for hospital resources in that in-patient beds were being blocked by patients waiting for often relatively minor hand surgery at the expense of elective surgical admissions. This encroachment on our elective surgical workload prompted us to examine other options for managing hand trauma and led to the introduction of the hand trauma day surgery (HTDS) operating list. Its aim was to improve the efficiency of our hand trauma service by reducing both unnecessary hospital admissions and patient waiting times.

We report our experience of the first 101 cases treated as out-patients at the Day Surgery Unit.

2. Patients and methods

All our referring Accident and Emergency departments and Minor Injuries Units were sent a letter explaining the rationale behind the introduction of the HTDS list and including a list of injuries suitable for inclusion on a day case list. (Table 1). Contraindications to inclusion were also listed (Table 2). All patients were told to expect surgery under a regional or local anaesthetic.

The HTDS list runs from 08:30 to 12:30 h on weekdays and can accommodate four patients with an expected total theatre time of up to 1 h for each. Suitable patients were given an appointment time over the telephone at which to attend the Day Surgery Unit the following day, 1 h before their expected surgical start time, to allow full assessment by the surgeon and placement of a regional anaesthetic block if necessary. All patients were asked to be 'nil by mouth' for 6 h prior to surgery as a precaution.

After surgery all patients who needed it were seen by the physiotherapists for initiation of their rehabilitation

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Table 1
Injuries suitable for the HTDS list

Isolated tendon injuries
Isolated digital nerve injuries
Small skin defects for grafting or local flap coverage
Finger tip injuries
Closed fractures for MUA or ORIF

regime and by the occupational therapists for fitting of a definitive orthosis before being allowed home. Where formal physiotherapy was not indicated, printed instruction sheets regarding hand exercises and rehabilitation were provided. If appropriate, an early outpatient appointment was made to ensure that correct physical rehabilitation was taking place, otherwise a 'routine' two week appointment was given. Most patients were prescribed a 5-day course of oral antibiotics, typically flucloxacillin 500 mg QDS.

We reviewed retrospectively the case notes of the first 101 patients treated on the HTDS list from its institution on 1st November, 1998 to 28th February, 1999. The data collected included age, mechanism of injury, operation performed, anaesthetic and hand therapy requirements as well as any complications.

3. Results

In the first 4 months of the HTDS list 101 patients were treated, of which 89 were male and 12 female. The average age was 37 years (range 17–70). The mechanism of injury is shown in Table 3. Thirty-eight patients were operated on under local anaesthetic, 53 under a regional anaesthetic and ten under a general anaesthetic. The complete range of operations performed is listed in Table 4. The commonest procedures undertaken were wound exploration (16/101), repair of a single extensor tendon (13/101) and repair of a digital nerve (11/101).

Forty-eight patients required both physiotherapy and occupational therapy input post-operatively, 12 required only physiotherapy and four had occupational therapy alone. A small number of patients had to be brought back the following day as their regional block was still too dense to co-operate with physiotherapy on the day of surgery. Only one patient needed admission to hospital directly after their 'day case' surgery, to receive intravenous antibiotics for an established severe hand infection. All ten patients who had a general anaesthetic were discharged the same day. All patients received an outpatient appointment for 1 or 2 weeks post-operatively depending on the severity of their injury and the need for close supervision of their physical rehabilitation programme.

There was a single case where an axillary block failed to provide anaesthesia to the surgical field; the patient then had a general anaesthetic and his flexor tendon repaired uneventfully. He was discharged home the same day. There were 13 early surgical complications after discharge from the day surgery unit in our follow-up period of between 3 and 6 months. In our series we encountered one patient who presented to our minor injuries unit with a large wound haematoma that required drainage but did not need admission. Seven patients suffered postoperative wound infections, four of which required subsequent admission to our hospital for intravenous antibiotics and three treated with oral antibiotics at home. Three patients ruptured their ten-

Table 2
Contraindications to the HTDS list

Under age 16
Bilateral injury
No transport to and from hospital
Poor domestic circumstances/support
Significant medical or psychiatric history

Table 3
Mechanism of injury

Mechanism of injury	No. of cases
Work	50
Domestic	47
Sport	2
Fight	1
Deliberate self harm	1

Table 4
Operations performed and structures repaired

Operation	No. of cases
Wound exploration	16
Single extensor tendon repair	13
DN repair	11
Single flexor tendon repair	10
Nail bed repair	10
Multiple extensor tendons repair	6
FDS+FDP+DN repair	5
Removal foreign body	5
Digital nerve+artery repair	4
Extensor tendon+DN repair	4
FDP+DN repair	3
Local flap	3
Terminalisation of digit	3
Full thickness skin graft	3
Joint capsule repair	2
Excision pyogenic granuloma	1
Median nerve repair+local flap	1
ORIF	1
Total	101

Abbreviations: DN, digital nerve; FDS, flexor digitorum superficialis; FDP, flexor digitorum profundus; ORIF, fracture open reduction and internal fixation.

don repair. Two of these ruptures occurred 5 weeks into the rehabilitation regime and the third occurred 6 days post-operatively during a physiotherapy session. This latter case become infected and needed admission for debridement and intravenous antibiotics. All three patients who ruptured their tendon repairs are being treated with delayed two-stage reconstructions. Continued close follow-up of our patients revealed one patient who had developed tendon adhesions for which he is awaiting tenolysis and one patient was diagnosed as having an early reflex sympathetic dystrophy for which he is receiving intensive physiotherapy.

4. Discussion

In the past, referral of hand injuries of a relatively minor nature from our regional Accident and Emergency Departments has been sporadic at best. A concerted effort to educate casualty medical and nursing staff by a twice yearly trauma course, as to what should be referred early to a specialist hand centre, has been successful and has resulted in a huge increase in the amount of hand trauma being seen in our unit. Previously these referrals were dealt with by admission to the Queen Victoria Hospital, where they waited their turn on a trauma list that ostensibly ran in the order in which the cases were booked. Inevitably minor operations, such as nail bed repairs were often relegated down the list behind bigger cases such as open fractures and dirty injuries. This resulted in many patients waiting for two or three days in hospital for minor surgery and blocking a surgical bed unnecessarily. It was also a considerable inconvenience for the patients.

The Royal College of Surgeons of England [1] and the two recent CEPOD [2,3] reports have voiced concerns at the amount of out of hours operating performed on emergency and trauma patients often with little or no consultant supervision. Several studies have shown benefits in both general surgery [4] and orthopaedics [5] from the introduction of dedicated daytime, or even half day, [6] consultant supervised emergency/trauma lists. Whilst the Queen Victoria Hospital already has a dedicated all day trauma list, hand surgery, which is increasingly being practised as a separate subspecialty by plastic and orthopaedic surgeons alike, has to take its turn with everything else on the general trauma list and many minor procedures are often left to be performed out of hours.

Ideally injuries should be treated promptly whilst the tissues are relatively untainted by inflammation, oedema and infection. We can do little to influence the delay between injury and presentation at the Accident department but we should strive to minimise the delays from time of referral to surgery.

The introduction of the HTDS list has addressed all these points. It provides a dedicated daytime hand trauma list allowing consultant supervision. It has reduced the number of hand trauma patients admitted to hospital and has released beds for elective surgery patients. The benefits to the hospital are obvious although we currently have no method of quantifying any cost benefits. Our admission to hospital rate of 1% is in line with other studies of ambulatory surgery [7,8]. From a surgical point of view the delay between injury and surgery has been reduced markedly and presents the tissues in better condition for surgery which is reflected in the lower rate (4%) of serious post-operative hand infections compared to other studies [9,10].

As the HTDS list for the following day is organised over the telephone between the on-call plastic surgical senior house officer and the referring Accident and Emergency Departments, it is effectively turned into a semi-elective list allowing surgeons, staff and hand therapists to plan their day more efficiently. This arrangement allows some flexibility, such that if there is an overwhelming clinical need, the HTDS list can be abandoned and no cases booked. Theatre resources and staff can then be directed elsewhere, such as to an emergency free flap procedure, although this is an infrequent occurrence. Unfortunately our HTDS list currently runs in the mornings only and can accommodate only four patients. Any further cases referred with a hand injury suitable for day care management are either treated in the standard fashion by admission and waiting or booked onto the HTDS list 2 days hence. The latter may be more convenient for the patient by avoiding admission, but does not eliminate the surgical delays already described.

By performing all procedures under either local anaesthetic digital ring block or regional anaesthetic techniques such as axillary brachial plexus blocks we aim to avoid the major potential complications of general anaesthesia [11]. There have been some teething problems in trying to use a regional anaesthetic technique service only. Some of the anaesthetists have found that placement of blocks takes longer and gives less reliable results than giving a routine general anaesthetic. It could be argued that this provides an excellent training opportunity for the junior anaesthetist to consolidate the skills of regional upper limb blocks.

There are obvious discrepancies between the stated indications for the HTDS list and the range of operations actually performed with much more complex injuries than expected being dealt with on the HTDS list. We accept that it is very difficult to fully and accurately assess the total extent of a patient's injuries when they are in pain, under the influence of alcohol or uncooperative on presentation to an accident department. In these circumstances it easy to understand how injuries are greatly underestimated, something that is only fully

appreciated when the patient is under anaesthetic and a full exploration can be undertaken.

5. Conclusion

On the basis of our early results we feel that the introduction of a HTDS operating list at our hospital has been a great success. It has allowed an increased throughput of hand trauma patients to be treated in a timely manner without increasing the rate of complications or impinging on our elective surgical work. Further work is in progress to assess the longer-term outcome of these patients. Based on our preliminary results we would recommend that any unit that has a significant proportion of hand injuries in its trauma workload should consider introducing a HTDS list.

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Pre-registration student nurses' perceptions of the day surgery unit

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Abstract

An increasing number of complex surgical interventions are now taking place on a day case basis with some surgical specialities able to perform 80% of their elective surgery as day surgery. It is important that student nurses are exposed to clinical practice within the day surgery unit. Some students, for a variety of reasons, exhibit a reluctance to experience a day-surgery placement. The writer describes a programme of study which takes place before the students take up their placements to demonstrate that day surgery offers many opportunities for the delivery of highly skilled, specialised nursing care. Day Surgery Nursing is emerging as a speciality in its own right. The clinical skills of the nurse are required alongside the interpersonal, informational and psychological care-giving skills to ensure safety and comfort for the patient whilst in the unit and transfer home where responsibility for care, normally performed by nurses, now lies with the patients and their carers.

Keywords: Student nurses; Perceptions; Day-surgery

When preparing the pre-registration student nurse for a clinical placement on the Day Surgery Unit (D-S-U), one is often met by a distinct lack of enthusiasm. Pre-conceived ideas of what day surgery is about have to be deconstructed in the classroom and the student's mind opened up to the exciting and innovative nature of day surgery. Comments made include such concerns as lack of opportunity to learn practical skills, a perceived lack of time for forming relationships with patients and a complete misconception that it is only 'minor' surgery, therefore, the patients 'do not need as much care'. A short questionnaire was given to 88 students to assess their attitude both before and after having an 8 week placement on the day surgery unit (see Table 1).

By referring to the Trolley of Procedures [1] (Table 2) and the development of anaesthetic and surgical techniques [2], it is relatively easy to dispel the myth that day surgery is not minor surgery. Research has demonstrated that so-called 'minor' procedures are no less threatening to the patient than more extensive surgical procedures [3].

1. The nature of caring

What is sometimes more difficult for the student to comprehend is the nature of caring which takes place within the D-S-U and that the day surgery experience for the patient lasts for much longer than the 3 or 4 h on the unit but may begin many weeks or months beforehand and may last for many weeks afterwards [4]. By taking the student nurse through the day surgery experience, from meeting the patient in the preassessment clinic, admitting them to the day surgery ward on the day of surgery, accompanying them to the operating theatre, assisting in postoperative recovery and preparation for discharge, the importance of the nurses' role is demonstrated. Alongside this we look at current research in nursing aspects of day surgery as this illuminates the importance of the day surgery nurse in allaying anxiety and giving comfort to the patient [5,6]. Other research demonstrates the distress, which may occur if pre-operative information and psycho-social support by nurses is inadequate and discharge policies for helping the patient resume normal activities are not in place [7,8]. Firstly, though, the concept of nursing and caring must be explored within the day surgery setting. Day surgery nursing is a relatively new surgical

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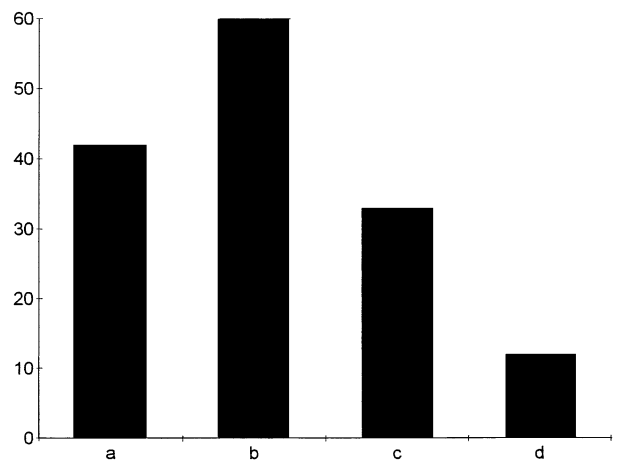
speciality and challenges the concept of the traditional bedside nurse, which is often held by the student. That is, an image of the nurse promoted by tradition and television — a sympathetic person — caring for a passive, dependent, bed-ridden patient. The essence of day surgery is identical to the essence of all nursing, namely that of delivering patient care — although how that care is delivered may be very different from in-patient surgical nursing. Indeed the gap between the in-patient surgical nurse and the day surgery nurse is getting even wider [9]. Classroom discussions of the nature of nursing are wide ranging but the students usually agree that nursing 'is concerned with promoting health, preventing illness, caring for the sick and restoring health' [10]. Next, usually follows a discussion of the attributes of a good nurse-caring, empathic, kind and competent. The philosophy of caring proposed by Watson is discussed and related to the work of the nurse in day surgery. Watson's theory combines science with humanism, nursing is a therapeutic interpersonal process. Nursing skills lie in, among other factors, the instillation of faith and hope, the development of a helping–trusting relationship, the systematic use of the scientific problem-solving method and the provision of a supportive, protective, physical, psychological and spiritual environment. Caring, states Watson, as the moral ideal of nursing, is nursing's unique contribution to humankind and has the potential to transform healthcare [10]. The success of day surgery must surely, in no small measure, be due to the ability of nurses to provide this caring environment for the day surgery patient as well as to the advances in surgical and anaesthetic practices. Mayeroff [11] states that caring is a human activity that is intrinsically interesting and whose understanding is central to the understanding of man. Caring is composed of certain ingredients which include devotion and commitment over a prolonged period of time, patience, which is participation in which we give fully of ourselves, for example, a nurse giving full attention to the patient and all their attendant worries and anxieties in the pre-assessment clinic rather than just attending to the pre-operative check list. Other attributes of caring include trust, both in oneself and in others, humility, always ready to learn more about the other person, and hope-as an expression of a present alive with the possible and mobilises energies needed for future activity [11]. The feeling of hope and optimism illuminates the work of day surgery nurses and makes it such a dynamic area of nursing practice. Without feelings of hope, day surgery nurses would not have the enthusiasm to initiate new practices to improve care for their patients. An important aspect of hope, says Mayeroff, is courage. Courage is involved in standing by the other under trying circumstances and is an ingredient of devotion [11]. What is nursing if it is not standing by others in trying circumstances, and do not day surgery nurses display these attributes in all aspects of the work? A video obtained from the British Association of Day patients 'Patients informing Patients' is a very useful tool for taking student nurses on a day surgery journey from the safety of the classroom environment and demonstrates well the attributes mentioned above. The helping–trusting relationship as de-

Table 1
Before a placement on Day Surgery Units



Question: I would not like a career in Day Surgery because
(a) you do not get the opportunity for wound care
(b) you do not have time to get to know the patient well
(c) I prefer high-dependency nursing
(d) it is very stressful

Number of students: 88.

Table 2
British Association of Day Surgery Trolley of Procedures 1999

Groin/abdominal hernia repair (Inguinal, femoral, umbilical, epigastric)
Excision of breast lump
Minor anal surgery (fissurel simple fistula)
Varicose vein surgery (including bilateral, or long and short saphenous one leg)
Cystoscopy, diagnostic and operative
Circumcision (including adults)
Release of Dupuyten's contracture
Arthroscopy (including hip and shoulder)
Hydrocele excision
Inguinal surgery children (orchidopexy and herniotomy)
Tonsillectomy in children
Correction of squint
Bat ears/minor plastic procedures
Sub-mucous resection
Reduction of nasal fractures
Cataract extraction
Laparoscopy with or without sterilisation
Termination of pregnancy
Trans-urethral resection/laser/diathermy/limited resection of bladder tumours
Pilonidal sinus excision and closure

scribed by Watson is developed in the pre-assessment clinic where as well as assessing fitness for day surgery, time is taken to explore patients' worries and concerns. The pre-assessment clinic also gives the nurses the opportunity to give procedural, behavioural and sensory information in varying amounts to meet the patient's individual needs — some patients requiring much more information than others [6,12,13]. The skill of the nurse lies here in assessing the amount and level of information each patient requires to meet his or her individual needs to ensure a less anxious and well prepared patient. In the ward, on the day of surgery, it is not uncommon to see patient and nurse walking down the ward arm-in-arm on the way to the operating theatre. This is a real demonstration of the helping–trusting relationship developed between patient and nurse and commented on so positively by patients [6].

2. Environmental concerns

Attention to the environment is important. Mitchell's research has demonstrated how a calm, friendly, professional relaxed environment helped to allay the patient's anxiety [6]. The provision of videos, audio-cassettes, plants and flowers, dimmed lighting, paintings for the walls and many hours devoted to writing patient information leaflets demonstrate commitment to the needs of day surgery patients by day surgery nurses. Privacy has often been mentioned as cause for concern in the Day Surgery Unit [14,15]. Privacy often serves the need to maintain an individual's dignity and sense of self. Humiliation, embarrassment and depersonalisation may result from an invasion of privacy [10]. Maslow's research [16] showed that healthy subjects have a very strong liking and need for privacy. The explicit opportunity for privacy acknowledged by the nurse in the care of the day surgery patient forms part of the helping–trusting relationship and promotion of the supportive environment mentioned earlier. From personal experience it is known that provision of privacy in Day Surgery Units can be hard to maintain. When one is giving private discharge information, one is mindful of the fact that there may only be a thin curtain separating one patient from the next. This may inhibit the patient's asking questions of an intimate nature [14]. The nurse can only work within the environment she has, private interview rooms may not always be available. Being mindful of these matters of privacy may alert the nurse to when this is being infringed and prompt them to take remedial action.

3. Anaesthetic and intra-operative aspects of care

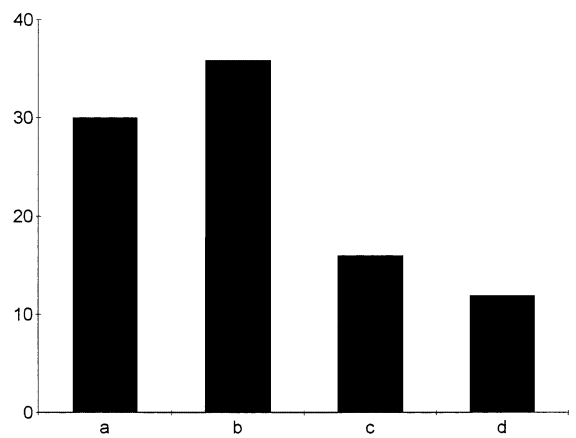
The role of the anaesthetic nurse is very important in day surgery. Research has constantly shown [6,17,18] that the anaesthetic is probably the most frightening aspect of the day surgery patient's hospital experience with fear of loss of control and experiencing pain during surgery also featuring highly.

Research has demonstrated that the role of the anaesthetist is very much misunderstood by the general public [19,20]. Indeed some of the surveyed patients did not even realise that the anaesthetist was a highly qualified medical practitioner, or the central role played by anaesthetists in the monitoring of vital signs during their operation. From personal experience and supported by research evidence it can be seen that patients obtain great comfort from the anaesthetist speaking and being with the patient [6,21]. In one study [22], patients rated meeting the anaesthetist before surgery as of the highest priority. However, anaesthetists have many demands on their time [23] and opportunities for patient education are limited. Here the contribution of the anaesthetic nurse is invaluable. She/he can, along with all the usual safety checks, introduce the anaesthetist and explain the procedures again. 'A reassuring and calm manner backed up by sound clinical expertise and good communication skills can help relieve the patients anxiety at the induction of anaesthesia' [24].

4. Discharge planning

The importance of adequate discharge planning and after care has to be stressed to the student nurses going to the day surgery unit. After what may be quite a

Table 3
After a placement on Day Surgery: 42 students



Question: I would consider a career in Day Surgery because
(a) I enjoyed the counselling educational aspects of the nurse's role
(b) I enjoyed the different aspects of the day surgery unit: pre-op assessment, operating theatre department, ward
(c) you have the opportunity to become multi-skilled
(d) pleasant day surgery unit environment

Table 4
Summary of modular content: preparation for placement on day surgery unit

History of the Emergence of Day Surgery	
Current Day Surgery Provision	Models of Day Surgery Provision
	Trolley of Procedures
The Nature of Nursing	
Philosophical considerations of the nature of caring applied to Day Surgery Nursing	
Understanding the various nursing roles within the Day Surgery Unit	Preassessment and discharge preparation
	Care of the patients whilst on day surgery ward
	Anaesthetic and intra-operative nursing roles
Skills and knowledge required by day surgery nurses	Communication skills
	Expert knowledge
	Clinical skills
	Psychological care giving skills
	Knowledge of law and ethics in relation to day surgery
	Scope of professional practice.
Future Developments	Formalised programme of pre-operative preparation
	Formalised anxiety management care-plans
	Development of post-discharge telephone help lines
	Further development of post-discharge home visits

complex surgical procedure the patients and their carers must be fully prepared for discharge and the responsibility for this lies with the patient's nurse. As well as looking at local discharge criteria and readmission procedures we must also look at other initiatives in place in some other localities to ensure a patient's safe return home. These include visits by the nurses working on day surgery units [25], post-discharge telephone calls [26], rapid response teams, etc. together with patient satisfaction questionnaires and day surgery audit of re-admission rates and pain and wound problems following discharge. According to Mayeroff [11] caring involves commitment and day surgery nurses are committed to constantly evaluating the care given to patients and eager to encourage innovative practices.

5. Attitude changes

Following a practice placement on the day surgery units the students' attitudes have usually changed considerably (see Table 3), this is due in no small part to the warm supportive learning environments provided by the nursing staff. The excellent programme of practical experience arranged for the students and the presence of very committed and enthusiastic day surgery nurses provide very powerful role models for the students. The importance of role models in the practice setting has been highlighted by many researchers [27] as one of the most important factors to facilitate student nurse learning within the clinical environment.

Following their placements the students, are, on the whole, full of enthusiasm for the Day Surgery Unit. They are most enthusiastic about the teaching-informative role of the nurse beginning in the pre-assessment clinic (see Table 3). They begin to accept that the stereotypical images of the nurse no longer hold in the modern surgical arena [27,28]. One of the most controversial perceptions held by the students before their day-surgery placement is that the patients 'do not need as much care' as in-patients. This is emphatically changed. The students realise that although Day Surgery Unit patients may need less physical nursing care they, nevertheless, need intensive nursing care in the form of anxiety management [28] psychological care, information giving, education for discharge planning, combined with the physical care of the patient to ensure their safety and comfort and preparations to ensure a safe discharge home. If this is not skilled nursing care then what is?

6. Conclusion

Before student nurses are allocated to the Day Surgery Unit they often have pre-conceived notions of the care required by day surgery patients. After a structured programme of clinical experience in the Day Surgery Units accompanied by classroom discussion of the theoretical concepts (see Table 4) surrounding the emergence of day surgery, it is gratifying to note a profound change of attitude.

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Wound infection in day-surgery

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Abstract

To determine the surgical wound infection rate associated with day-surgery and to assess whether infection was related to patient factors, a prospective study of all electively operated adult day-cases was carried out during a 6 month period between January and June 1996. The study included gastroenterological orthopaedic, vascular, plastic and urological surgery. No operations involving obviously infected patients were performed in the unit. Strict criteria for diagnosis of infection were used. All patients were examined on the 7th and 30th post-operative day. A total of 642 (98.8%) patients were included (316 females 334 males). Infection developed in 22 of the 642 patients (3.5%), only three were diagnosed before the 7th day visit. Orthopaedic procedures accounted for more than 40% of the surgery, but only 22.7% of the wound infections. Gastroenterology made up nearly 36% of the procedures and accounted for 36.4% of the infections. Vascular procedures were 5.7% of the total but accounted for 18% of the infections. No correlation was found between age, gender, operation time or ASA-group and the infection rate. The study is to small to quantify with statistical significance risk-factors associated with wound infection in ambulatory surgery. Our data may suggest that the type of surgery as well as individual factors associated with surgeons may influence the wound infection rate.

Keywords: Wound infection; Day-surgery; Patient

1. Introduction

Absence of post-operative wound infection is an important part of the successful outcome of an operative procedure. Surgical wound infection rates have been determined for a number of surgical procedures, but most of these figures have been compiled from data on hospital inpatients. Whereas wound infection rates in inpatients are evaluated routinely during quality-assurance reviews, this has not been the case in most day-surgery clinics as close patient follow-up is difficult to achieve after discharge.

The amount of ambulatory surgery being performed is increasing. The number of cases scheduled, as well as the list of procedures offered, has grown.

The primary objective of this study was to determine the surgical wound infection rate associated with elective operations in the adult day-surgery unit of a large, university-based, teaching hospital. A secondary objective was to assess whether the infections were related to patient factors, such as ASA-group [1], obesity or type of the surgical incision or external factors such as duration of surgery, surgeon in charge or time during the day that the operation took place.

2. Materials and methods

The day surgery unit at Ullevaal hospital is physically separated from the rest of the hospital. It includes two operating theatres, six post-operative beds and a step-down area. The unit is located in an old building with virtually no controlled ventilation.

Particle concentration in the air (number per m^3) were measured at two different occasions immediately prior to the study. A considerable increase in the number of particles during the day (from < 100 to > 300 particles per m^3) were demonstrated (personal communication).

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2.1. Patients

A prospective study of all adult patients undergoing elective day-case surgery was carried out during a 6 month period between January and June 1996.

Patients using antibiotics, pre- or post-operatively, whether as prophylaxis or treatment, were excluded.

No operations involving obviously infected wounds were performed in the unit. Patients suffering from hepatitis or human immunodeficiency virus (HIV) and patients with anorectal surgery were excluded.

Skin preparation consisted of electric shaving immediately prior to surgery. Red chlorhexidine gluconate solution (5 mg/ml) was used as a pre-operative antiseptic skin preparation. Cloth drapes were standard and steridrapes were not used.

2.2. Definition of infection

All incisions were examined on the 7th and 30th post-operative day by one of two observers. The diagnosis of infection was based on fulfilment of one from the following criteria,

1. discharge of pus from the wound;
2. microrganisms present in swabs taken from any discharge from the wound;
3. surgical revision and drainage of the wound with positive bacteriology;
4. antibiotic treatment due to clinically suspect infection.

Deep infection was defined as infection located under the deep fascia or intra-articularly.

If in doubt, whether there was an infection or not, the patient was invited to follow-up visits until the wound was healed or classified as infected.

2.3. Collection of data

Factors associated with the procedures were documented for each patient at the time of the operation. Such factors included the name of the surgeon; name of the scrub- and assisting nurse; type and duration of the procedure; location of the incision; ASA-class of anaesthesia risk [1] and whether the procedure involved the use of implants.

2.4. Analysis of the data

A rate of infection was calculated for the entire population as well as for each speciality and each possible risk factor. The data were analysed with Student's t-test and $P < 0.05$ was considered statistically significant.

3. Results

Of the 692 patients operated on in the unit during the study period 42 had anal or perianal procedures and were therefore excluded. Six hundred and fifty patients (316 women, 334 men) were thus recruited for the study. All patients attended the 7th day visit. A total of 35 patients failed to attend the 30th day visit. They were contacted either by telephone or by a letter. Eight patients could not be traced which left 642 (98.8%; 316 female, 334 male) patients for complete evaluation.

The average age of the 334 male patients was 49 years (range 4–81 years), and the average age of the 316 female patients was 46 years (range 6–85 years). Occasionally children are operated on in the adult unit. In our study 15 patients were less than 16 years of age (Fig. 1).

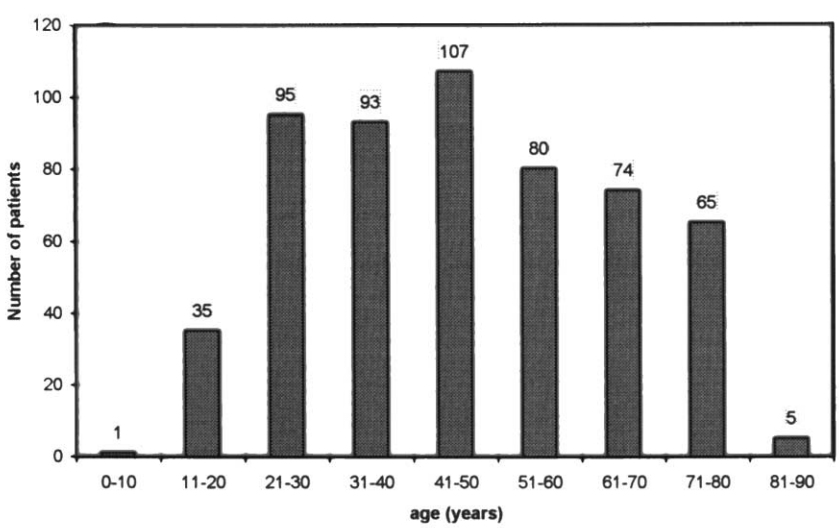

Fig. 1. Age distribution of 642 patients operated on in a day surgery unit.

Table 1
Demographic data for the total number of patients operated compared with patients suffering post-operative wound infection

	Total	Infected	%	
Age (years)	46.6 (18.7)	50.5 (19.1)		ns
Gender (men)	334	12	3.6	
(women)	316	10	3.2	
Operation time (min)	58.0 (46.1)	48.2 (40.3)		ns
ASA				
1	517	14	2.7	
2	105	6	5.6	
3	20	1	5.0	
4	0	0		
Body mass index (BMI)	25.1 (3.1)	23.7 (4.8)		ns

Numbers within parenthesis are S.D.

The study included surgeons from five different specialities (gastroenterological, orthopaedic, vascular, plastic and urological surgery). The number of procedures within each speciality are depicted in Table 1. All procedures were elective.

3.1. Over-all rate of wound infection

Superficial infection of the operation wound developed in 22 of 642 patients (ten female, 12 male), a rate of 3.5% (Tables 1 and 2). There was no significant difference in age between the infected and non-infected patients. No relationship was observed between increasing ASA-group and the rate of infection. No deep infection was encountered.

There was no correlation between the duration of surgery and the infection rate. Neither was there any relationship between infection rate and different scrub nurses.

Four infections (early infections) were evident before the control at the 7th post-operative day. The remaining 18 infections (late infections) were diagnosed at a mean of 12.1 days post-operatively (range 8–20 days).

Twelve of the infected patients were treated by their local physician before the 7th day visit. Nine were treated with antibiotics due to clinically suspect wounds without swabs being taken (criteria 4). Three were treated after swabs were taken (criteria 2). Ten patients were treated by hospital doctors, four had to be readmitted and three were surgically revised (criteria 3). Orthopaedic procedures accounted for more than 40% of the surgery, but only 22.7% of the wound infections. Gastroenterology made up nearly 36% of the procedures and accounted for 36.4% of the infections. Vascular procedures were 5.7% of the total but accounted for 18% of the infections.

Table 2
Numbers of procedures and post-operative infections for each speciality

Speciality	Number of procedures	Number of infections
Orthopaedic	264 (41.1)	5 (1.9)
Gastroenterology	230 (35.8)	8 (3.5)
Plastic	107 (16.6)	5 (4.7)
Vascular	37 (5.7)	4 (10.8)
Urology	12 (1.8)	0
Total	642	22 (3.4)

Numbers within parenthesis are percent of total.

Four patients were hospitalised for treatment of the infection while 18 received antibiotic treatment as outpatients.

A total of 64 (47 female, 17 male) laparoscopic cholecystectomies were performed of which three (4.7%) suffered an infection (two female, one male). All three were infected in the umbilical incision.

Of the 166 other gastroenterology procedures, five patients suffered a wound infection (3.0%). All five had an inguinal hernia operation (five infections out of 95 inguinal hernial operations, 5.3%). One patient had a prolonged procedure with laparoscopic technique which, during the procedure, was converted to open technique. All of the infected patients were males. One surgeon had three infections out of nine cases, the other two infections occurred after two different surgeons performing more than 20 procedures each.

4. Discussion

It has been claimed that ambulatory surgery results in less wound infections compared with inpatient treatment [2–5]. This could be due to less formal follow-up on ambulatory surgery patients and thereby often fragmentary information on complications such as wound infections. However, ambulatory surgery patients are less exposed to hospital bacterial strains, both because of the short stay and the frequent localisation of this kind of surgery in separate, dedicated units. On the other hand ambulatory patients are less exposed to post-operative professional care and this may result in a higher rate of infection as well as less chance of early diagnosis and proper treatment.

The frequency of incisional wound infections in hospitalised patients reported in different studies varies between 5 and 17% [6]. This wide range is explained primarily by different wound and patient categories [7]. For clean surgical wound incisions, the overall infection rate has been reported as less than 2% [8]. According to the Center for Disease Control (CDC) guidelines for prevention of surgical wound infection, the clean wound infection rate is between 1 and 5% [9].

In our study, the overall infection rate was 3.5%. This is within the limits recommended by CDC. The infection rate may seem high compared with other

studies of ambulatory surgery. However, this may be due to confounding factors. We had almost 100% follow-up of our patients for 30 post-operative days, using strict objective criteria for infection. This minimised the risk of underestimation of the infection rate, which seems to be a problem with most previous studies.

In one study, the authors failed to document the criteria for wound infection [10] and reported an extremely low overall infection rate (0.63%). In another study, a wound infection rate of 0.02% from a surgical cohort of 13,433 was reported [11]. In this study, neither the criteria for wound infection nor the type of procedures were defined. Most of the studies were carried out by passive reporting through a questionnaire returned by the patient or attending surgeon [10,11].

Zoutman et al. [5] followed a cohort of 635 patients undergoing day surgery procedures. The patients were telephoned 1 month after their procedure and were questioned about occurrence of a wound infection. They discovered an infection rate of 5.1%.

The definition of a wound infection has proved difficult [12]. The wound infection rate in any study depends as much on the definition of infection and the adequacy of the follow-up as on the surgical practice assessed by the study [13].

To diagnose a surgical wound infection we used the criteria defined by CDC. A more narrow definition would be only those cases, which either needed treatment or had any prolonged recovery or change in outcome. With this definition 17 cases (2.6%) had a clinical significant wound infection in our study.

Our study is to small to quantify with statistical significance risk-factors associated with wound infection in ambulatory surgery. However, our data may suggest that the type of surgery may influence the wound infection rate as well as individual factors associated with surgeons and nurses. These suggestions should be explored in larger scale studies.

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Abstracts

December 1999, Vol. 4, No. 4

Ambulatory Surgical Treatment of Varicose Veins Under Intradural Anesthesia pp. 524–529

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Introduction

Nowadays, ambulatory surgery is the fastest growing subspecialty within clinical anesthesiology, owing to the advances in anesthetic and surgical technology. Several side-effects of subdural anesthesia (post-dural puncture headache, impairig the ability to ambulate and void) can prevent the challenge of anesthesia for ambulatory patients (rapid return to street readiness). The aim of this study was to evaluate spinal anesthesia by using pencil-point needles in adult outpatient surgery (uni- or bilateral saphenectomy).

Material and method

We studied prospectively 520 patients operated on for saphenectomy. After vascular replacement, 10 ml/kg of Hartmaní solution, and a premedication with metoclopramide, 10 mg, and midazolam, 0.03 mg/kg, patients received subdural anesthesia (pencil point needle 25–27 G) with either 60 mg of mepivacaine 0.2% unilateral saphenectomy or bupivacaine 0.5% 10 mg or 0.25% 7.5 mg (bilateral saphenectomy). In every patient, we measured sensitive block, heart rate, blood pressure, surgery duration, time for hospital discharge and side-effects (nausea/vomiting, urinary retention, and PDPH).

Results

Unilateral or bilateral saphenectomy was performed in 80.9 and 19.1% of the patients, respectively. The age was (mean $\pm$ standard deviation) 41 ± 17, and 68% were women. Sensory blockade in every patient was adequate to perform the operation, and the duration of the operation was (mean + standard deviation) 58 ± 23 min and 136 ± 42 min for uni- or bilateral saphenectomy, respectively. Nausea/vomiting appeared in 6% of patients, 7% of patients presented hypotension, 4% bradycardia, 7% urinary retention, and two patients suffered postdural puncture headache. The time for hospital discharge was $9 + 2$ h (mean $\pm$ standard deviation), but 11% of patients had to be readmitted to the hospital.

Discussion

Regional anaesthesia for ambulatory saphenectomy has many advantages: short hospital stay, residual analgesia optimization of health resources and its cost-saving and cost-effectiveness. Indeed, the low incidence of side-effects and the good quality of recovery after spinal anesthesia suggest that regional anesthesia is a valid alternative for saphenectomy.

Endoscopy in a Gynecological Day Surgery Unit pp. 530–537

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Over the last decades, we have been able to increase the number of surgical procedures undertaken in day surgery units due to two main factors: the outstanding progress in the techniques used in anesthesia and the development of endoscopy. In gynecology, this fact has been particularly significant due to laparoscopy and histeroscopy. In this paper, we present their posibilities in our environment.

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Microlaryngeal Surgery as Ambulatory Surgery. Results During the Period 1995–1998 pp. 538–542

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The objective is to prove that microlaryngeal surgery is a safe procedure to include as ambulatory surgery.

We reviewed the direct laryngoscopies performed as ambulatory surgical procedures in a day surgery unit during the 1995–1998 period. In this retrospective study, 132 patients were included. The type of pathology, anaesthetic risk, intra and postoperative complications and discharge criteria were analyzed.

Only 3.78% of the patients had some intraoperative complication, three, bronchial spasm and two, skin rash. Among the causes of admission to the hospital (4.54%), social problems not related to surgical procedures (2.27%), nausea and vomiting (0.76%), fever (0.76%) and dizziness (0.76%) were most common.

We conclude that microlaryngeal surgery can be safely performed as an outpatient procedure as long as the patients are selected.

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Ambulatory Surgery as a Part of a General Surgery Department pp. 18–21

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Our Department for General and Digestive Surgery started a full program for ambulatory surgery in January 1998.

In this paper, we present the activity, methods and results of the different operations performed as ambulatory surgery during this period. During the first year, 279 patients underwent surgery on the 45 working days of surgery. We noticed the low index of complications and the substitution indexes regarding programmed activity of 35.5% (global), 60% for hernias, 94.3% for hemorrhoidectomies, 96.8% for fissurectomies and 80.5% for pilonidal sinus operations.

Control of Post-operative Pain in Ambulatory Hemorroidectomy pp. 22–24

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Objectives

To evaluate the control of post-operative analgesia after hemorrhoidectomy as an ambulatory procedure in our Department and to assess the use of a topical treatment with 2% lidocaine cream (EMLAr).

Material and methods

We undertook a randomized prospective study including 50 patients who suffered from III–IV degree hemorrhoids (three groups) and who underwent ambulatory hemorrhoidectomy. These patients were divided into two groups depending on whether we applied lidocaine cream on the dressing or not.

Results

Both groups showed low levels of post-operative pain, and there were no statistically significant differences between the groups.

Conclusions

The lidocaine cream did not significantly improve the control of post-operative pain in hemorrhoidectomy. Low figures in pain level observed, which we think are due to a good protocol for the administration of oral analgesics, making this surgical procedure for high degree hemorrhoids feasible in ambulatory surgery programs.

Criteria for Laparoscopic Cholecistectomy in a Program for Ambulatory Surgery pp. 25–28

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Symptomatic cholelithiasis is one of the highest prevailing surgical pathologies, and therefore, laparoscopic cholecystectomy is the most common operation in programs for laparoscopic surgery. This is the reason for the interest in including this procedure in ambulatory surgery programs.

The greatest difficulty resides in establishing predictive criteria that will allow us to select patients who can be included in a program for ambulatory surgery.

In our search for these parameters, we designed a retospective study using 32 variables that we considered most representative following our experience, following the litterature and using the Chi-square test and a

multivariate logistic regression analysis. This statistical procedure was applied to 265 patients who underwent laparoscopic cholecystectomy and who stayed in hospital overnight. For our convenience, we divided them into those who stayed in for under 24 h, as they were operated on in an afternoon theatre program and discharged first thing in the morning, and those who stayed in over 24 h.

We can conclude, after this analysis, that ASA I patients, who have not had previous surgery and whose surgical procedure is estimated to last less than 90 min, are the best candidates for a program for ambulatory surgery. Patients whose GGT, GOT or GPT are altered or whose gall bladder has a wall of 4 mm or more, as seen with ultrasonography, or with signs of cholecystitis should not be included in such programs.

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Analysis and Assesment of Patients Undergoing Ambulatory Surgery pp. 66–70

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Introduction

Ambulatory surgery is a good alternative to conventional surgery as it offers a more detailed follow-up and implication of nursing staff.

Objective

To determine the morbidity and patient's general health state after ambulatory surgery.

Methods and materials

A prospective study of all patients undergoing ambulatory surgery between September 1996 and December 1997 was carried out. Patients requiring post-operative hospitalization and those undergoing opthamic surgery were excluded.

Results

Ninety-four per cent of the patients studied did not present clinically significant problems. Eighty-seven problems were detected in the remaing 6% of cases, none serious in nature. The complications most frequently observed included generalized pain (28%) and bleeding or suppuration (22%). The patient's general health was excellent in 53.5% and good in 32.5%, and 0.5% were in regular/bad condition.

Conclusions

Few problems were observed. The most frequent problems observed were pain, probably due to incorrect administration of analgesics, followed by bleeding, usually blood-stained gauzes. A high percentage of patients reported excellent/good general health, reflecting the acceptance of both the patient and health-care staff. The post-operative follow-up register is a good source of information.

Target-controlled Infusion Systems (TCI) for Sedation in Procedures Requiring Local and Regional Anesthesia pp. 71–76

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It is general practice to complement the procedures that are carried out under local and regional anesthesia with various drugs that produce sedation in the patients. The pharmacokinetic properties of Propofol (rapid onset, short duration of action and prompt recovery) indicate that it is one of the most interesting intravenous agents in maintaining sedation.

The development of reliable infusion systems such as the target-controlled intravenous anaesthesia (TCI), gives us a safer, more predictable and easier technique than others used in the past.

The objetive of this work has been to study the ideal target concentration of Propofol (μg/ml of plasma) when administered through a target-controlled infusion device for sedation in patients undergoing local and regional anaesthesia.

Use of Remifentanil in Early Discharge of Patients Undergoing Vascular Ambulatory Surgery pp. 77–81

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Background and goals

Remifentanil is a selective new mu opiate receptor agonist with a rapid onset and short duration, which makes it very useful in this type of surgery as it allows early discharge of patients. The goal is to study the effectiveness and security of this drug in relation to the early discharge of patients undergoing unilateral saphenectomy and to describe a new anaesthetic technique.

Material and methods

One hundred patients underwent unilateral saphenectomy with complete vein extraction and ligation of collateral veins, under general anesthesia. As pre-medication, 1.5 mg of bromocepam was administered 1 h before the operation. Induction was performed with 2 mg/kg of propofol and 0.07 mg/kg of atropine, and patients were intubated with 1 mg/kg of succinilcolline. An orogastric tube was then put in place and removed at the end of the operation when 4 mg of ondansetron were administered intravenously to reduce post-operative nausea and vomiting. Diclofenac (75 mg) was also administered. Anesthesia was maintained with O_2/N_2O (33%/66%), and 0.3–0.5 g/kg/min of remifentanil was infused after intubation.

Halogenate gases and neuromuscular relaxants were avoided. To prevent sudden awakening and post-operative pain, midazolam and a vial of magnesia metamizol were administered intravenously 10 and 15 min before the end of the operation. Protoxid and the infusion of remifentanil were disconnected at the end of the procedure. The criteria for discharge were based on the modified Aldrete scale and when over 8. Patient should not complain of pain, nausea, vomiting or trembling.

We studied the length of time for anesthesia and extubation in the reanimation room and before discharge.

Results

The 100 patients were classified as ASA I or II. There were 21 men and 79 women. Microsurgery was undertaken in 42 patients. The mean anesthesia time was 48.3 min, the time for extubation was 5.2 min, and the reanimation time was 25.8 min. Discharge from hospital took place after 204 min. Complications included eight patients with nausea and vomiting, five with trembling, six with pain (VAS > 5), two with dizziness, two with hypotension and one who required re-operating. Discharge was not possible in nine cases: both cases of dizziness and hypotension, two of the patients with vomiting, one with pain, the one who underwent surgical revision and in one case due to social problems.

Conclusions

We think that the use of remifentanil in this type of surgery is of great help as patients can be discharged promptly, and there is no need to use halogenate anesthetics or muscle relaxants. There were no cases of intra-operative awakening.

Ambulatory Surgery for Cataracts. Is a Chest X-ray Necessary as a Routine Pre-operative Test? pp. 82–86

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Objective

The aim of this study was to determine the clinical utility of preoperative chest X-ray (PCR). In our hospital, the PCR is a routine test for patients undergoing ophthalmic ambulatory surgery.

Material and methods

A total of 1172 patients scheduled between 5/18/98 and 10/6/99 were studied retrospectively. The characteristics of the patients, type of anesthesia, length of time of surgery and time until the discharge were registered. Also, the changes in the anaesthetic or surgical management, as well as the postoperative complications, related to the findings of the PCR were recorded.

Results

In 50 patients (4.2%), the procedure was cancelled due to causes unrelated to the radiological findings. A total of 1136 patients were operated on (56.26% were women, and 43.74% were men), with an average age of 71.68 ± 10.42 years. The ASA classification was: 14.43% ASA I, 57.75% ASA II, 22.37% ASA III, and 1.87 ASA IV. Eighty-five per cent of patients showed some type of associated pathology. A total of 1158 PCR were assessed: in 13 cases (1.12%), the anomalies in the PCR advised consulting the Department for respiratory diseases. Nevertheless, in no case was the anaesthetic plan modified, and no changes in the surgical planning were made.

Conclusions

The request of a routine PCR is unnecessary in this type of patients.

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Letter to editor

Day case ACL reconstruction

Sir

We read with interest the article by Haug et al. [1] in the August 2000 issue entitled 'Anterior cruciate ligament reconstruction as a day case with extended recovery'.

The expansion of dedicated Day Surgery Units in the UK in the past decade has been popular with orthopaedic surgeons, nursing staff, management and patients and the number of procedures performed in these units continue to grow. Anthroscopically assisted reconstruction of the anterior cruciate ligament is ideal for day surgery as it is reserved for young healthy people. We have therefore sought to make it a procedure that can be easily tolerated with minimal complications. We support the short stay approach of this article and commend the multidisciplinary approach to pre-operative preparation. We would like to highlight the differences in our practice that we believe have helped us omit any extended recovery thus avoiding the necessity for a hospital bed with nursing care overnight.

We employed a femoral nerve block and sensory blockade of the common peroneal nerve, which gave 48 h analgesia. We modified our surgical technique to minimise morbidity. We harvested gracilis and semitendinosis for the graft and this resulted in less donor site morbidity. Proximal fixation was achieved with the continuous loop endobutton and distal fixation with the bioscrew and a staple. The tourniquet was deflated intra-operatively, as soon as the graft was in place to limit ischaemic pain. Post-operatively our patients are protected in a knee-brace, which is locked at 0° of extension. This is only removed under physiotherapist supervision until adequate quadriceps control has been regained.

In our system an overnight stay means using an in patient bed and we therefore need to restrict this to a minimum in our day surgery practice. We therefore recommend regional anaesthesia combined with hamstring graft reconstruction of the ACL for day surgery practice.

References

[1] Haug M, Sorensen L, Dichmann O. Anterior cruciate ligament reconstruction as a day case with extended recovery. Ambul Surg 2000;8:171–3.

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