

AMBULATORY SURGERY

International Journal covering Surgery,
Anaesthesiology, Nursing and
Management Issues in Day Surgery



The Official Clinical Journal of the
INTERNATIONAL ASSOCIATION
FOR AMBULATORY SURGERY

VOLUME 14.2 JULY 2008

AMBULATORY SURGERY

VOLUME 14.2

Editorial	27
Effectiveness of Ondansetron to prevent postoperative nausea and vomiting in ambulatory two port needlescopic cholecystectomy: a randomised controlled trial	28
W.W.C.Ng, A.C.N.Li, D.W.H.Lee, T.L.Leung, C.W.Ko, K.F.Leung, K.W.Lee, T.S.Sze, C.M.Poon, A.C.W.Chan	
The Walk In Walk Out hernia clinic: A study of its cost effectiveness	32
R.A. Khan, R.P. Bhutiani	
The Effect of General Anaesthesia on Post-operative Cognitive Function in the Ambulatory Setting: A Literature Review	36
A.T. Ratcliffe	
Day Surgery for knee arthroscopy, open hernia repair and laparoscopic cholecystectomy anaesthetic routine and practice: The Results from a Swedish Nationwide Survey	42
J. Jakobsson, M. Warrén Stomberg, N. Rawal, M. Brattwall, M. Segerdahl	
Subarachnoid hematoma following spinal anesthesia	49
I. Emazabel-Yunta, I. Casado-Campo, S. Telletxea-Benguria, F. Torre-Mollinedo, L. Fernando Ortega Largo, A. Arízaga Maguregui	
Comparison of supplementation rates for perivascular axillary and coracoid infraclavicular blocks in ambulatory upper extremity surgery	53
E.R. Mariano, G.S. Cheng, V.J. Loland, L.F. Chu	

In this edition of *Ambulatory Surgery*, we learn about international practice, on the system and on the specific level. In a Swedish nation-wide survey, Jakobssen et al present the percentages of several common operations that are done as ambulatory surgery. Knee arthroscopy was scheduled as day surgery in 74/74 Swedish units, herniorrhaphy in 70/73 units and laparoscopic cholecystectomy in 34/65 units. In the U.K., Khan et al. present the improved patient access, reduction in waste and duplication of resources, and potential cost savings that can accrue for inguinal hernia repair when the patient chooses and schedules preoperative assessment and surgery to be done on the same day. Ratcliffe reviews the literature on cognitive dysfunction after general anesthetics for ambulatory surgery, and finds an earlier return to baseline cognitive function in the sevoflurane and desflurane groups, compared to propofol or isoflurane, though this was statistically significant only in the first hour of recovery.

In the specific reports, Emazabel-Yunta et al. discuss a subarachnoid hematoma following spinal anesthesia. Mariano et al. report that supplementation rates for upper extremity blocks are higher than with perivascular axillary blocks than coracoid infraclavicular blocks, 52% and 20%, to produce acceptable anesthesia. Of special interest is the randomised, blinded trial performed by Ng et al. These researchers find that the incidence of PONV after laparoscopic cholecystectomy is reduced from 46–72% to 15–22% with the use of an improved surgical technique, using 2=port needlescopic surgery. With the improved surgical technique, and thereby less surgical intrusion and postsurgical discomfort, ondansetron does not significantly reduce the incidence of PONV.

We also want to remind all our readers to plan to attend the 8th International Congress on Ambulatory Surgery, in Brisbane, Australia on 3-6 July, 2009. The program is being developed to present all attendees with the latest information on science and practice in all disciplines of Ambulatory Surgery – covering surgery, anaesthesiology, nursing and management issues. We welcome you to attend!

Beverly K. Philip MD
Editor-in-Chief, *Ambulatory Surgery*

Effectiveness of Ondansetron to prevent postoperative nausea and vomiting in ambulatory two port needlescopic cholecystectomy: a randomised controlled trial

W.W.C.Ng^a, A.C.N.Li^a, D.W.H.Lee^a, T.L.Leung^a, C.W.Ko^a, K.F.Leung^c, K.W.Lee^c, T.S.Sze^b, C.M.Poon^a, A.C.W.Chan^a

Abstract

Aim: To investigate the effectiveness of ondansetron in the relief of post-operative nausea and vomiting in patients following ambulatory two port needlescopic cholecystectomy.

Methods: Consecutive adult patients undergoing ambulatory two port needlescopic cholecystectomy were randomised to receive either a single dose of 8mg intravenous ondansetron or nothing. The primary outcome measure was the degree of post-operative nausea and vomiting (score 1 to 4) at 4 hours after surgery.

Results: Patients' characteristics in the ondansetron (O) group (n=40) and the control (C) groups (n=41) were comparable. There was no significant difference between O and C groups in the incidence of PONV (17.5% versus 22%, $p=0.615$) and median PONV score (1 versus 1, $p=0.226$) at 4 hours after surgery. The post-operative pain score, analgesia consumption and post-operative stay were also similar in the two groups. Almost all the patients in both groups (97.5% versus 95.1%) could be discharged on the same day of operation.

Conclusion: The administration of 8mg ondansetron conferred no additional benefit in post-operative nausea and vomiting.

Keywords: Needlescopic cholecystectomy; Post-operative nausea and vomiting.

Authors' addresses: ^aDepartments of Surgery and ^bAnaesthesia, North District Hospital, Sheung Shui, Hong Kong SAR, China and ^cDepartment of Surgery, Tuen Mun Hospital, Tuen Mun, Hong Kong SAR, China.

Corresponding author: Dr.W.W.C. Ng Tel: (852) 2683-8235 Fax: (852) 2683-8240 E-mail: lamyn@ha.org.hk

Background

Laparoscopic cholecystectomy (LC) has been widely practiced in Hong Kong since 1990 and it is one of the most commonly performed operations in current surgical practice [1]. Although access trauma is much reduced compared with open cholecystectomy that requires a large incision, the conventional four port technique still leaves a patient with significant post-operative discomfort [2,3,4]. The two port LC was devised with the aim to decrease such discomfort, hence a shorter hospital stay and recovery period. Our previous prospective randomized controlled trial comparing two port versus four port LC has demonstrated the benefit of reducing port site wound pain in the two port group while the duration of hospital stay was similar between the two groups [5]. Two port technique is modified using needlescopic instruments, making the port site even smaller [6]. Recent reports in the literature suggest that post-operative nausea and vomiting (PONV) are common distressing complications following LC and it is a major factor in prolonging hospital stay [7,8,9]. Ondansetron is a potent prophylaxis against nausea and vomiting following chemotherapy [10] and its use for PONV has been documented [11,12,13,14]. This study was performed to evaluate the efficacy of ondansetron in preventing PONV following ambulatory two port needlescopic cholecystectomy (NC) in a prospective randomized trial. To the best of our knowledge, this is the first prospective randomized trial comparing antiemetic prophylaxis of PONV following two port NC

Patients and Method

Between August 2003 and May 2004, patients with symptomatic gallstones or benign gallbladder polyp scheduled for elective laparoscopic cholecystectomy were invited to join this study if they fulfilled the following specified criteria: (1) clinically and radiologically symptomatic gallstone disease, or gallbladder polyps smaller than 1cm, (2) American Society of Anaesthesiologists (ASA) grade I and II, (3) age between 18 and 70 years old, (4) post-operative home assistance was available. Patients were excluded in the study according to the following exclusion criteria: (1) body mass index greater than 28 [15], (2) history of upper abdominal surgery, (3) impaired liver function test, (4) suspected biliary tree obstruction, (5) concomitant pathology requiring additional surgical intervention, (6) allergic to ondansetron, (7) two port NC was unsuccessful and it included the addition of ports or conversion to open surgery. The study protocol obtained approval from the local ethics committee and written informed consent was obtained from all patients enrolled in the study.

Randomisation was carried out at the end of the operation at the time of gallbladder retrieval by computer generated random number inside a numbered, sealed, opaque envelope. Patients were randomly allocated to receive either a single dose of ondansetron 8mg given intravenously or nothing immediately after randomisation.

All patients received a standardised anaesthetic technique using isoflurane in the two hospitals. Under general anaesthesia and after administration of intravenous prophylactic antibiotic (cefuroxime 1.5gm), surgery was performed with a standard two-port needlescopic technique. In short, a 12 mm supra-umbilical port

and a 3 mm subxiphisternal port were created. 10mm operating telescope and 3mm needlescopic instruments were used for dissection. The cystic duct and artery were controlled with double Tayside extracorporeal knots before division[6]. At least one specialist surgeon who was familiar with the technique scrubbed up in the operation theatre and was in charge of the whole operation. The operating surgeon could decide on the use of additional ports or conversion as appropriate. Each surgical wound was infiltrated with 0.25% bupivacaine at the conclusion of surgery.

Post-operatively, a team of surgeon and nursing staff who were blinded to the study was responsible for managing these patients in the day surgery centres. Oral dologesic, ibuprofen or intramuscular injection of pethidine as required could be given for pain control. An intravenous injection of metoclopramide at 10mg per dose every eight hours could also be given for PONV as requested by the patients. The independent surgeon could discharge the patients on the same day when they were ambulatory and tolerated a normal diet. Those patients who could not meet the discharge criteria were admitted to hospital for further observation and management. All patients discharged on the day of operation received a telephone interview by an independent nurse one day after the operation. Any major complications were recorded and appropriate medical advice would be given to them if necessary.

The primary outcome measure was the degree of post-operative nausea and vomiting at 4 hours after the operation. PONV was scored according to a PONV scale from one to four (1= no symptoms, 2= symptoms not requiring pharmacological treatment, 3=symptoms relieved by pharmacological treatment and 4= symptoms not relieved by pharmacological treatment). Post-operative pain at 4 hours was scored using an unscaled 0-10 visual analogue scale (VAS) where 0 and 10 represent no pain and the most severe pain respectively. Other outcome measures including the length of post-operative stay and patient's overall satisfaction with the surgery were also recorded. Patient's satisfaction was rated by a 1-4 satisfaction score(1= very unsatisfied, 2= unsatisfied, 3=satisfied and 4= very satisfied).

Statistics

Several randomised prospective trials have studied the incidence of PONV after LC. The incidence in the placebo arm varied from 46 to 72% [13, 16, 17]. It was estimated that a sample size of around 40 patients in each group was required if the expected difference in the incidence of nausea and vomiting between the two groups was at least 30 %, with a power of 80% at the 0.05 level of significance. Categorical data were analysed with the chi square test or Fisher's exact test as appropriate. Continuous data were analysed by student's t-test if normally distributed or Mann-Whitney U test otherwise. All data were analysed by Statistical Package for the Social Science for Windows (SPSS version 10.0).

Results

81 patients were enrolled in the study from August 2003 to May 2004. Their ages ranged from 22 to 68 year old. 40 patients were randomized to the ondansetron group (O) and 41 patients were randomized to the control group (C). Demographically, there was no statistically significant difference between the 2 groups (Table 1). The incidence of PONV at 4 hours with a score greater than or equal to 2 (i.e symptoms that might or might not require pharmacological treatment) were 27.5% in the ondansetron and 39.0% in the control group respectively (p=0.271). 7 patients (17.5%) in the ondansetron group and 9 patients (22%) in the control group experienced vomiting (p=0.615). Among those patients who experienced PONV, only 5 patients (12.5%) in the ondansetron group and 5 patients (12.2%) in the control group required pharmacological treatment. The median PONV score at 4 hours was 1 (range: 1-4) in both groups and no significant difference was detected between the two groups (p=0.226). Both groups also had comparable mean operation times (54.3+/-19.9 minutes in O group versus 57.9+/-23.3minutes in C group; p=0.46). The mean post-operative pain score at 4 hours was also similar in both groups (3.8+/- 2.1 in C group versus 3.9+/- 1.9 in O group respectively (p=0.774). The need for post-operative

Table 1 Comparison of baseline characteristics and outcomes between ondansetron group and control group.

	Control group N=41	Ondansetron group N=40	P value
Male : Female	13: 28	15: 25	0.584
Age – years Mean (SD)	49.2 (8.6)	48.6 (10.9)	0.760
Incidence of PONV with score >or =2 (%)	16/41 (39.0)	11/40 (27.5)	0.271
No. of patients with vomiting (%)	9 (22)	7 (17.5)	0.615
PONV score at 4 hours Median (range)	1 (1-4)	1 (1-4)	0.226
Pain score at 4 hours Mean (SD)	3.8 (2.1)	3.9 (1.9)	0.774
Need for post-operative Analgesia (%)	17/41 (41.5)	15/40 (37.5)	0.715
Operation time (minutes) Mean (SD)	57.9 (23.3)	54.3 (19.9)	0.460
Satisfaction score Median (range)	4 (1-4)	4 (1-4)	0.996
No. of patients needing overnight hospital	2 (4.9)	1 (2.5)	1.000

analgesia was also comparable in both groups (37.5% in O group and 41.5% in C group, $p=0.715$). Most patients in both groups were highly satisfied with the operation and the median satisfaction score was 4 in both groups (range 1-4; $p=0.996$). All patients except 3 were discharged on the same day of operation (1 in O group and 2 in C group). One patient in the ondansetron group had significant post-operative pain in the day surgery centre and was observed overnight. He was discharged the next day. One patient in the control group had persistent low blood pressure and another patient had mild wheezing after the operation. Both patients could be discharged the next day after conservative management. No patients were readmitted. No other major post-operative complication was detected in our study.

Discussion

With the increase in popularity of minimally invasive surgery in past two decades and the constraints of tight budgeting in medical care today, there is a tremendous growth in ambulatory surgery in developed countries. However, it is estimated that about 30% of patients will have post-operative nausea and vomiting [18,19] and this is the major factor in prolonging hospital stay in ambulatory surgery [7,8,9]. The aetiology of PONV is multifactorial and it includes patient factors, anaesthetic factors and post-operative care [20]. In fact, laparoscopic surgery itself is a main risk factor for PONV and its incidence can be as high as 72% [17]. For laparoscopic cholecystectomy, PONV may be associated with stretching of the peritoneum due to CO₂ pneumoperitoneum and the gallbladder surgery itself [2]. Routine prophylaxis for PONV remains controversial. One recent large and multicentre European randomised controlled trial of post-operative nausea and vomiting ($n=5199$) has recommended single antiemetic prophylaxis in moderate risks patients and multiple antiemetics prophylaxis for high risks patients for the prevention of PONV [21].

Among the antiemetic prophylaxis used worldwide, droperidol, dexamethasone and ondansetron are the 3 commonly used drugs in recent published English literature. Ondansetron is a highly selective 5-HT₃ receptor antagonist and it is also a very potent antiemetic drug with few side effects. Its effectiveness in prevention of PONV following chemotherapy [10], surgery [11] and LC [12,13,17] is well documented. Our previous prospective randomised controlled trial [5] comparing two port versus four port LC has demonstrated the benefit of reducing port site wound pain in the two port group while the duration of hospital stay was similar in both groups. In order to minimise the effect of PONV, we used ondansetron as the antiemetic prophylaxis to conduct the first prospective randomised study comparing PONV in two port NC. There are some limitations in this study. We have tried to minimise the impact of patient factors in PONV by setting out the inclusion criteria and only good risk patients are recruited for ambulatory surgery. Patients could enter the randomisation process only if successful two port NC was performed. Patients with extremes of age and high body mass index (>28) were excluded from this study. In reality the surgery is usually performed for a heterogeneous group of patients especially the obese patient who has a higher incidence of symptomatic gallstone. Patient history of motion sickness is not recorded in this study and this is one of the important factors affecting PONV. Although we have standardized the anaesthetic technique using isoflurane, there may be minor differences in practice of the anaesthetic technique in the two hospitals as 2 groups of anaesthetists were involved in this study.

Based on the results of published ondansetron trials for LC [13,16,17,22], the incidence of PONV has ranged from 46 to 72% in control groups and 32 to 64% in ondansetron groups. In our study, our reported incidence of PONV is low compared with other studies.

The incidence of PONV at 4 hours after surgery was 27.5% in the ondansetron group and 39.0% in the control group. The incidence of PONV requiring pharmacological treatment was even lower with 12.5% in ondansetron group and 12.2% in the control group. The median PONV score at 4 hours was 1 (range 1-4) in both groups. Hence no beneficial effect was observed in the ondansetron group for prevention of PONV. We speculate that this may be due to the short duration of operation time which can effectively reduce the incidence of PONV. The median post-operative hospital stay in this study was even better than that (1 Vs 2 days) reported in our previous study [5] using a similar 2 port technique for LC. The reason behind this may be due to better patient selection in this study. Our results suggest that this is a negative antiemetic prophylaxis trial. Both groups of patients have similar demographics. However, there was no significant difference in the incidence of PONV, PONV score, pain score, need of post-operative analgesia, operative time and patient satisfaction score. Moreover, almost all the patients (78/81) in both groups could be discharged on the same day of operation. In conclusion, the prophylactic administration of 8mg ondansetron following 2 port needleoscopic cholecystectomy confers no additional benefit in good risk patients in terms of post-operative nausea and vomiting. Moreover ambulatory 2 port NC can be performed in good risk patients with high patient satisfaction.

References

- Chan AC, Chung SC, Lau JW, Brockwell J, Li MK, Tate JJ, Au KT, Li AK. Laparoscopic cholecystectomy: Results of first 300 cases in Hong Kong. *J R Coll Surg Edin* 1994; **39**:26-30.
- Fredman B, Jedeikin R, Olsfanger D, Flor B, Gruzman A. Residual pneumoperitoneum: a cause of pain after laparoscopic cholecystectomy. *Anesth Analg* 1994; **79**:152-4.
- Lee IO, Kim SH, Kong MH, Lee MK, Lim NS, Choi YS, Lim SH. Pain after laparoscopic cholecystectomy: the effect and timing of incisional and intraperitoneal bupivacaine. *Can J Anaesth* 2001 Jun; **48**(6): 545-50.
- Bisgaard T, Klarskov B, Trap R, Kehlet H, Rosenberg J. Microlaparoscopic versus conventional laparoscopic cholecystectomy: a prospective randomized double-blind trial. *Surg Endosc* 2002 Mar; **16**(3): 458-64.
- Poon CM, Chan KW, Lee DW, Chan KC, Ko CW, Cheung HY, Lee KW. Two-port versus four-port laparoscopic cholecystectomy. *Surg Endosc* 2003; **17**:1624-7.
- Lee KW, Poon CM, Leung KF, Lee DW, Ko CW. Two-port needleoscopic cholecystectomy: a prospective study of 100 cases. *Hong Kong Med J*. 2005; **11**:30-5.
- Madsen MR, Jensen KE. Postoperative pain and nausea after laparoscopic cholecystectomy. *Surg Laparosc Endosc*. 1992 Dec; **2**(4): 303-5.
- Patel N, Strogen CP, Patel B, Baker T. A comparison of the incidence of nausea after laparoscopic cholecystectomy and diagnostic laparoscopy. *Anesthesiol Rev*. 1993 Sep-Oct; **20**(5): 182-184.
- Frimer ML. Prevention of nausea after laparoscopic cholecystectomy. *Can J Surg*. 1995 Feb; **38**(1): 99.
- Hutcher ME. Global experience with Ondansetron. *Oncology* 1993; **50**: 191-197.
- Gan TJ, Collis R, Hetreed M. Double blind comparison of ondansetron, doperidol and saline in the prevention of postoperative nausea and vomiting. *Br J Anesth* 1994; **72**: 544-547.
- Helmey SAK. Prophylactic antiemetic efficacy of ondansetron in laparoscopic cholecystectomy under total intravenous anesthesia. *Anaesthesia* 1999; **54**: 266-269.
- Lieberman MA, Howe S, Lane M. Ondansetron versus placebo for prophylaxis of nausea and vomiting in patients undergoing laparoscopic cholecystectomy. *Am J Surg* 2000; **179**:60-62.
- So JBY, Cheong KF, Sng C, Cheah WK, Goh P. Ondansetron in the prevention of postoperative nausea and vomiting after laparoscopic cholecystectomy. *Surg Endosc* 2002; **16**:286-288.
- Goodwin AP, Ogg TW. Preoperative preparation for day surgery. *Br J Hosp Med* 1992 Feb 5-18; **47**(3): 197-201.
- Wilson EB, Bass CS, Abrameit W, Roberson R, Smith RW. Metoclopramide versus ondansetron in prophylaxis of nausea and vomiting for laparoscopic cholecystectomy. *Am J Surg*. 2001; **181**(2):138-141.

17. Naguib M, el Bakry AK, Khoshim MH, et al. Prophylactic antiemetic therapy with ondansetron, tropisetron, granisetron, and metoclopramide in patients undergoing laparoscopic cholecystectomy: a randomized, double-blind comparison with placebo. *Can J Anaesth* 1996;**43**:226–31.
18. Gan TJ. Postoperative nausea and vomiting – can it be eliminated? *JAMA* 2002; **287**:1233–6.
19. Kovac AL. Prevention and treatment of postoperative nausea and vomiting. *Drugs* 2000; **59**:213–43.
20. Palazzo MG, Strunin L. Anaesthesia and emesis. I : etiology. *Can Anaesth Soc J*. 1984; **31**:178–187.
21. Apfel CC, Korttila K, Abdalla M et al. A factorial trial of six interventions for the prevention of postoperative nausea and vomiting. *N Engl J Med*. 2004; **350(24)**:2441-2451.
22. Koivuranta MK, Laara E, Ryhanen PT. Antiemetic efficacy of prophylactic ondansetron in laparoscopic cholecystectomy. A randomized, double-blind, placebocontrolled trial. *Anesthesia* 1996; **51**: 52–5.

The Walk In Walk Out hernia clinic: A study of its cost effectiveness

R.A. Khan, R.P. Bhutiani

Abstract

Background: There is a significant amount of wastage and duplication in the treatment of routine operations such as hernias. We have assessed the cost savings of elective inguinal herniorrhaphy performed in a "Walk In Walk Out" (WIWO) hernia clinic as compared to day case or inpatient herniorrhaphy under general anaesthesia.

Methods and Results: This study includes 1106 patients listed for elective inguinal herniorrhaphy. 44.9% either did not attend or their operation was cancelled. There is a potential saving of approximately £700,000 per year by using the WIWO clinic protocol.

Interpretation: The WIWO protocol if followed for the majority of abdominal wall hernias could show very significant financial savings.

Keywords: Inguinal hernia; Herniorrhaphy; Local anaesthesia; Walk in walk out clinic; Cost effectiveness.

Authors' addresses: Dept. Surgery, Central Middlesex Hospital, NWLH, Acton Lane, NW10 7NS, London, U.K.

Corresponding author: R.P. Bhutiani Tel: +44 (0) 7762137050 E-mail: bhutiani@aol.com

Introduction

In the current environment, when the majority of National Health Service (NHS) Trusts are in heavy debt, it is imperative that we find ways to provide safe, efficient, cost effective and patient centred healthcare. A significant amount of resources are wasted because a number of patients either "Do Not Attend" (DNA) or their operations are cancelled due to bed shortages, restricted theatre time, emergencies admitted the night before, or they are found to be unfit on the day of surgery (Table 1) and due to poor organisation. Although inguinal herniorrhaphy under Local anaesthetic (L.A) has been shown to be associated with quick recovery, fewer complications and improved patient satisfaction, less than 10% of the operations are carried out under L.A in the NHS.

Nearly 120,000 new groin hernias are diagnosed every year in England. Almost 80,000 are referred to hospitals and 40,000 are

advised against surgery due to high co-morbidity (patients who are likely to occupy inpatient beds). [1] In a normal case scenario (Fig 1) a patient makes a minimum of 3 hospital visits and waits an average of 41–53 weeks (time from first visit to general practitioner to time of surgery) for herniorrhaphy. In our WIWO hernia clinic [1] we have reduced this into a two-step procedure (Fig 2) and by allowing the patient to choose their own date of operation to fit in with their life and work, we have reduced the DNA/Cancellation rate from 44.9% to <3%. The patients in the WIWO clinic have their consultation and operation in one single visit and leave the hospital 2–3 hours after operation. They do not need a regular follow up but have open access to the surgeon through his secretary. This reassures the patient and allows the surgeon to keep a check on his complications.

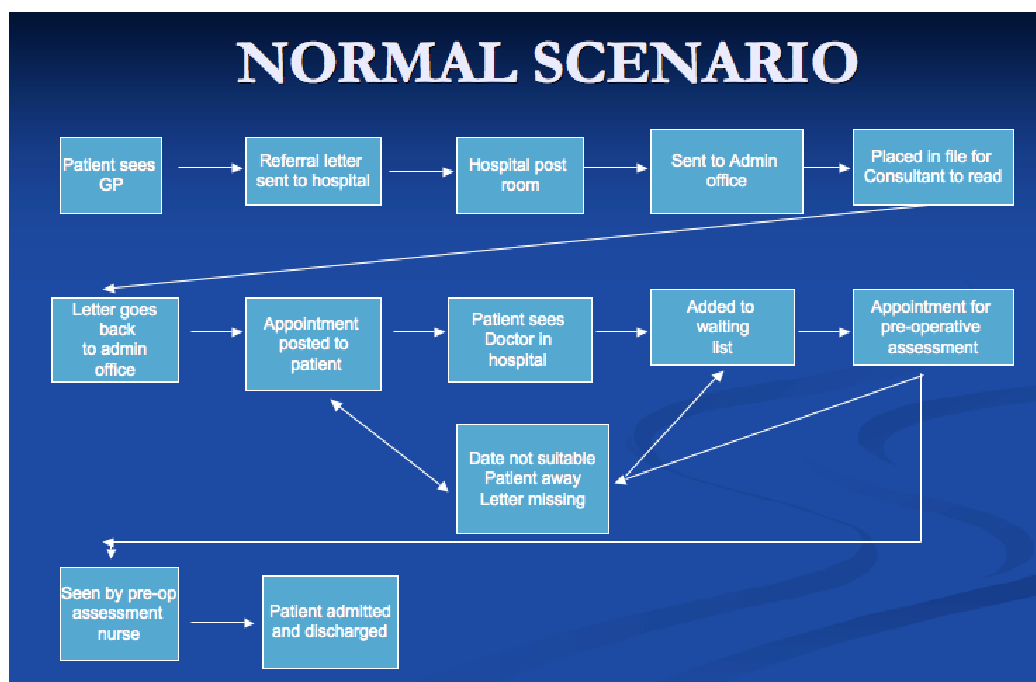


Figure 1

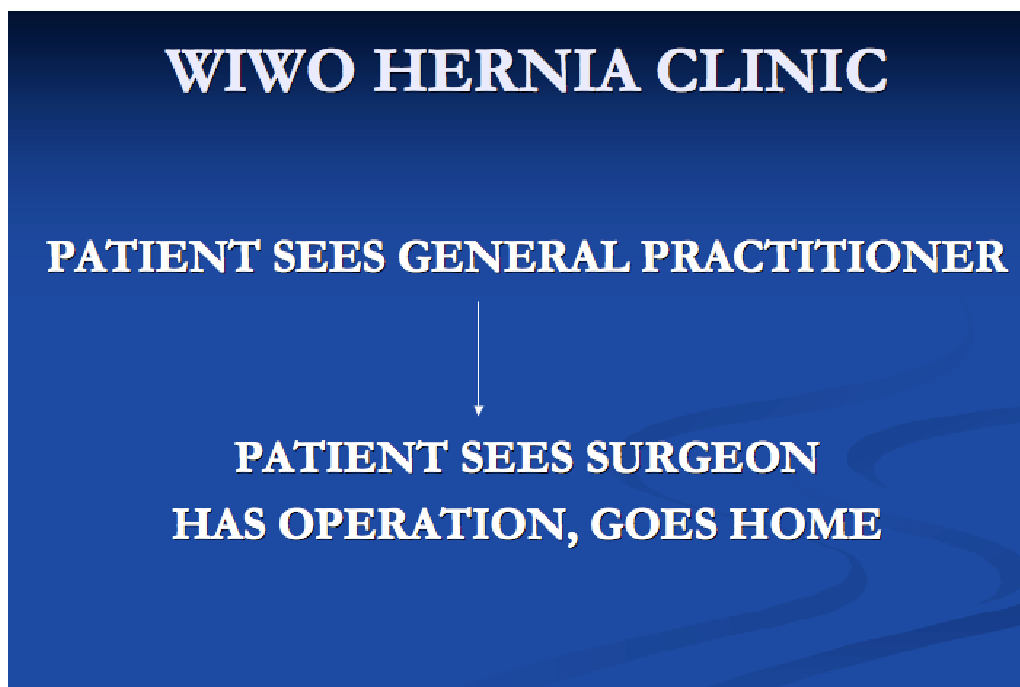


Figure 2

Patients and Methods

In this retrospective study, we examined the hospital records and operation notes of all adult patients (age 16 years+) who were given a date for inguinal herniorrhaphy between 1st March 2005–28th February 2006. We have studied the cost of inguinal herniorrhaphy under general anaesthetic (G.A) as a day case and as an inpatient as compared to the operation under local anaesthetic (L.A) in the WIWO hernia clinic. The type of treatment was the choice of the individual patient in conjunction with their general practitioner. A record was made of the DNA/Cancellation rates in the three groups and its financial implications. Data was collected from the computer generated data sheets and operation notes of all the patients. The perspective used in the cost analysis was from the financial officer of our Ambulatory Care and Diagnostic Centre (ACAD) and all the concerned departments involved. The costs of drugs and resources were calculated based on the actual acquisition cost to the centre. These included costs of pre-operative outpatient consultations, investigations, preassessment clinics; anaesthetic sessions, anaesthetic drugs and consumables, postoperative stay and follow up consultations. The cost of the pre-assessment clinic was calculated on the basis of investigations done, nursing and junior doctor's time and resources used.

Results

A total of 1106 patients were given a date for inguinal herniorrhaphy. 497 patients (44.9%) of the total, either DNA or were cancelled on the day after admission for various reasons (Table 1). The remaining 609 patients underwent a standard tension free mesh repair. 122 patients were treated in the WIWO clinic, 173 under G.A as a day case and 314 under G.A as inpatients. The patients operated on as inpatients stayed an average of 1.5 nights (Table 2).

The total cost of inguinal herniorrhaphy in our trust as a day case under GA is £1440. The same operation as an inpatient cost £1890 (£1440+£450). £450 is the average cost of an extra stay of 1.5 nights @ £300 per night. In the WIWO clinic the total cost is £1029 (Fig 3).

Table 1 Reasons for cancellations.

Anaesthetist not available/sick	1
Changed date admission (admin)	140
Error in input	54
Operation not required	3
Patient "DNA"	44
Patient already treated	5
Patient cancelled TCI	129
Patient not fit	77
Surgeon cancelled operation	3
Surgeon not available	24
Patient refused operation	1
Session over run	7
No reason given	1
Bed shortage	7
Further investigations required	1
Total	497

We have recorded a financial saving of £411 per patient, when a patient was operated on according to the WIWO clinic protocol, as compared to when operated under G.A as a day case. This resulted in a total saving of £50,142 over the year (£411 per patient x 122 patients). However, when compared to the cost of operation as an inpatient, the savings totalled £105,042 (£861x 122).

Scrutiny of the operation notes of all the operated patients revealed that 90% of the patients operated on as day cases or as inpatients under G.A were suitable to have their operation in the WIWO hernia clinic. If all these patients were treated according to the WIWO clinic protocol, we estimate an additional potential saving of £308,247

Table 2 Duration of inpatient stay.

No. of patients	Duration of stay (days)	Total no. of bed days
246	1	246
38	2	76
13	3	39
6	4	24
1	5	5
5	6	30
2	7	14
2	9	18
1	15	15
314		467

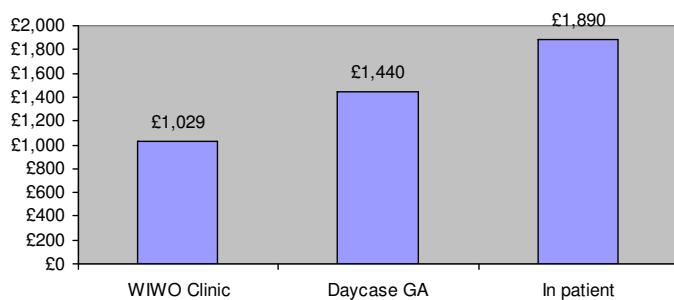


Figure 3 Cost of hernia repair.

(£243,663 from inpatient cases and £64,584 from day cases).

Total treated as day cases under G.A	173
Total suitable for WIWO clinic (90%)	156
Potential saving	£414x 156 = £64,584
Total treated as inpatient	314
Total suitable for WIWO clinic (90%)	283
Potential savings	£ 861x283 = £243,663

These real and potential savings shown above do not include the potential cost savings of £349,391 (@ £703 per patient) from lost revenue due to DNA/Cancellation (Table 3). By giving the patients the choice to decide the date of their operation, we have reduced the DNA/cancellation rate, from 44.9% to <3% in the WIWO hernia clinic (Fig 4).

Discussion

Increasing demands on the hospital trusts to keep to targets and stay within the confines of limited resources has forced the medical profession to develop more efficient, cost effective and, above all, patient centred treatment protocols for routine surgical procedures of which inguinal herniorrhaphy is one of the commonest. It comprises 12% of elective surgical procedures in the UK and is one of the six elective procedures with the longest waiting times. It has been estimated that it costs the health service in England and Wales nearly 15 millions pounds per year². Reducing the number of unnecessary hospital visits, routine pre-operative investigations and allowing the patients to choose the date of their procedure to fit in with their life and work, is one significant way forward in making huge financial

Table 3 Cost of inguinal herniorrhaphy.

	Cost
Outpatient clinic	£177
Pre-assessment with investigations	£128
	BREAKDOWN: ECG £47, CXR £60, FBC / U & E £7, PRHO £7, NURSE £7
Correspondence	£17
Anaesthetic session /patient	£65
Anaesthetic con- sumables	£24
Recovery nurse	£16
Bed used/ day	£300
DNA/cancellation cost	£703 (177+128+17+65+16+300)

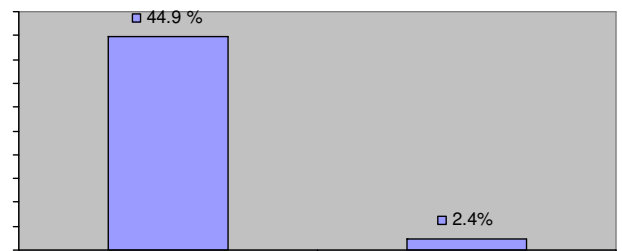


Figure 4 DNA cancellation rates.

savings for the NHS, without compromising patient care.

In 2005-2006, the majority of NHS Trusts have been in major financial crisis with reported debts of up to 20 million pounds. There have been job losses, bed closures, hospital closures and curtailment of services. A significant amount of money is wasted when patients DNA or are cancelled by the hospitals on the day of surgery. We have shown that for routine procedures such as herniorrhaphy, if the patients are given a choice of making an appointment for both consultation and the operation, on the dates that best suit their life and work, rather than being dictated to by the hospitals, the number of DNA/cancellations and its associated cost in wasted resources can be reduced dramatically. Our study has shown that in our Trust there is a potential to save approximately £657,638 in one year from inguinal herniorrhaphy alone. If the same WIWO hernia clinic protocol was adopted for other hernias such as umbilical, para-umbilical and epigastric and across all the NHS trusts, the savings could run into millions of pounds every year.

In an extensive literature search, we have not been able to find any publication giving a detailed breakdown of the costs involved in hernia repair as a day case under GA and LA. Most of the studies point out that hernia repair done under local anaesthesia is a low cost procedure and is the most cost effective method though the cost saving differs in different regions.

A study in Denmark by Callesen et al reported a cost reduction of £160 per patient in inguinal hernia repair done under LA as compared to the cost under general/regional anaesthesia. The authors, as in our study, reported an average of £50 savings per patient by avoiding unnecessary routine pre-operative investigations.[3] We

have in addition dramatically reduced the DNA/cancellation rate from 44.9% to <3% by giving the patients the choice of fixing the date of their operation. This has very significant potential financial implications.

In Belgium Van den Oever R and Debbaut B reported that the mean treatment cost of inguinal herniorrhaphy was 53,704 BEF for inpatients as compared to 30,510 BEF, as a day case under GA and 27,501 BEF for outpatients under LA. This shows nearly 10% savings for inguinal herniorrhaphy under LA as compared to day case under GA and 49% compared to under GA as an inpatient.[4]

Song D et al in the USA reported an extensive study comparing the cost of inguinal herniorrhaphy under LA and under GA. They have shown a significant difference in total anaesthetic costs which were \$132.73 +/- 33.80 in the LA group as compared to \$172.67 +/- 31.03 in the GA group. [5] However this study did not compare the total cost of the operation. In addition, the authors used intravenous propofol sedation in patients undergoing inguinal herniorrhaphy under LA. This we feel is unnecessary and requires the presence of a qualified anaesthetist in the operating theatre, a cost that we have been able to save, as the surgeon himself induces the nerve and infiltration block.

Studies done at the British Hernia Centre in England also show that the direct and indirect costs of anaesthesia for inguinal herniorrhaphy are lowest when using local anaesthesia with or without sedation. [6, 7] However, no details of the costs were mentioned.

Our study concurs with the work of Sanjay et al.[8] in that patients with unilateral reducible inguinal hernia can have their hernias operated in the WIWO clinic, irrespective of their ASA status.

Our study has shown significant cost savings and potential savings for inguinal herniorrhaphy, when performed according to the WIWO clinic protocol. If other abdominal wall hernias such as umbilical, para-umbilical and epigastric are repaired the same way, there is a potential for saving of millions of pounds.

Conclusions

Herniorrhaphy performed according to the WIWO hernia clinic protocol, is patient centred, extremely cost effective and is suitable for the majority of patients with significant co-morbidities who would normally occupy acute inpatient beds. This protocol if repeated across all the NHS trusts and for the majority of abdominal wall hernias could show very significant financial savings and release inpatient beds.

References

1. Daniel R Leff, Rajinder P. Bhutiani. Give the patients the choice- the Walk in Walkout (WIWO) hernia clinic. *J Ambulatory Surgery* 2006;12:125-129.
2. McPherson K. Variations in hospitalization rates: why and how to study them. In Ham C, ed. Health Care Variations: assessing the evidence. London:Kings Fund Institute, 1988.
3. Callesen T, Bech K, Kehlet H. The feasibility, safety and cost infiltration anaesthesia for hernia repair. *Anaesthesia*. 1998;01:31-35.
4. Van den Oever R, Debbaut B. Zentralbl *Cost analysis of inguinal hernia surgery in ambulatory and inpatient management*. 1996:836-40.
5. Song D, Greillich NB, White PF, Watcha MF, Tongier WK. Recovery profiles and costs of anesthesia for outpatient unilateral inguinal herniorrhaphy. *Anesth Analg*. 200 Oct;91(4):876-81.
6. Kark AE, Kurzer M, Waters KJ. Tension-free mesh hernia repair: review of 1098 cases under local anaesthesia in a day unit. *Ann R Coll Surg Engl*. 1995; 77(4):299-304.
7. Kark AE, kurzer MN, Belsham PA. Three thousand and one hundred seventyfive primary inguinal hernia repairs: Advantages of ambulatory open mesh repair using local anaesthesia. *J Am Coll Surg*. 1998 Apr; 186(4):447-55.
8. Sanjay P, Jones P, Woodward A. Hernia. Inguinal hernia repair: are ASA grades 3 and 4 patients suitable for day case hernia repair? 2006; 10(4):299-302. Epub 2006 Apr 1.

The Effect of General Anaesthesia on Post-operative Cognitive Function in the Ambulatory Setting: A Literature Review

A.T. Ratcliffe

Abstract

This review focuses on the post-operative recovery of cognitive function following general anaesthesia in day case surgery. A MEDLINE and bibliography search of the current literature revealed 41 articles that were included in this analysis. The effects of the inhalational agents sevoflurane, desflurane and isoflurane along with intravenous propofol were examined. An earlier return to baseline cognitive function was found in the sevoflurane and desflurane groups though this was only statistically

significant within the first hour of recovery. However, these agents were associated with considerable nausea and vomiting when compared to propofol. Post-operative cognitive dysfunction in the elderly undergoing ambulatory surgery was also addressed in this review. Current evidence on this subject appears limited, though there is some data suggesting a link between the two.

Keywords: Cognitive function, ambulatory surgery, postoperative cognitive dysfunction, inhalational anaesthetics.

Author's address: Medical Student, University of Leeds Medical School, School of Medicine, Level 7, Worsley Building, University of Leeds, LS2 9JT.

Corresponding author: A.T. Ratcliffe Tel +44 (0) 7743761669 E-mail: ugm4atr@leeds.ac.uk

Introduction

There have been a number of studies reporting that following surgical procedures under general anaesthesia (GA) many patients experience significant delays in regaining full cognitive functions, notably learning, memory, attention, concentration and verbal capabilities. [1] There appears little doubt that a definite decline in neurological ability occurs following GA, yet the degree of functional decline and the speed of recovery has considerable inter-patient variability and may also be associated with the type, depth and length of anaesthesia as well as the surgical procedure itself.

The extent of cognitive deterioration following surgery has a significant impact on the health of the patient during the immediate post-operative period and is associated with prolonged hospital recovery, greater morbidity and delays in functional recovery. [2] This is of considerable importance for patients admitted for day case surgery and for those considered more vulnerable to the effects of anaesthesia, i.e. the elderly. This review focuses primarily on these two subsets of patients and systematically examines the evidence for and the extent of cognitive deterioration in these groups.

Methods

A MEDLINE search of peer reviewed, published, full text articles in the English language between the years of 1980–2007 was performed. Papers examining the cognitive effects of the inhalational anaesthetic agents sevoflurane, desflurane and isoflurane were identified by using search terms including, but not limited to: cognitive function, post-operative cognitive decline, general anaesthesia (including listing the aforementioned anaesthetic agents), day case surgery and ambulatory setting. Additional methods of accessing articles were through reviewing the bibliography of the relevant articles.

Papers included in this review required a study size of at least 20 subjects who had their cognition assessed pre-operatively and

post-operatively using one of the acknowledged cognitive tests (eg. digit-symbol substitution test, mini mental state, cognitive failings questionnaire). Articles analysed in this review include randomised control trials, observational studies, previous review articles and case control studies.

Exclusion criteria included anaesthetics in the paediatric setting, studies in which patients stayed in hospital for longer than one night post-operatively and those involving only single subjects i.e. case reports and case series.

General Anaesthesia in Ambulatory Surgery

In an era where many elective procedures are being performed in day case units, delays in patients regaining full mental capacities following general anaesthesia has significant implications for the viability of such units. Advances in anaesthetics have seen the development of drugs with a shorter onset, reduced duration of action and fewer side effects [3]. Consequently it is expected that patients will achieve levels of cognition in-line with their pre-operative state within hours of the procedure and thus allow same day discharge to occur.

The short and long term effects of these newer volatile agents on post-operative cognition have not been systematically reviewed. Several studies report differences in the timing of and recovery from GA depending on the anaesthetic used. While most suggest patients achieve pre-operative cognitive function within hours of the procedure some studies suggest that the effects may last much longer than anticipated and affect a patient's functional capabilities for several days. [4]

Choice of anaesthetic agent and cognitive function Propofol vs sevoflurane

Research in Italy [5] examined the post-operative recovery in patients undergoing day surgery and anaesthetically maintained with either

propofol or sevoflurane. Cognitive function, assessed using the digit-symbol substitution test (DSST) was significantly decreased at 60, 90 and 120 minutes post-operatively in patients given propofol. Although this study only had a small sample size thus reducing the reliability of the conclusion, similar findings of improved cognition in patients given sevoflurane have been reported in a number of other investigations.[6,7]

These results conflict with those of Larsen and colleagues who compared the cognitive function in patients after remifentanyl and propofol anaesthesia to those given desflurane or sevoflurane. Those subjects randomised to the remifentanyl/propofol arm were achieving 87% and 98% correct answers to DSST questions at 30 and 60 minutes respectively, whilst the sevoflurane arm only achieved 78% correct answers at 30 minutes after termination of the anaesthetic. [8]

One should also be aware of a report by Sanou and colleagues which found that up to three hours after cessation of propofol anaesthesia patients still had a noticeable reduction in higher cognitive functions, but by 6 hours levels had returned to the preoperative state. [9]

Propofol vs desflurane

Of the papers comparing the outcome after propofol or desflurane anaesthesia two found a significant difference in post-operative cognitive functioning. An investigation by Apfelbaum [10] found that not only was recovery much faster in the desflurane group, but subjects achieved higher psychomotor scores one hour after anaesthesia compared to those given propofol. After one hour there was no difference between the groups. These results were concordant with the findings of an earlier study comparing post-operative cognitive function using the same anaesthetic criteria. [11] Other studies comparing the two agents have not examined the cognitive impairment, but have concluded that desflurane consistently results in a more rapid recovery after anaesthesia than propofol. [12,13]

Propofol vs isoflurane

Maintenance with propofol compared to isoflurane has also been studied by a number of investigators. [3,14,15] Pollard [14] found that psychomotor functioning in both study groups (i.e. those given either propofol or isoflurane) had returned to baseline characteristics at 24 hours. However, in the immediate period following surgery propofol was associated with an increased ability to maintain concentration and speed in the cognitive tasks set. Similar outcomes have also been demonstrated by Valanne. [15]

Sevoflurane vs desflurane

Studies comparing recovery following maintenance with either desflurane or sevoflurane in the ambulatory setting have found convincing evidence of more rapid recovery in those patients given desflurane. [16,17] However, attainment of psychomotor function following anaesthesia has produced less compelling evidence. A study by Tarazi [18] examined the percentage of patients able to perform DSST during the postoperative period. Sevoflurane was associated with marginally better results, particularly in the first 15 and 30 mins after termination of the anaesthetic, but later the differences were considerably smaller and throughout the 2 hour post-operative period examined there were no significant differences between the two agents. These results are consistent with other investigations [16,19] which also suggest that there is no significant difference in cognitive dysfunction following anaesthesia with sevoflurane or desflurane for day-case surgery.

Sevoflurane vs Isoflurane

It has been shown that for prolonged operations of greater than 1 hour, sevoflurane offers a faster recovery of cognition when compared to isoflurane. [20,21] Yet, although not extensively investigated, this recovery profile does not appear to be replicated in the ambulatory setting. A recent study by Mahajan and colleagues examined the

cognitive recovery profiles of 71 elderly patients undergoing ambulatory surgery and anaesthetised with either sevoflurane or isoflurane. They examined the extent of cognitive impairment at 1, 3 and 6 hours post-operatively and concluded that there was no statistical difference between the groups during this period. [22]

Other investigators have produced evidence to the contrary. The Sevoflurane Multicenter Ambulatory Group, compared the recovery profile of the two inhalational © 2008, International Association for Ambulatory Surgery agents and found patients maintained with sevoflurane performed better in the psychomotor tests at 60 mins post procedure than those given isoflurane. [23]

Issues surrounding cognitive testing in the ambulatory setting

Many of the tests used to measure the degree of cognitive deterioration have considerable limitations which will affect the degree of neurological impairment detected in the patient. With some of the more simple tests employed in the studies, (DSST, MMSE), there is the potential for patients to “learn” the correct responses. This is the so-called “practise effect” which has been documented in a number of investigations. [24,25,26] Patients who are able to adapt to the tests in such a way will appear to have higher levels of cognition than suggested by the investigations.

Other issues affecting the test include variability resulting from different examiners administering the test, time of day the test was performed and distractions in the examining room, especially if performed as a bed side test on the ward. [26] Consequently it has been suggested that rather than using one single test, as was the case in several trials reviewed [1,2,8,11], a test battery (i.e using multiple cognitive function tests) such as that used in the ISPOCD study [27] may be more appropriate.

This too however has been reported to have significant limitations. The results of the ISPOCD study show that the degree of decline detected in the population increased as the number of test parameters increased. For example, when only one test was used the percentage of patients found to have an element of cognitive decline was 0.6%, whereas at five test parameters 29% of patients had detectable cognitive impairments. [26] Thus as more parameters are included there appears to be a greater likelihood of identifying at least one area of cognitive deterioration.

Limitations of the studies

The conclusions made from these studies with regards to which agent offers optimal post-operative cognitive recovery must be held with some significant caution. Although many of the studies suggest some form of cognitive decline occurs following surgery, the methods by which the authors conducted their anaesthesia and the tests used to measure cognitive deterioration varied quite considerably across the papers reviewed.

1. The depth of anaesthesia induced and maintained for the procedures may have a significant impact on the patient’s recovery profile. [28] Several trials [1,2] used the bispectral index (BIS) to ensure that all groups studied were anaesthetised to the same comparable depth. This will assist in the post-operative period when comparing the effects of the anaesthetic. Many other studies [8,10,11,16,22] did not use such methods to rule out confounding factors and consequently the conclusions offered by these papers may not be as accurate or indeed as viable as others.
2. The lack of a universally accepted method of measuring cognition means that the authors used tests with somewhat different sensitivities. There has been extensive research into the DSST with regards to its efficacy [29,30] and consequently it was used as the main method of cognitive evaluation in several papers.

Table 1 Early, intermediate and late cognitive effects of anaesthetic agents used in the trials analysed in the review. (Prop = propofol, sevo = sevoflurane, remi = remifentanyl, des = desflurane, iso = isoflurane).

Study	Maintenance anaesthetic used	Cognitive effects early (30 min)	Cognitive effects intermediate (60 min)	Cognitive effects late (>60 min)	Conclusion
Peduto [5]	Prop vs sevo	Sevo better	Sevo better	Sevo better	Sevo better
Raeder [6]	Prop vs sevo	Sevo better	No difference	No difference	Sevo faster up to 60 min
Wandel [7]	Prop vs sevo	Sevo better	Sevo better	Sevo better	Sevo better
Larsen [8]	Remi vs sevo vs des	remi<des<sevo		No difference	Remi faster up to 60 min
Apfelbaum [10]	Prop vs des	Des better	No difference	No difference	Des better up to 60 min + more rapid recovery
Song [12]	Prop vs des	Des better	Des marginally better	No difference	Des better up to 60 min
Van Hemelrijck [13]	Prop vs des	Des better	Des better	No difference	Des better up to 60 min
Pollard [14]	Prop vs iso	Prop better	No difference	No difference	Prop better in early stages
Valanne [15]	Prop vs iso	Prop better	Prop better	Prop better	Prop better
Nathanson [16]	Sevo vs des	No difference	No difference	No difference	No difference
Wellborn [17]	Sevo vs des	No difference	No difference	No difference	No difference
Tarazi [18]	Sevo vs des	Sevo better	No difference	No difference	Sevo better in early stages
Mahajan [22]	Sevo vs iso	No difference	No difference	No difference	No Difference
Philip [23]	Sevo vs iso	Sevo better	Sevo better	No difference	Sevo better in early stages

[8,16,23] Nevertheless a number studies measured their outcome by different means (Maddox Wing Test,[10,14] Mini mental state exam [1,2,22]). There exists a possibility that the findings of one study using, for example the MMSE may not have been replicated if another, more sensitive test had been employed; thereby suggesting that the results may be more dependent on the measuring tool used rather than the anaesthetic regime implemented.

3. Within individual studies the method for induction was maintained as a constant, however inter-paper differences in drugs used to induce anaesthesia showed some considerable variability which may lead to a difference in the final outcome of the paper. Similarly, the residual effect of drugs required as premedication or for use intra-operatively may influence the post-operative cognitive recovery in certain patients. [3]

Neuropsychological testing for cognitive deterioration – does statistical difference equate to clinical significance?

The question remains, therefore, whether cognitive function needs to be formally assessed as a routine measurement of fitness for discharge. Currently it is not standard practise to assess neurological function following general surgical procedures. Following operations in the ambulatory setting, most patients are discharged within 6 hours of the operation. Neurological testing in the studies outlined above have shown that regardless of the anaesthetic used, there appears to be some form of statistical decline in cognition in the immediate post-

operative period. Yet by one hour following surgery the studies report little, if any difference between the anaesthetics used.

One may infer from this that early statistical differences (i.e. within the first hour), although interesting to note and potentially useful in pre-operative planning, should not significantly affect patient care plans or discharge times.

Anaesthetic Implications

Post-operative recovery following general anaesthesia needs to take into account numerous factors including post-operative nausea and vomiting, analgesia, time spent in PACU and time to discharge. The success or otherwise of the anaesthetics used in the studies has been analysed solely on the basis of post-operative recovery of cognitive function. Consequently the implications drawn from these studies relate purely to the ability to fully regain mental capabilities after general anaesthesia.

The ideal anaesthetic for day case surgery must not affect mental capabilities for long periods of time. The use of volatile agents that have a lower solubility and thus are more rapidly eliminated from the body leading to a decreased exposure to the anaesthetic appears to have some correlation to the recovery of cognitive function. The papers suggest that sevoflurane and desflurane, both of which have relatively low solubilities, have favourable cognitive effects over isoflurane (higher solubility) and propofol.

Although the inhalational agents provide an earlier return of cognitive

function, they are associated with considerable nausea and vomiting when compared to propofol.[3] A balance must be found between drugs that provide a rapid recovery of post-operative cognition with those that have minimal side effects. Additionally, in the current climate of unprecedented financial attention being paid to the NHS and where rapid turnover of patients is a fundamental to hospital outcome, anaesthetists need to be aware of the costs associated not only with the agents themselves but also those incurred by prolonged hospital stay following surgery.

The studies offer statistical evidence that sevoflurane and desflurane offer equal and superior outcomes to isoflurane and propofol. However these advantages appear exclusively limited to the immediate (<1hour) post-operative period. The clinical implications of this would therefore appear much less significant considering that very few patients would be discharged within this time period.

Post-operative Cognitive Dysfunction in the elderly population undergoing minor/ambulatory surgery

Post-operative cognitive dysfunction (POCD) is defined as a decline in mental capabilities such as concentration, memory, perception and problem solving abilities which last for weeks or months following surgical procedures.[31] The risk of developing POCD appears closely related to increasing age and type of surgery. Numerous studies have shown significant associations between cardiac surgery and the development of POCD in the elderly population. More recently this link has been extended to major non-cardiac surgery and there exists extensive reviews of these subject areas. [32,33] The development of POCD after ambulatory surgery, although not as extensively investigated, has also produced some viable evidence which, until now, has not been collated and reviewed.

A recent study by the ISPOCD2 investigators [34] enrolled 372 patients aged 60 and over who were admitted for minor procedures involving either 1 night's postoperative stay or same day discharge. All patients underwent general anaesthesia. They found that at 7 days and 3 months post procedure 6.8% and 6.6% of patients had some form of POCD respectively. However, when examined more closely, the incidence of cognitive failings at 7 days was significantly higher in those patients who spent 1 night in hospital (Table 2). They suggested that hospital stay significantly effects the development of POCD in the immediate post-operative period. [34]

Table 2 Adapted from Canet J. et al Cognitive dysfunction after minor surgery in the elderly. [34]

Risk	Incidence of POCD	
	7 days	3 months
All patients	6.8%	6.6%
Inpatient	9.8%	8.8%
Outpatient	3.5%	4.5%

Although these findings are consistent with others,35 the results must be interpreted with caution. The apparent large difference between the inpatient and outpatient incidence of POCD may not be a true reflection on the development of cognitive decline but rather more directly related to patient comorbidities and hospital factors. Those patients in the same day discharge group were generally fitter than their counterparts in the inpatient cohort; similarly patients were not randomised into the two groups, the decision being left to individual

hospital protocols and the physician's preference. [34] Consequently direct comparisons and concrete conclusions are difficult to gain with certainty from this trial. Nevertheless, it does highlight that even after minor surgical procedures the elderly may still be at risk of developing some form of cognitive dysfunction.

Rohan et al [36] also examined the effect of general anaesthesia on the development of POCD in the elderly population (aged ≥ 73) undergoing minor procedures. Although patient recruitment numbers were significantly lower than in the previous trial (30 cf. 372), the authors still found a significant increase in cognitive deterioration in the first 24 hours following surgery; 47% of patients had experienced POCD, compared to only 7% of the control group. Clearly the small sample size of this study may cause the results to be disproportionately high yet the close matching of the control and study group combined with the strict adherence to guidelines [37] relating to the measuring of POCD give the results some significant strength.

The suggestion that cognitive decline occurs within the first 24 hours post-operatively and may continue for up to 3 days has considerable implications on the immediate care and advice given to patients. However, there is also evidence to suggest that patients are capable of full cognitive capabilities at the time of discharge from ambulatory surgery. [38]

Cohen [38] compared patients admitted for day case surgery involving either local or general anaesthesia and examined their post-operative cognitive function prior to discharge. In contrast to the findings of the previous papers, the authors found no clinically significant cognitive deterioration in patients given either local or general anaesthetic and concluded that patients could safely be discharged with full cognitive function on the same day as surgery. These conclusions however carry considerable caveats. Not only was the sample size particularly small (20 patients) but the age range of the subjects was much broader than in the previous papers (range from 21–45). The development of POCD in middle aged patients has been shown to be much reduced when compared to the elderly population [39, 40] which may account for the low occurrence of cognitive failings in this study.

At 24 hours post procedure, Heath [41] produced findings in line with the Cohen study in that there appeared to be no deterioration in cognitive function in their cohort of patients undergoing surgery. There was however a detectable difference at 1 and 2 hours after termination of the anaesthetic.

The results from a study by Tzabar [4] appear to offer further evidence of an apparent prolonged cognitive decline of up to 3 days in patients receiving general anaesthesia for day case surgery. Cognitive deterioration was measured by asking patients to fill in a cognitive failings questionnaire during the 3 days following surgery. As the answers to this survey required patients to individually complete the forms at home, problems of patient apathy in correctly answering the questions and potential for subjects to become confused or uncertain as to the exact timing of events means that the accuracy of the answers given may not be as high as other cognitive tests carried out under the supervision of healthcare practitioners.

Anaesthetic Implications

The papers published appear to present conflicting evidence as to the extent of POCD following ambulatory surgery. Whilst there appears to be some evidence of a link between the two, the limited number of trials specifically examining this area of anaesthesia makes definite conclusions challenging. Similarly, significant problems of patient recruitment and inconsistencies in the data collection methods between each paper create difficulties in detailing with any certainty the incidence of POCD in this group of patients.

Nevertheless, the research indicates the potential for a link to exist and consequently physicians should be cautious in their post-operative care plans, particularly with regards to elderly patient discharge. The possibility of POCD presenting late, (i.e. after 24 hours) suggests that patients should be monitored for longer periods of time and their mental state closely monitored for subtle signs of decline. The PACU provides a suitable opportunity to assess these areas, yet the vast number of methods available for testing cognitive function presents problems in ensuring adequate assessment has been made.

The need to develop a standardised cognitive function test has already been discussed. Such a test would identify those patients whose cognition has been significantly impaired following surgery and thus improve patient safety regarding discharge times and advice. It would also allow further research into this area of anaesthetics to confirm or refute the evidence as it currently stands.

Conclusions

Cognitive decline following anaesthesia in the ambulatory setting may be significantly more prevalent than previously realised. It appears that the inhalational agents offer a faster return to the pre-operative cognitive state than their intravenous alternatives, yet the considerable side effects of these drugs also need consideration. The need for close post-operative observation of neurological decline in addition to functional recovery needs to take place. Before policies concerning the immediate care of ambulatory patients are significantly altered further research into postoperative cognitive function needs to be undertaken and methods of testing such variants standardised.

Post-operative cognitive decline in patients undergoing day case procedures also requires further investigation. Preliminary studies suggest there may be an associated deterioration in cognitive function; however the papers are limited and provide conflicting evidence. Nevertheless, the suggestion that POCD may develop up to and beyond 24 hours post procedure should be taken seriously and physicians and patients should be vigilant for subtle signs of cognitive impairment.

Learning points

- Inhalational agents offer superior cognitive recovery profiles when compared to the commonly used intravenous agent propofol
- Sevoflurane and desflurane should be considered for ambulatory surgery if rapid cognitive recovery is required amongst the elderly population may also occur in the ambulatory setting

Future research

- An agreement needs to be made regarding which neurological test is most appropriate to evaluate cognitive decline in the immediate postoperative period
- Further research into POCD in the ambulatory setting is required to determine the extent of the condition following minor operative procedures

References

- 1 Rohm K.D., Piper S.N., Suttner S. et al. Early recovery, cognitive function and costs of a desflurane inhalational vs. a total intravenous anaesthesia regimen in long-term surgery. *Acta Anaesthesiologica Scandinavica* **50**: 14–18 (2006).
- 2 Chen X., Zhao M., White P.F., et al. The recovery of cognitive function after general anaesthesia in elderly patients: a comparison of desflurane and sevoflurane. *Anaesthesia and analgesia* **93**:1489–1494 (2001).
- 3 Gupta A., Stierer T., Zuckerman R. et al. Comparison of Recovery Profile After Ambulatory Anesthesia with Propofol, Isoflurane, Sevoflurane and Desflurane: A Systematic Review. *Anaesthesia and analgesia* **98**:632–641 (2004).
- 4 Tzabar Y., Asbury A.J., Millar K. Cognitive failures after general anaesthesia for day case surgery. *British Journal of Anaesthesia* **76**:194–197 (1996).
- 5 Peduto V.A., Mezzetti D., Properzi M. et al Sevoflurane provides better recovery than propofol plus fentanyl in anaesthesia for day –case surgery. *European Journal of Anaesthesiology* **17**:138–143 (2000).
- 6 Raeder J, Gupta A, Pedersen FM. Recovery characteristics of sevoflurane – or propofol –based anaesthesia for daycare surgery. *Acta Anaesthesiol Scand*; **41**: 988–994 (1997).
- 7 Wandel C, Neff S, Bohrer H, et al . Recovery characteristics following anaesthesia with sevoflurane or propofol in adults undergoing out –patient surgery. *Eur J Clin Pharmacol*; **48**: 185–188 (1995).
- 8 Larsen B., Seitz A, Larsen R. Recovery of cognitive function after remifentanyl –propofol anaesthesia: comparison with desflurane and sevoflurane anaesthesia. *Anaesthesia and Analgesia* **90**:168 (2000).
- 9 Sanou J., Goodall G., Capuron L. et al. Cognitive sequelae of propofol anaesthesia. *Neuroreport* **7**:1130–1132 (1996).
- 10 Apfelbaum J.L., Lichtor J.L., Lane B.S., et al Awakening, clinical recovery and psychomotor effects after desflurane and propofol anaesthesia. *Anaesthesia and analgesia* **83**:721–725 (1996).
- 11 Wrigley S.R., Fairfield J.E., Jones R.M., et al. Induction and recovery characteristics of desflurane in day case patients. A comparison with propofol. *Anaesthesia* **46**:615–622 (1991).
- 12 Song D., Joshi G.P., White P. Fast track eligibility after ambulatory anaesthesia: a comparison of desflurane, sevoflurane and propofol. *Anaesthetics and analgesia* **86**:267–273 (1998).
- 13 Van Hemelrijck J., Smith I., White P.F. Use of desflurane for out patient anaesthesia: a comparison with propofol and nitrous oxide. *Anaesthesiology* **75**:197–203 (1991).
- 14 Pollard B.J., Bryan A., Bennett D., et al Recovery after oral surgery with halothane, enflurane, isoflurane or propofol anaesthesia. *British Journal of Anaesthesia* **72**:559–566 (1994).
- 15 Valanne J. Recovery and discharge of patients after long propofol infusion vs isoflurane anaesthesia for ambulatory surgery. *Acta Anaesthesiol Scand*; **36**: 530–533 (1992).
- 16 Nathanson M.H, Fredman B, Smith I, et al. Sevoflurane versus desflurane for outpatient anaesthesia: a comparison of maintenance and recovery profiles. *Anesthesia and Analgesia*; **81**:1186–90 (1995).
- 17 Welborn L.G., Hannallah R.S., Norden J.M, et al. Comparison of emergence and recovery characteristics of sevoflurane, desflurane, and halothane in pediatric ambulatory patients. *Anesth Analg*; **83**:917–20(1996).
- 18 Tarazi E.M., Philip B.K. A comparison of recovery following sevoflurane and desflurane in ambulatory anaesthesia. *Journal of Clinical Anaesthesia*. **10**(4):272–277 (1998).
- 19 Heavner J.E., Kaye A.D., Lin B.K., et al Recovery of elderly patients from two or more hours of desflurane or sevoflurane anaesthesia. *British Journal of Anaesthesia* **91**(4):502–506 (2003).
- 20 Ebert, T.J, Robinson, B.J, Uhrich, T.D et al.. Recovery from sevoflurane anaesthesia: a comparison to isoflurane and propofol anaesthesia. *Anesthesiology*; **89**: 1524–1531 (1998).
- 21 Campbell, C., Nahrwold, M.L., Miller, D.D. Clinical comparison of sevoflurane and isoflurane when administered with nitrous oxide for surgical procedures of intermediate duration. *Can J Anaesth* 1995; **42**: 884–890.
- 22 Mahajan V.A., Chonghaile M. Ni., Bokhari S.A., et al. Recovery of older patients undergoing ambulatory anaesthesia with isoflurane or sevoflurane. *European Journal of Anaesthesiology*. **24**(6): 505 –510 (2007).
- 23 Philip B.K., Kallar S.K., Bogetz M.S., et al. A multicentre comparison of maintenance and recovery with sevoflurane or isoflurane for adult ambulatory anaesthesia. The sevoflurane multicentre ambulatory group. *Anesthesia and analgesia* **83**:314–319 (1996).
- 24 Galasko D., Abramson I., Corey-Bloom J., et al. Repeated exposure to the Mini Mental State Examination and the Information Memory Concentration Test results in a practise effect in Alzheimer's Disease. *Neurology* **43**(8):1559–1653 (1993).

- 25 Matarazzo J.D., Herman D.O. Base rate data for the WAIS-R: test - retest stability and VIQ - PIQ differences. **Journal of Clinical Neuropsychology** 6: 351 -366 (1984).
- 26 Rasmussen L.S., Larsen K., Houx P., et al. The assessment of postoperative cognitive function. **Acta Anaesthesiologica Scandinavica** 45:275-289 (2001).
- 27 Moller J.T., Cluitmans P., Rasmussen L.S., et al. for the ISPOCD investigators. Long-term postoperative cognitive dysfunction in the elderly: ISPOCD I study. **Lancet** 351: 857-861 (1998).
- 28 Farag E., Chelune G., Schubert A., et al. Is depth of anesthesia, assessed by the bispectral index, related to postoperative cognitive dysfunction and recovery? **Anesthesia and analgesia** 103(3): 633 -640 (2006).
- 29 Iohom G., Collins I., Murphy D., et al Postoperative changes in visual evoked potentials and cognitive function tests following sevoflurane anaesthesia. **British Journal of Anaesthesia** 87(6):855 - 859 (2001).
- 30 Tsai S.K., Lee C, Kwan W.F., et al Recovery of cognitive functions after anaesthesia with desflurane or isoflurane and nitrous oxide. **British Journal of Anaesthesia**; 69: 255-8 (1992).
- 31 Rasmussen L.S. Postoperative cognitive dysfunction: incidence and prevention. **Best practice and clinical anaesthesiology**. 20:2;315 -330 (2006).
- 32 Newman S., Stygall J., Shashivadan H., et al. Postoperative cognitive dysfunction after noncardiac surgery: A systematic review. **Anesthesiology** 106(3):572 -590 (2007).
- 33 van Dijk D, Keizer A.M.A., Diephuis J.C., et al Neurocognitive dysfunction after coronary artery bypass surgery: A systematic review. **Journal of Thoracic and Cardiovascular Surgery** 120:632-9 (2000).
- 34 Canet J., Raeder J., Rasmussen L.S., et al. Cognitive dysfunction after minor surgery in the elderly. **Acta Anaesthesiologica Scandinavica** 47:10 1204 -1210 (2003).
- 35 Smith C, Carter M, Sebel P, Yate P . Mental function after general anaesthesia for transurethral procedures. **British Journal of Anaesthesia**; 67: 262- 8 (1991).
- 36 Rohan D., Buggy D.J., Crowley S., et al. Increased incidence of postoperative cognitive dysfunction 24hr after minor surgery in the elderly. **Canadian Journal of Anaesthesia** 52:137-142 (2005).
- 37 Rasmussen L.S., Larsen K., Houx P., et al The assessment of postoperative cognitive function. **Acta Anaesthesiologica Scandinavica** 45:275-289 (2001).
- 38 Cohen R.L., MacKenzie A.I. Anaesthesia and cognitive functioning. **Anaesthesia** 37:47-52 (1982).
- 39 Smith R.J., Roberts N.M., Rodgers R.J., et al. Adverse cognitive effects of general anaesthesia in young and elderly patients. **International Clinical Psychopharmacology** 1:253 -259 (1986).
- 40 Johnson T., Monk T., Rasmussen L.S et al. Postoperative cognitive dysfunction in middle aged patients. **Anesthesiology** 96:1351-1357 (2002).
- 41 Health P.J., Ogg T.W., Gilks W.R., Recovery after day case anaesthesia. **Anaesthesia** 45:911-915 (1990).

Day Surgery for knee arthroscopy, open hernia repair and laparoscopic cholecystectomy anaesthetic routine and practice: The Results from a Swedish Nationwide Survey

J Jakobsson^{1,2}, M. Warrén Stomberg^{3,4}, N Rawal⁵, M Brattwall⁶, M Segerdahl⁷

Abstract

The aim of the present survey was to get an overview of anaesthetic routines in Sweden for three specific cases: knee arthroscopy, herniorrhaphy and laparoscopic cholecystectomy. A questionnaire was sent to all anesthesiology departments in Sweden. Knee arthroscopy was scheduled as day surgery in all, herniorrhaphy in 70/73 units and laparoscopic cholecystectomy in 34/65 units. General anaesthesia was the most common anaesthetic technique. Pain management was based on paracetamol (acetaminophen)/NSAID/weak-opioid in 95% of units

Keywords: day surgery, discharge, postoperative pain, analgesics, PONV, survey.

Authors' addresses: ¹Karolinska Institute ²Foot & Ankle Surgery Clinic, Stockholm ³University of Skövde; School of Life Sciences, Skövde,

⁴Göteborg University, Sahlgrenska Academy, Institute of Health and Care Sciences, Göteborg

⁵Department of Anesthesia and Intensive Care, Örebro University Hospital, Örebro

⁶Sahlgrenska University Hospital/Mölndal, Unit of Day Care Surgery, Göteborg Department of Physiology and Pharmacology, Unit for Anaesthesia,

⁷Dept of Clinical Science, Intervention and Technology, Unit for Anaesthesia, Karolinska Institute, Stockholm Sweden.

Corresponding author: Märta Segerdahl CLINTEC Unit for Anesthesia, Karolinska Institutet at Karolinska Universitetssjukhuset Huddinge, S-141 86 Stockholm, Sweden. E-mail: marta.segerdahl@ki.se

with intravenous opioid as in-hospital rescue medication. Take-home analgesics were provided by 71% of units, often including strong opioids. Most common complaints on day 1–2 postoperatively were pain, emesis and wound dressing problems. In conclusion, routines were uniform, but pain is still a major problem, in spite of provision of adequate take-home analgesics.

Introduction

Day surgery, defined as arriving and leaving the hospital on the day of surgery, without overnight stay, has grown dramatically and now accounts for the majority of numbers of performed operations in Europe and North America, >60%. However, routines vary between countries [1–3].

There are many reasons for the increased adoption of day care surgery. Cost reduction is the most important driving factor. Other important factors are also the development of minimally invasive surgery and improved anaesthesia including drugs with rapid offset of action. Also, it may be perceived by patients as an advantage to return to home to a familiar environment as soon as possible. Especially children and elderly are groups that may benefit from early/same day discharge to recuperate in familiar surroundings [4,5]. Nevertheless, early discharge calls for a vigilant plan to ascertain not only safety but also adequate quality of care, e.g. management of pain and nausea and rehabilitation.

The aim of the present survey was to gain an overview of current clinical routines around three explicit surgical procedures in adult patients: knee arthroscopy, herniorrhaphy and laparoscopic cholecystectomy.

Methods

A Swedish national survey was sent to 92 anaesthesia departments in Sweden, regarding their institutional routines at their day surgery units. With this survey, an appended section included questions on

three hypothetical procedure-specific patients' cases. The study was performed during February 2006 to April 2006. The study aimed at patient routines for day surgery performed January – December 2005. Written reminders were sent three times to non-responders followed by a telephone call if the questionnaire was still not returned.

Ambulatory surgery was defined as elective surgery routinely requiring some kind of anaesthesiology service intraoperatively, not scheduled for in-house overnight stay. We wanted the answers restricted to the general consensus of the day surgery unit(s). Most questions had a multiple choice design part with an open subquestion asking for additional information or comments. Several responses could be given to the same question.

The three cases were:

- Patient A: A healthy man, 31 yrs old, undergoing knee arthroscopy after a sports injury.
- Patient B: A man, 74 yrs old, ASA class I–II, undergoing herniorrhaphy.
- Patient C: A woman, 53 yrs old, ASA class I–II, undergoing laparoscopic cholecystectomy.

Questions asked were aimed at whether this particular procedure was performed as day surgery, the standard method of anaesthesia, and routines for pain relief in the PACU and after discharge, regarding type of drug, drug combinations, take-home drugs and prescriptions provided. The same was asked about routines for anti-emetics.

In addition, rates of overnight admission and readmission to hospital

were inquired. For some questions more answers than number of units are provided, as some units gave several alternatives. All questions had the opportunity for the responder to give an extra comment.

All data was entered into a computerized database by an independent assistant and processed using the Statistical Package for the Social Sciences (SPSS version 14.0). Only descriptive statistics were performed including frequency counts, percentages, mean or median value and standard deviation or range. To clarify the varying degree of internal missing data, i.e. not all questions in the questionnaire were responded to, the total number of answers and % of possible given responses are provided, e.g. data on cholecystectomy are given as % of units actually performing cholecystectomy.

Results

The overall response rate to the questionnaire was 88%, 81 of the 92 departments. Seventy-four units responded that they normally performed knee arthroscopy as day surgery, median 100% (range 90–100) of cases. Only one centre answered that they more or less routinely had the arthroscopy patients as in-patients. For herniorrhaphy, 70 units normally performed this as day surgery, in 95% (range 30- 100) of their hernia cases, while three units had in-hospital care only. Laparoscopic cholecystectomy was normally performed as day surgery in 34 units and as in-house procedures in 31 units. The rate of day vs. in-house surgery varied between 0 and 100%. Seven units reported all laparoscopic cholecystectomies being performed as day surgery (Table 1).

In 94% of units, an anaesthetist performed preoperative assessments. At 60% of the units, preoperative assessments were performed prior to arrival in the day surgical unit, while at the rest of units this was done at the day of surgery most often just prior to anaesthesia start. Anxiolytic premedication was provided in 38% of units, in a majority of cases with a low dose of an oral benzodiazepine.

Knee arthroscopy was performed under general anaesthesia at 68 out of 74 units and commonly maintained by inhalational anaesthetics.

Anesthesia method was local infiltration anaesthesia/peripheral blocks alone was used only by 4 units, and spinal anaesthesia by two (Table 1). For herniorrhaphy, anaesthesia techniques varied. Local and regional blocks only was the preferred technique at 19 units, spinal anaesthesia at 4 and epidural at one unit (Table 1). Laparoscopic cholecystectomy was always performed under general inhalational anaesthesia, sometimes combined with local wound infiltration or intercostal block (Table 1).

Pain management was generally based on a multi-modal approach, where 94% of units used a combination of paracetamol (acetaminophen) and NSAID/Coxib as basal pain medication. Pain management was initiated prior to surgery with paracetamol (acetaminophen) at 95% and an NSAID at 73% or a Coxib at 15% of units. Written guidelines for rescue pain medication based on pain intensity assessments by VAS score was routine at 85% of units. Most commonly set cut-off for rescue analgesia was a VAS of 33 (44%) or 34 (43%). Immediately postoperatively, classical strong opioids, IV morphine or ketobemidone, were the most commonly used rescue analgesics by 41 and 11 units, respectively. Tramadol was used on a regular basis at 9 units and alfentanil at 4 units.

At discharge, patients were often provided with “take-home medication” as well as a prescription for analgesics. Take-home medication was provided for a median of 2 days, range 1–14, for all three procedures (Table 2). A strong oral opioid was frequently included in the “take-home-medication package” (Table 3). The amount of oral opioids was 4 tablets for knee arthroscopy patients reporting severe pain during recovery and 3 tablets for patients undergoing herniorrhaphy and laparoscopic cholecystectomy, respectively (Table 3). Prescriptions for analgesics were common after all three procedures (Table 2), including a variety of drugs (Table 4).

Only 1 in 5 units provided take-home and 3 in 5 units provided prescriptions for anti-emetics (Table 2).

A regular structured follow-up system covering the first 30 days after surgery including registration of major adverse events and readmission was not standard. Twenty-seven units (34%) had a formal follow-up of admission/readmissions (Table 5). Admissions and readmissions rates were in average low, 2.2% (0-90%) and 1 (0- 3%)

Table 1 Routine for three surgical procedures results from the questionnaire survey.

	Knee arthroscopy (n=74)	Inguinal hernia repair (n=70)	Laparoscopic Cholecystectomy (n=34)
Day surgery vs. In-hospital surgery (no of units)	74/1	70/3	34/31
<i>Preferred anaesthetic technique (number of units)</i>			
Regional Anesthesia			
Spinal/ epidural	2/0	4/ 1	0
TIVA	15	6	15
Inhaled GA	41	23	33
GA + local	6	1	0
Local anesthesia / peripheral blocks	4	19	0
Combinations	7	17	2

Table 2 Routines for pain medication following discharge.

	Knee arthroscopy	Inguinal hernia repair	Laparoscopic Cholecystectomy
Take-home only	15	25	9
Prescription only	19	8	5
Both	29	32	17
Anti-emetics take-home only	1	3	5
Anti-emetics prescription only	4	3	3
Both	0	0	2

Table 3 Provision of strong opioids.

	Knee arthroscopy	Inguinal hernia repair	Laparoscopic Cholecystectomy
<i>Opioids provided? (number of units)</i>			
No	40	30	19
Sometimes, "if needed"	34	27	15
Routinely	0	13	6
<i>Number of Tablets</i>			
Median (range)	4 (1-8)	3 (2-10)	3 (2-8)

respectively. The most common cause for admission/readmission was severe pain for all three procedures, followed by micturition problems in herniorrhaphy patients, PONV in cholecystectomy and more extensive surgery for knee arthroscopy (Table 6).

At 40 percent of units, nurses acquired qualitative but not quantitative information by telephone follow-up on day 1–2 after surgery. Problems encountered were mainly related to pain and nausea, related to perceived severity, incidence and number of units reporting it (Fig 1). A common reply on follow-ups was that there were few complications, and that good written information sheet was helpful but could have been more extensive.

Discussion

The present survey of routines for 3 specific cases, displayed a diverse picture, with practice varying considerably between units as well as between surgical procedures. Both knee arthroscopies and herniorrhaphy were predominantly performed as day cases. There was a wide variability between units for hernia repair, while laparoscopic cholecystectomy was routinely performed as a day surgery operation in about 50% of units only. Our frequency data should of course be interpreted with caution, as there are always limitations with questionnaire surveys. We aimed at gathering as robust data as possible by asking for numbers and proportions of surgical procedures from institutional yearly statistics, and by asking that the anaesthetist in charge of the day surgery unit to be responsible for providing accurate information. Our results, showing a diverse adaptation of day-surgery, are much in line with earlier studies and also with the figure provided by the International Association for Ambulatory Surgery [1–3]). Our figures are also coherent with official figures from the Swedish Health Authority Board [6]. Knee arthroscopy was only rarely scheduled for in-hospital care. Knee arthroscopy has been reported to be safely and effectively managed and can even safely move out of the day surgery unit into the office-based setting [7]. Herniorrhaphy was

mainly performed as day surgery, but the estimated percentage varied considerably between units and the reported routines for doing day surgery laparoscopic cholecystectomy was far lower than figures from the USA [1]. When compared to the figure of 83% reported from Norway, which should be comparable considering general overall health care similarities, our numbers were lower: however, it should be taken under consideration that the Norwegian results are reported from only one centre, specialized in laparoscopic surgery [8]. It is not possible to make any firm conclusion from the present survey as to why the adaptation of day surgery varies. Other authors have also reported great variability in day surgery adaptation between both different areas and hospitals in the same region [9].

General balanced anaesthesia was the most commonly used anaesthetic technique in all three procedures. For elective knee arthroscopy there are studies comparing general anaesthesia to both regional anaesthesia and local anaesthesia only, supporting the use of local anaesthesia without additional drugs for routine meniscus resection or in combination with light sedation when needed (7, 10). For more complex procedures the failure rates with local anaesthesia have been shown to increase [7]. The low use of regional anaesthesia was a change from the results of an earlier Swedish survey from 1995 [11]. Selective spinal anaesthesia has been suggested as an alternative for arthroscopic meniscus resections, but the 2-hour time to home readiness may be considered as too long in many units [12]. Two of the reason for the common use of balanced general anaesthesia are difficulties in predicting when local anaesthesia will be insufficient and the rapid onset as well as fast recovery associated to modern general anaesthetics, in line with the British routines [13].

For herniorrhaphy, more diversity was found in choices of routine anaesthetic techniques. A number of different methods have been suggested. Some studies advocate local anaesthesia with or without add-on general anaesthesia [14, 15]. Local infiltrational anaesthesia is becoming increasingly popular, but is used as a main anaesthetic only in a few units. Similarly to knee arthroscopy, spinal and epidural

Table 4 Drug choices for analgesics.

	Type of surgery		
	Knee arthroscopy (n=74)	Inguinal hernia repair (n=70)	Laparoscopic Cholecystectomy (n=34)
Analgesics			
Take-home analgesics			
Paracetamol	39	51	22
NSAID	36	39	15
Coxib	1	1	2
Dextropropoxyphen	6	10	5
Codeine	5	7	0
Tramadol	11	13	5
Oxycodone	0	11	7
Choice of strong opioid if needed (no of units)			
Oxycodone	16	22	14
Morphine	1	2	1
Ketobemidon	4	7	5
Prescription analgesics			
Paracetamol	24	25	17
NSAID	34	23	20
Coxib	1	1	3
Dextropropoxyphen	1	2	1
Codeine	6	5	0
Tramadol	12	13	7
Non-specified weak opioid	-	-	9
Ketobemidone	1	1	2
Oxycodone	3	4	1
Non-specified strong opioid		5	3

Table 5 Day surgery units recording unplanned admissions and readmissions.

Yes	27 (34%)	
No	33 (42%)	
Missing	19 (24%)	
Specialty	Admissions	Readmissions
Surgery	4% (range 0–90%)	1% (range 0–3%)
Orthopaedics	2,8% (range 0–7%)	1% (range 0–2%)
Gynaecology	2,2% (range 0–11%)	1% (range 0–1%)

anaesthesia were uncommon. Spinal anaesthesia has been associated with delayed discharge [16], as reported from two units in the present study where this was an important reason for overnight admission. Inhalational anaesthetic technique with an IV induction and the use of laryngeal mask airway is a simple, safe and cost effective technique allowing rapid discharge [17]. Laparoscopic surgery requires general anaesthesia and intubation is still preferred although papers describing positive experience from the use of laryngeal mask airway have been

published [19]. Unfortunately, we did not include more explicit questions around other adjunct drugs in the perioperative period that have shown to have major positive influence on recovery and patients' satisfaction [20].

A pain management regime based on a combination of analgesics, in accordance with abundant evidence-based recommendations, improves efficacy and reduces adverse effects [21]. Both herniorrhaphy and laparoscopic cholecystectomy are included in the PROSPECT

Table 6 Readmissions.

<i>Herniorraphy (noted by 19 out of 27 units):</i>	
Most important symptom causing readmission	no of units
pain	5
micturition difficulties	4
bleeding	2
social issues	3
late hours	2
dizziness	1
PONV	1
extended surgery	1
<i>Cholecystectomy (noted by 8 out of 27 units)</i>	
Most important symptom causing readmission	no of units
pain	3
PONV	4
extended surgery	2
fatigue	1
late hours	1
dizziness	1
<i>Knee arthroscopy (noted by 12 out of 27 units)</i>	
Most important symptom causing readmission	no of units
pain	3
extended surgery	3
suspected infection	2
PONV	2
mobilisation difficulties	1
extended spinal block	1
dizziness	1

library on procedure-specific pain strategies, and both include local anaesthesia, paracetamol and NSAID as basis for the pain management [22–24]. It was also reassuring to note that a majority of units had routines both as to evaluation of pain and provision of intravenous rescue analgesia while in hospital. Provision of take-home medication was surprisingly common but the amount of tablets and the selection of analgesics varied considerably. Even strong opioids were, however, not uncommonly provided after hernia repair as well as after cholecystectomy. This has been considered effective and safe also in the ambulatory setting [25]. Still, admission/readmission was frequently associated to pain and need for supplemental analgesia. Structured follow-up was infrequent and it is therefore impossible to evaluate perioperative care vs. outcome. Approximately 50% of units had some form of nurse-performed telephone follow-ups on postoperative day 1–2 providing more of qualitative than quantitative information. Interestingly, in spite of the fact that patients to a large extent received a take-home package of analgesics, often including strong opioids, and that they were provided with a prescription including weak as well as strong opioids, postoperative pain was a common problem encountered on phone follow-up. It is of course not possible to give any explicit reason for the commonly addressed

pain queries. The main pain problem is known to often occur after discharge, when perianaesthetic analgesia has worn off and patients begin to mobilise [26]. Contributing factors may be that the information on how to take analgesics is often sparse, and yet of great importance for patient treatment compliance. The importance of adequate and extensive information to the daysurgical patient has been emphasised repeatedly and further improvements in patient preparation and information indeed seem warranted [27, 28]. In addition, postoperative nausea and vomiting (PONV) was a frequent complaint at follow-up. Provision of take-home and or prescribe anti-emetics was far more neglected than pain medication and further efforts in the management of PONV should be taken. In fact, PONV was noted as an important reason for hospital admission and readmission.

In Sweden 2005, day-surgery practice for the three procedures studied varied; with knee arthroscopy and herniorraphy almost routine as day-surgery while laparoscopic cholecystectomy was still often scheduled as an in-hospital procedure in about 50% of units. General balanced anaesthesia was the most common anaesthetic technique but local anaesthesia with adjunct sedatives was becoming increasingly popular for knee arthroscopy and herniorraphy. The

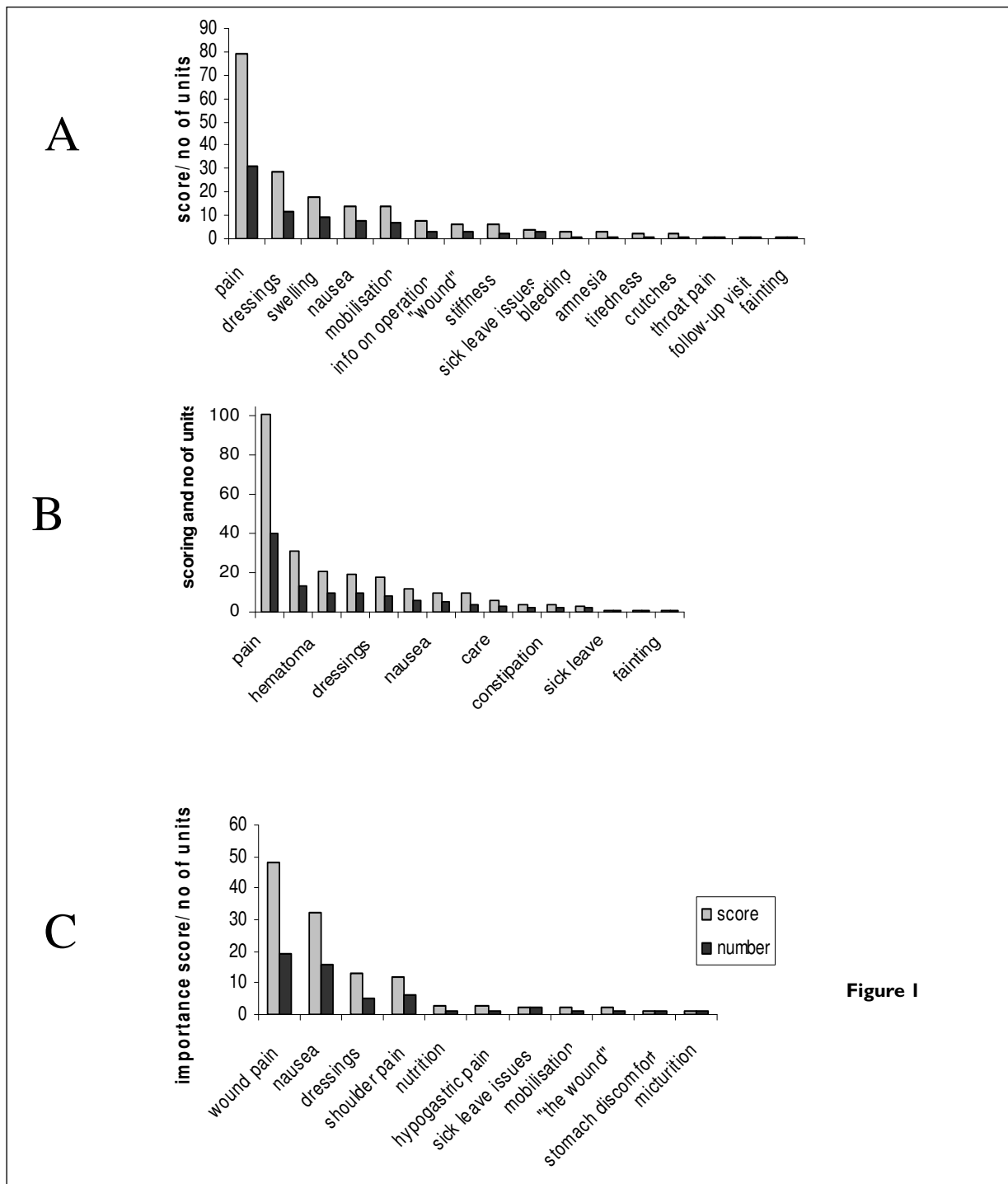


Figure I

awareness and attitude towards pain is reassuring, and take home medication, including strong oral opioids when needed, is commonly provided. There is however room for improvement in structured outcome follow-ups in order to evaluate and compare practices. From the qualitative data gained on phone-follow-up improvement in information around the overall postoperative course including clear guidance for pain management, prophylaxis and treatment of PONV, wound care and rehabilitation are warranted.

References

1. Pregler JL, Kapur PA. The development of ambulatory anesthesia and future challenges. *Anesthesiol Clin North America*. 2003;21:207–28.
2. De Lathouwer C, Poullier JP. How much ambulatory surgery in the World in 1996–1997 and trends? *Ambul. Surg*. 2000;8:191–210.
3. Jarrett PEM, Staniszewski A. The development of ambulatory surgery and future challenges. In: *Day surgery development and practice*: International Association for Ambulatory (IAAS), 2006:21–34.
4. Canet J, Raeder J, Rasmussen LS, Enlund M, Kuipers HM, Hanning CD, Jolles J, Korttila K, Siersma VD, Dodds C, Abildstrom H, Sneyd JR, Vila P, Johnson T, Munoz Corsini L, Silverstein JH, Nielsen IK, Moller JT; ISPOCD2 investigators. Cognitive dysfunction after minor surgery in the elderly. *Acta Anaesthesiol Scand*. 2003; 47: 1204–10.
5. Lonnqvist PA, Morton NS. Paediatric day-case anaesthesia and pain control. *Curr Opin Anaesthesiol*. 2006; 19: 617–21.
6. Hospital Discharge Registry 2005, Socialstyrelsen Sweden, National Board of Health and Welfare.
7. Jacobson E, Forssblad M, Rosenberg J, Westman L, Weidenhielm L. Can local anesthesia be recommended for routine use in elective knee

arthroscopy? A comparison between local, spinal, and general anesthesia.

Arthroscopy 2000; **16**: 183–90.

8. Skattum J, Edwin B, Trondsen E, Mjaland O, Raede J, Buanes T.

Outpatient laparoscopic surgery: feasibility and consequences for education and health care costs. **Surg Endosc**. 2004; **18**: 796–801.

9. Smith I. Dissecting the myths of surgery: the anaesthetist's view. **J Perioper Pract**. 2006; **16**: 244–8.

10. Miskulin M, Maldini B. Outpatient arthroscopic knee surgery under multimodal analgesic regimens. **Arthroscopy** 2006; **22**: 978–83.

11. Holmstrom B., Rawal N., Arner S., Gilmartin J. & Erkal S. The use of central regional anesthesia techniques in Sweden: results of a nation-wide survey. Swedish Association of Anesthesia and Intensive care Contemporary day surgery: patients' experience of discharge and recovery Patients' experiences at home after day case cystoscopy. **Acta Anaesthesiol Scand** 1997; **41**, 565–72.

12. Korhonen AM, Valanne JV, Jokela RM, Ravaska P, Korttila KT. A comparison of selective spinal anesthesia with hyperbaric bupivacaine and general anesthesia with desflurane for outpatient knee arthroscopy. **Anesth Analg**. 2004; **99**: 1668–7

13. Payne K, Moore EW, Elliott RA, Pollard BJ, McHugh GA. Anaesthesia for day case surgery: a survey of adult clinical practice in the UK. **Eur J Anaesth** 2003; **20**: 311–24.

14. Kehlet H, Aasvang E. Groin hernia repair: anesthesia. **World J Surg**. 2005; **29**: 1058–61.

15. Nordin P, Zetterstrom H, Gunnarsson U, Nilsson E. Local, regional, or general anaesthesia in groin hernia repair: multicentre randomised trial. **Lancet**. 2003; **362**: 853–8.

16. Gupta A, Axelsson K, Thorn SE, Matthiessen P, Larsson LG, Holmstrom B, Wattwil M. Low-dose bupivacaine plus fentanyl for spinal anesthesia during ambulatory inguinal herniorrhaphy: a comparison between 6 mg and 7.5 mg of bupivacaine. **Acta Anaesthesiol Scand**. 2003; **47**: 13–9.

17. Dolk A, Cannerfelt R, Anderson RE, Jakobsson J. Inhalation anaesthesia is cost-effective for ambulatory surgery: a clinical comparison with propofol during elective knee arthroscopy. **Eur J Anaesth** 2002; **19**: 88–92.

18. Maltby JR, Beriault MT, Watson NC, Liepert D, Fick GH. The LMA-ProSeal is an effective alternative to tracheal intubation for laparoscopic cholecystectomy. **Can J Anaesth**. 2002; **49**: 857–62.

19. Lu PP, Brimacombe J, Yang C, Shyr M. ProSeal versus the Classic laryngeal mask airway for positive pressure ventilation during laparoscopic cholecystectomy. **Br J Anaesth**. 2002; **88**: 824–7.

20. Bisgaard T, Klarskov B, Kehlet H, Rosenberg J. Preoperative dexamethasone improves surgical outcome after laparoscopic cholecystectomy: a randomized double-blind placebo-controlled trial. **Ann Surg**. 2003; **238**: 651–60.

21. Kamming D, Chung F, Williams D, McGrath BM, Curti B. Pain management in ambulatory surgery. **J Perianesth Nurs**. 2004; **19**: 174–82.

22. Kehlet H, Gray AW, Bonnet F, Camu F, Fischer HB, McCloy RF, Neugebauer EA, Puig MM, Rawal N, Simanski CJ. A procedure-specific systematic review and consensus recommendations for postoperative analgesia following laparoscopic cholecystectomy. **Surg Endosc**. 2005; **19**: 1396–415. 1

23. Neugebauer EA, Wilkinson RC, Kehlet H, Schug SA; PROSPECT Working Group. PROSPECT: a practical method for formulating evidence-based expert recommendations for the management of postoperative pain. **Surg Endosc** 2007; **21**: 1047–53.

24. <http://www.postoppain.org/>

25. Reuben SS, Steinberg RB, Maciolek H, Joshi W. Preoperative administration of controlled-release oxycodone for the management of pain after ambulatory laparoscopic tubal ligation surgery. **J Clin Anesth**. 2002; **14**: 223–7.

26. Mattila K, Toivonen J, Janhunen L, Rosenberg PH, Hynynen M. Postdischarge symptoms after ambulatory surgery: first-week incidence, intensity, and risk factors. **Anesth Analg**. 2005; **101**: 1643–50.

27. Bandyopadhyay M, Markovic M, Manderson L. Women's perspectives of pain following day surgery in Australia. **Aust J Adv Nurs**. 2007; **24**: 19–23.

28. Watt-Watson J, Chung F, Chan VW, McGillion M. Pain management following discharge after ambulatory same-day surgery. **J Nurs Manag**. 2004; **12**: 153–61.

Subarachnoid hematoma following spinal anesthesia

*Izaskun Emazabel-Yunta MD**, *Isabel Casado-Campo MD*, *Sorkunde Telletxea-Benguria MD PhD*, *Fernando Torre-Mollinedo MD*, *Luis Fernando Ortega Largo MD* and *Antón Arízaga Maguregui, MD*

Abstract

We conducted a survey on anaesthesia practise for ambulatory surgery in The Netherlands with the purpose of identifying patterns and comparing them to published recommendations. Overall response rate was 69%. 97% of Dutch hospitals have ambulatory wards and 25% have dedicated operating rooms. Preoperative anxiolytic use is relatively high, approximately 40%. Prophylactic anti-emetic use is low, 33% for laparoscopic cholecystectomy, but a further 33% of patients require rescue treatment. Combination analgesic use is infrequent, with

just one analgesic being used in more than 50% of patients. There is a strong preference for both locoregional, 85% for upper limb surgery, and neuroaxial techniques, 65% for lower limb surgery. However, use of continuous peripheral nerve block catheters for pain control following discharge is limited. We conclude that closer adherence to guidelines on PONV prophylaxis and greater use of multimodal approaches to pain management would be beneficial.

Keywords: Spinal anesthesia; subarachnoid hematoma; conservative treatment.

Authors' addresses: Galdakao Hospital, Anesthesia and Reanimation Service, Galdakao, Bizkaia, Spain.

Corresponding author: Dr. Izaskun Emazabel-Yunta. Galdakao Hospital, Anesthesia and Reanimation Service, Barrio Labeaga s/n, E-48960 Galdakao, Bizkaia, Spain E-mail: lfortea@hgda.osakidetza.net

Introduction

Spinal anesthesia is an anesthetic technique which is widely used in daily clinical practice, offering to the anesthetist an alternative to general anesthesia. The advantages of this technique with respect to general anesthesia include a reduced risk of respiratory depression and of pulmonary thromboembolism, a reduced incidence of deep vein thrombosis and a very low mortality rate [1, 2]. Nevertheless, the technique is not without its risks and like all invasive techniques, it can present complications such as lumbar pain, neurological alterations and even death.

Neuraxial hematoma is a rare neurological complication whose incidence ranges between 1:150,000 for epidural anesthesia and less than 1:22,000 for subarachnoid anesthesia [2, 3, 4, 5, 6]. These incidence rates are approximations, since many hematomas are minute and probably go clinically unnoticed. Also, the rates are based on published data, suggesting that the magnitude of the problem is likely to be underestimated [7, 8]. The severity of symptoms depends on the magnitude of the compression that the hematoma exerts on the spinal cord, and may even lead to death when blood diffuses intracranially [5]. Clinical outcome depends fundamentally on rapid diagnosis and the choice of an appropriate therapeutic strategy, thus avoiding permanent neurological sequelae [9].

Case Report

A sixty year-old man, with no significant medical history came to the Accident and Emergency Service of our hospital complaining of bilateral pain in the area of the calves and headache six days after an inguinal herniorrhaphy with intradural anesthesia. The patient was referred to the hospital Anesthesia and Reanimation Service for detailed examination and pain treatment.

The patient reported an absence of complications during the immediate post-operative period following his inguinal

herniorrhaphy. Twenty four hours following surgery, continuous pain began to develop in the region of the calves of both legs, which was not relieved by postural changes. The patient did not report any motor or sensory deficits, or sphincter dysfunction. Forty eight hours later, bilateral lumbar pain began in the region of the sciatic nerve. The patient experienced headache with tensional characteristics which did not get worse upon remaining standing upright.

The surgical procedure, which was not performed in our hospital, reported a single, atraumatic puncture with a 25 gauge pencil point spinal needle (polymedic clinical elliptic shaped spinal needle). Results from preoperative tests, including evaluation of coagulation and platelet levels, were within normal limits. The patient was not routinely taking any medication and antithrombotic prophylaxis had not been administered. It was noted that the patient had spinal anesthesia on two previous occasions; one for a herniorrhaphy and the other for a hemorrhoidectomy, both without noteworthy incidents.

Upon physical examination, the patient was found to be fully conscious, well-oriented in time and space, but experiencing pain. The examination included: Normal cranial nerve function; conserved motor force, no sensory alterations; slow but present bilateral and symmetric reflexes; flexor, plantar cutaneous reflex; absence of muscular atrophy. The patient complained of bilateral lumbar pain in the territory of the sciatic nerve, as well as continual, bilateral pain in the region of the calves, which was not relieved by postural changes. Headache intensity was not increased by remaining seated or during walking and did not change in nature upon lying down.

Since the patient did not fulfill the criteria for postdural puncture headache (PDPH) and since pain appeared to be directly related to the spinal anesthesia, we decided to carry out emergency magnetic resonance imaging (MRI) in order to rule out the presence of neuraxial hematoma. The results revealed the presence of a subarachnoid hemorrhage localized at the level of L2-L3 with an anterior and left lateral disposition, surrounding the emerging left L3 and L4 segments. The L3 root in particular was found to be discreetly

enlarged, and associated reactive-irritative meningeal embossing was noticed.

The hospital Neurological Service was then consulted and it was decided to admit the patient to hospital under the supervision of the said Service for follow-up and treatment. Medical treatment was initiated with anti-inflammatory and analgesic drugs. Blood analysis revealed normal coagulation and platelet number. Four days later, MRI was performed revealing ischemic lesions localized to the frontoparietal subcortical zone, which were considered to be normal in number for the age of the patient. At the lumbar level, we saw cervical arthrosis, lumbar discarthrosis and intradural hematoma localized anterior to the left lateralized horse tail, presenting mild improvement with respect to that observed during the initial study. The patient evolved satisfactorily during his stay, with symptoms disappearing gradually. Seven days later, the patient was discharged.

MRI was performed one month later and revealed signs of multiple degenerative discopathy with hypointensity of the diffuse signal associated with all of the visualized lumbar discs, as well as mild loss of thickness of the L1-L2 and L5-S1 discs. Axial images revealed two mild circumferential protrusions in the L4-L5 and L5-S1 spaces, without evidence of latero-foraminal occupation or of spinal root contact. The epidural space was found to be normal, without any signs of hematic accumulations or hematomas.

Discussion

Spinal hematoma is a rare complication associated with subarachnoid anesthesia. Three types of spinal hematomas have been defined on the basis of their location: epidural hematoma (EH), subdural hematoma (SH) and subarachnoid hematoma (SAH), the most common being EH with an incidence of 1:150,000 following epidural anesthesia and 1:22,000 following subarachnoid anesthesia [4, 3]. Depending on the chronology of the clinical course of events, these hematomas can be classified as being acute, subacute or chronic.

Spinal hematomas appear more frequently in patients undergoing platelet antiaggregation treatments, treatments with low molecular weight heparin (LMWH) and also in the context of diseases involving coagulopathy [9, 10, 11]. Drug induced thrombocytopenia is another of the factors associated with spinal hematomas [12]. The development of a spinal hematoma following a so-called "clean" puncture is rare, appearing more frequently in difficult [6, 7] and repeated [13] punctures. Such was the case described by Peiro [5] in which the spinal hematoma was induced by repeated and traumatic lumbar puncture, after which the patient died. Cases have also been reported to be associated with lordosis, scoliosis, degenerative changes in the spinal column, osteoporosis, interventions by paramedical personnel and Quincke-type spinal needles [6, 14].

Cases of spinal hematomas have been reported with pencil point needles [16], as is the present case. Walsh et al. [5] reported the case of a patient who following an atraumatic diagnostic puncture developed a spinal hematoma. They attributed this to the laceration of the spinal root veins during the puncture and the LMWH treatment which commenced before the recommended 12 hours. However, in almost 30% of reported spinal hematomas, the causal factor has not been identified [6], as is the present case: subarachnoid hematoma following clean, atraumatic, intradural puncture with a pencil point needle, in the absence of antithrombotic prophylaxis and of diseases which alter coagulation or medication which might increase the risk of producing a spinal hematoma.

The symptomatology associated with spinal hematoma is not very precise and may vary from persistent back pain to frank paraplegia

[12]. It is caused by compression of the spinal cord or of the nerve roots, which may lead to spinal ischemia. In very few cases, death of the patient is the result of diffuse intracranial bleeding [17]. The appearance of symptoms may vary from as early as 2 min following puncture to as late as 10 days post-puncture [14, 18]. There is one case where headache has even been reported 5 min after puncture, the diagnosis of SAH being made with the help of computer tomography [19]. Typical symptoms include spinal root pain, lumbalgia, paraparesis, sphincter dysfunction [5] and headache that do not fulfill PDPH criteria. In some cases, the symptoms are not so clear cut, rendering the diagnosis quite difficult. When headache follows an intradural puncture, differential diagnosis should include: PDPH, migraine, headache produced by drugs [19], benign intracranial hypertension, meningitis, pneumoencephalos, thrombosis of intracranial veins [20, 15], and subdural as well as subarachnoid cerebral hemorrhages. The possibility of a spinal hematoma should also be borne in mind, despite the very low incidence of this type of complication. Early diagnosis is absolutely essential, since delayed diagnosis worsens the prognosis and the possibility of recovery [6]. When spinal hematoma is suspected (on the basis of clinical criteria and lumbar puncture antecedents), MRI should be performed immediately. In many cases, CAT scans do not give conclusive results. In contradistinction, MRI permits a diagnosis of hematoma, its extension and the degree to which it affects the spine; it also permits the detection of associated vascular lesions [21, 6]. It is important to accompany a spinal MRI with a cerebral MRI, in order to rule out the presence of an intracranial hemorrhage that could jeopardize patient outcome.

In this patient, with the clinical suspicion, the antecedent dural puncture and the detailed neurological exploration, we decided to carry out MRI that revealed the presence of a subarachnoid hematoma. The treatment of choice for spinal hematoma is evacuating laminectomy. The rapidity of diagnosis and of application of the corresponding treatment are directly related to the degree of success of the subsequent neurological results. It is recommended not to delay the treatment for more than 8 h [22], although there are reports of cases in which cord decompression was carried out 12 and 72 h later, with complete recovery from symptomatology [6]. A number of cases have been reported in which persistent headache following spinal anesthesia that is resistant to traditional treatments may be indicative of the presence of a subarachnoid hematoma [23]. NMR confirmation is late.

There are cases in which surgical intervention is not necessary, since clinical symptoms can be cured with medical treatment [6]. In the present case, in the absence of significant clinical signs of spinal cord compression, we decided to initiate medical rather than surgical treatment, under strict neurological evaluation in the event of the appearance of clinical signs of hematoma progression. A significant clinical improvement was observed, accompanied by a progressive reduction of the hematoma, as assessed by MRI in subsequent examinations. In summary, subarachnoid hematoma is a rare complication associated with spinal anesthesia. Taking into account the appropriateness of the anesthetic technique and the absence of coagulopathy or factors which might alter coagulation, the probability of incidence of a subarachnoid hematoma, such as the present one, is minimal. Early diagnosis by means of MRI following clinical suspicion and the rapid application of the appropriate treatment are crucial for the satisfactory recovery of the patient.



Figure 1 Lumbar MRI:subarachnoid hemorrhage.

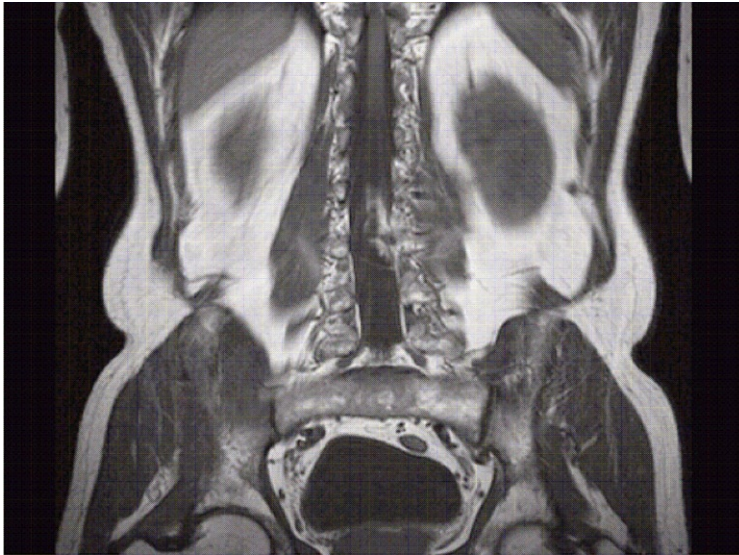


Figure 1 Lumbar MRI:subarachnoid hemorrhage localized at the level of L2-L3 with an anterior and left lateral disposition.

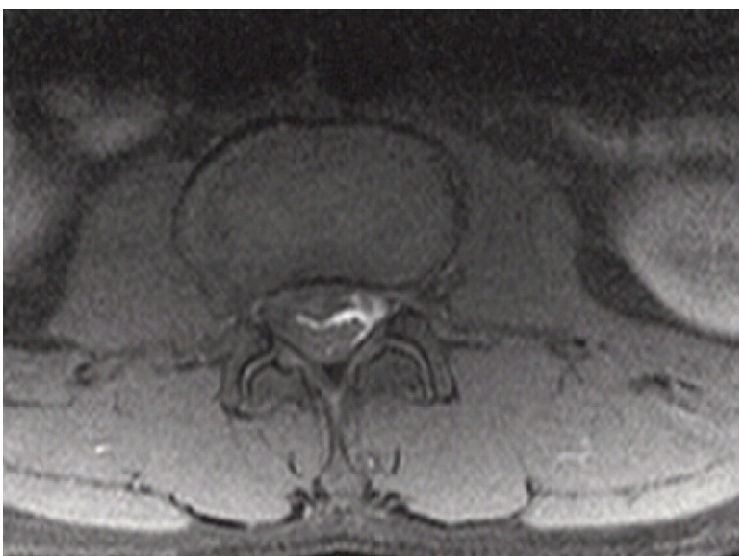


Figure 1 Lumbar MRI:subarachnoid hemorrhage surrounding the emerging left L3 and L4 segments. L3 root is discretely enlarged..

References

1. Rogers A, Walker N, Schurg S, McKee H, Van Zundert A, Sage D, Futter M, Saville G, Clark T, MacMahon S. Reduction of postoperative mortality and morbidity with epidural and spinal anaesthesia. Results from overview of randomised trials. *BMJ* 2000; **321**: 1493–7.
2. James W, Heitzand, Eugene R, Viscusi. Neuroaxial Anesthesia and Anticoagulants. *Techniques in Orthopaedics* 2004; **19(4)**: 303–316.
3. Vibeke Moen, Nils Dahlgren, Lars Irestedt. Severe Neurological Complications after Central Neuraxial Blockades in Sweden 1990–1999. *Anesthesiology* 2004; **101**: 950–9.
4. Horlocker TT. Complications of spinal and epidural anaesthesia. *Anesthesiology Clin North Am* 2000; **18**: 416–86.
5. Peiró CM, Caballe N, Errando C, Moliner S. Hematoma espinal y cerebral postpunción lumbar diagnóstica con evolución letal. *Rev Esp Anestesiol Reanim* 2003;**50(9)**:481–485.
6. Martín S, Smaran A, Archilla J, Gómez de Orellana J, Ramasco F, Muñoz B, Colmenero A, Simón F, Tabatabaian A. Hematoma neuroaxial tras anestesia locorregional combinada resuelto de forma conservadora. *Rev. Esp. Anestesiol. Reanim* 2005;**52**:433–437.
7. Castillo J, Santiveri X, Escolano F, Castaño J. Hematomas raquídeos con compresión medular relacionados con las anestésias neuroaxiales en España. *Rev. Esp. Anestesiol. Reanim* 2003;**50**:504–509.
8. Tyagi A, Bhattacharya A. Central neuraxial blocks and anticoagulants: a review of current trends. *Eur J Anaesth* 2002; **19**: 217–29.
9. Llau J.V, Andres J, Gomar C, Gomez A, Hidalgo F, Sahagún J, Torres M.L. Fármacos que alteran la hemostasia y técnicas regionales anestésicas: 12 © 2008, International Association for Ambulatory Surgery recomendaciones de seguridad. Foro de consenso. *Rev. Esp. Anestesiol. Reanim* 2001;**48**:270–278.
10. Horlocker TT, Heit JA. Low molecular weight heparin: Biochemistry, pharmacology, perioperative prophylaxis regimens, and guidelines for regional anesthetic management. *Anesth Analg* 1997; **85**: 874–85.
11. Ursula N. Landman, Roseline M. Jeione, Peter S.A. Glass. Subdural hematoma after atraumatic spinal. *Journal of Clinical Anaesthesia* 2005; **17**: 379–381.
12. Balaji Pai S, Krishna K N, Chandrashekar S. Postlumbar puncture spinal subarachnoid hematoma causing paraplegia: a short report. *Neurology India* 50 September 2002.
13. Leonad E., Egede, M.D, Howard Moses, M.D, and Henry Wang, M.D. Spinal subdural hematoma: a rare complication of lumbar puncture. *Maryland Medical Journal* 1999 January/February.
14. Reina MA, Lopez Garcia A, de Andrez Ibañez, Dittman M, Cascales MR, del Caño MC, et al. Microscopia electrónica de las lesiones producidas en la duramadre humana por la agujas de bisel Quinke y Whitscre. *Rev Esp Anestesiol Reanim* 1997;**44(2)**:56–61.
15. Reina M.A, Lopez A, Benito–Leon J, Pullido P, Maria F. Hematoma subdural intracraneal y espinal, una complicación poco común de la anestesia epidural y subaracnoidea. *Rev. Esp. Anestesiol. Reanim* 2004;**51** 28–39.
16. Likar R, Mathiaschitz K, Spindel M, Krumpholz R, Martin E. Acute spinal subdural hematoma after attempted spinal anesthesia. *Anaesthesist* 1996;**45**:66–69.
17. Achara R, Chhabra SS, Ratra M, Sehgal AD, Cranial subdural haematoma after spinal anaesthesia. *Abr J Anaesth* 2001;**86(6)**:893–895.
18. Rodrigo Casanova M.P, Garcia Peña J.M, Bedia del Rio E, Freijo Guerrero J, Aguilera Celorrio L. Hematoma subaracnoideo tras punción lumbar diagnóstica.
19. Egger S.M, Egger K.A Subaracnoid haemorrhage following spinal anaesthesia in an obstretic patient. *British Journal of Anaesthesia* 2001; **86(3)**: 442– 444.
20. Davignon K, Dennehy K. Update on postdural puncture headache. *Int Anesth Clin* 2002;**40**:89–102.
21. Macias Pingarrón J.P, Torrado Criado M.D, Alfonso Sanz F, Robles Barragán J, Gallego Córdoba J.M, Hematoma epidural tras anestesia regional combinada en una paciente sin trastorno de la coagulación. *Rev Esp Anestesiología Reanimación*.
22. Horlocker TT and Wedel JW. Spinal and epidural blockade and perioperative low molecular Weight Heparin: smooth sailing on the Titanic. *Anesth Analg* 1998; **86**: 1153–6.
23. Kelsaka E, Sarihasan B. Baris S. Tur A. Subdural hematoma as a late complication of spinal anesthesia. *Journal of Neurosurgical Anesthesiology* 2003; **15(1)**: 47–9. 14.

Comparison of supplementation rates for perivascular axillary and coracoid infraclavicular blocks in ambulatory upper extremity surgery

Edward R. Mariano MD*, Gloria S. Cheng MD*, Vanessa J. Loland MD*,
Larry F. Chu MD MS (Biochemistry)*, MS (Epidemiology)[§]

Abstract

Background and Objectives: Efficacy of perivascular axillary block (AXB) and double-stimulation infraclavicular block (ICB) techniques in providing brachial plexus anesthesia have not been previously compared.

Methods: After IRB approval, we reviewed a regional anesthesia database to compare supplementation rates for 141 axillary and 157 infraclavicular blocks.

Results: Supplementation rates for AXB and ICB were 52% and 20%, respectively (OR = 2.57, 95%CI 1.61 – 4.12). Conversion to general anesthesia was infrequent in both groups although higher in the AXB group (OR = 6.78, 95%CI 1.05 – 43.38).

Discussion: Although ICB has significantly higher initial success, AXB provides reliable anesthesia when appropriately supplemented.

Keywords: ambulatory surgery; axillary block; infraclavicular block; regional anesthesia; supplementation rate.

Authors' addresses: *Department of Anesthesia, University of California, San Diego Medical Center [§]Department of Anesthesia, Stanford University School of Medicine.

Corresponding author: Edward R. Mariano MD Department of Anesthesia, University of California, San Diego Medical Center, 200 West Arbor Drive, San Diego, CA 92103-8770; (619) Tel: 543-5720 Fax: (619) 543-5424 E-mail: ermario@ucsd.edu

Financial Source(s): University of California, San Diego Department of Anesthesia; Dr. Chu's work is supported by a career development award from the National Institute of General Medical Sciences of the National Institutes of Health (5K23GM071400-02).

Introduction

Axillary and infraclavicular blocks have been used to provide brachial plexus anesthesia for similar surgical indications [1]. Results from previous studies comparing supplementation rates for nerve stimulator-assisted axillary block (AXB) and infraclavicular block (ICB) are conflicting [2, 3].

Perivascular AXB is an efficient multiple-injection technique performed without electrical nerve stimulation; whereas the coracoid ICB using a double-stimulation technique has a high degree of success [4–7]. We performed this study to determine which of these two approaches most consistently provides complete brachial plexus anesthesia.

Methods

After IRB approval, we retrospectively reviewed the regional anesthesia database of one staff anesthesiologist (ERM) from a university hospital outpatient surgery center collected over one year as part of an ongoing quality assurance (QA) project. Data from patients who received perivascular AXB or coracoid ICB were included. Nerve blocks were performed preoperatively using sterile technique in a regional anesthesia induction area with 30 ml of 0.5% bupivacaine + epinephrine 2.5 mcg/ml or 1.5% mepivacaine + epinephrine 5 mcg/ml.

Perivascular Axillary Block

With the shoulder abducted 90° and elbow flexed, the axillary artery was identified in the proximal axilla. While palpating the axillary

pulse, 20 ml of local anesthetic (LA) was injected incrementally in a fan-like perivascular distribution above and below the artery using 22-gauge B-bevel needles and 10 ml control syringes following negative aspiration of blood [8]. Five ml of LA was injected within the coracobrachialis muscle, and another 5 ml was infiltrated along the medial aspect of the upper arm to anesthetize the intercostobrachial nerve distribution for a total injectate volume of 30 ml.

Coracoid Infraclavicular Block

With the ipsilateral arm positioned at the patient's side, a 22-gauge insulated needle was inserted plumb-bob approximately 2 cm medial and 2 cm caudad to the coracoid process with an initial stimulating current of 1.0 mA, pulse width of 0.1 msec, and frequency of 2 Hz using the landmarks described by Wilson et al (6). Upon elicitation of a sustained motor response from the radial, median, or ulnar nerves at <0.5 mA current, 15 ml of LA was injected incrementally following negative aspiration of blood. The remaining 15 ml of LA was injected after a second distinct motor response from one of the previously-mentioned nerves was elicited at <0.5 mA current.

Block Assessment

A complete brachial plexus block was defined as anesthesia of the musculocutaneous, radial, median, ulnar, and medial antebrachial cutaneous nerves. Strength of elbow flexion and extension against resistance assessed the quality of *musculocutaneous* and *radial* nerve blockade, respectively. Pinprick sensation of the index finger, small finger, and medial aspect of the forearm assessed anesthesia in the distribution of the *median*, *ulnar*, and *medial antebrachial cutaneous* nerves, respectively.

Distal supplementation

For patients with incomplete anesthesia after 20 min, individual supplementary nerve blocks (median, ulnar, radial, lateral antebrachial cutaneous, or medial antebrachial cutaneous) were performed at the elbow using nerve stimulation or at the wrist using infiltration.

Outcome Measures and Statistical Analysis

Data were collected immediately post-procedure and on the first postoperative day (POD 1). The primary outcome of interest was rate of supplementation following initial block placement. Secondary outcomes included: rate of conversion to general anesthesia (GA), patient satisfaction on a Likert scale (5=Outstanding to 1=Poor), and whether or not patients would choose regional anesthesia again for future surgery.

Descriptive statistics were used to summarize study data. Normality was determined using the Kolmogorov-Smirnov test. Odds ratios (OR) with 95% confidence intervals (CI) were calculated for comparisons of supplementation and GA conversion. Statistical analysis was performed using Student's *t* test for continuous normally distributed variables or Pearson's χ^2 test for categorical variables (NCSS 2004, Kaysville, UT, USA) with $p < 0.05$ considered statistically significant.

Results

Of the 298 subjects, 141 received AXB, and 157 received ICB. Demographic data are displayed as Table 1. There was a higher proportion of patients in the ICB group who underwent elbow surgery ($p < 0.001$) and received bupivacaine as their local anesthetic ($p < 0.01$) compared to the AXB group.

The rate of supplementation following AXB was 52% compared to 20% following ICB (OR = 2.57, 95%CI 1.61–4.12). The number of nerves requiring supplementation for each block technique is shown in Figure 1. Six patients following axillary block (4.9%) and 1 patient following infraclavicular block (0.7%) did not achieve complete anesthesia despite supplementation and were converted to GA (OR = 6.78, 95%CI 1.05 – 43.38).

On POD 1, 185 (62%) patients were successfully contacted via telephone. Median patient satisfaction score was 5/5 with >95% of patients reporting that they would choose a nerve block again for future surgery for both groups.

Discussion

Patients who receive perivascular AXB are 2.5 times more likely to require supplementation compared to coracoid ICB. Although AXB may be efficient in terms of preparation time and equipment, ICB using a double-stimulation technique has a significantly higher rate of complete brachial plexus anesthesia following initial block placement.

Our findings are consistent with the results of Rodriguez et al who found low rates of supplementation (21%) following double-injection coracoid ICB [7]. A previous study comparing nerve stimulator-guided AXB and lateral ICB demonstrated a greater extent of anesthesia with ICB [9]. Multiple injections have been shown to improve the efficacy of nerve stimulator-assisted nerve blocks [2, 3] at the cost of increased patient discomfort [10].

The efficacy of the fan technique perivascular axillary block has not been described previously, and there have been no studies to date comparing this technique to other methods of brachial plexus blockade. Despite a paucity of scientific data on this approach

Table 1 Demographic data and frequencies of various surgical sites by peripheral nerve block technique presented as percent (%) unless otherwise specified.

	Axillary (n=141)	Infraclavicular (n=157)	P value*
Age in Years (mean \pm SD)	45 \pm 17	44 \pm 18	NS
Gender (% male)	63	48	0.02
Surgical Site			
Hand	52.5	37.6	
Wrist	19.9	14.0	
Forearm	24.1	24.2	
Elbow	3.5	24.2	<0.001
Planned MAC	86	84	NS
GA Conversion	4.9	0.7	NS
Local Anesthetic			
Mepivacaine	43	24	<0.01
Bupivacaine	57	76	<0.01

*p-value is based on Student's *t* test for continuous normally-distributed variables and Pearson's χ^2 test for categorical variables.

in the published literature, we have successfully utilized the perivascular axillary block in our clinical practice with appropriate supplementation. A randomized prospective study to compare these techniques is warranted.

Ultrasound may improve the success of the perivascular axillary block without employing electrical stimulation. In a study comparing nerve stimulation-guided axillary block to ultrasound-guidance and ultrasound-guided electrical stimulation, nerve stimulation alone achieved complete brachial plexus anesthesia only 62.9% of the time; ultrasound with or without electrical stimulation improved the success rate to >80% [11].

By extrapolating this data, the supplementation rate of the perivascular axillary block will most likely decrease by adding image-guidance to a traditionally "blind" technique.

Limitations include the retrospective design and lack of randomization. However, data regarding block performance and patient satisfaction are collected prospectively as a part of our ongoing QA process. Since subjects were not randomly assigned, choice of nerve block technique was left to the discretion of the anesthesiologist, which accounts for the unequal distribution of surgical sites between the 2 groups. A potential confounder is the use of two local anesthetic solutions with different predicted onset times. Despite the higher proportion of bupivacaine use in the ICB group, the supplementation rate after 20 min is still significantly lower than in the AXB group. A randomized prospective study to confirm these results is warranted.

Although perivascular AXB has a higher rate of supplementation, rates of conversion to GA following either technique in our practice are low, and patient satisfaction is consistently high. An important consideration is the "block room" model employed in our regional anesthesia practice which facilitates successful supplementation of incomplete blocks prior to scheduled surgery.

In conclusion, the clinical utility of the perivascular AXB depends on

the answer to the question: “Is the glass half-empty or half-full?” For a busy ambulatory anesthesia practice without a block room model, 50% supplementation may be considered unacceptable. Alternatively, the perivascular AXB technique may be viewed as a rapid procedure which may be performed in between cases without electrical stimulation, and only 50% of blocks require supplementation to provide surgical anesthesia. The addition of ultrasound may reduce the need for supplementation with this technique. When adequately supplemented, perivascular AXB remains a reasonable alternative to ICB for ambulatory upper extremity surgery.

References

1. Klein SM, Evans H, Nielsen KC, Tucker MS, Warner DS, Steele SM. Peripheral nerve block techniques for ambulatory surgery. *Anesth Analg* 2005; **101**:1663–1676.
2. Koscielniak-Nielsen ZJ, Rotboll Nielsen P, Risby Mortensen C. A comparison of coracoid and axillary approaches to the brachial plexus. *Acta Anaesthesiol Scand* 2000; **44**:274–279.
3. Deleuze A, Gentili ME, Marret E, Lamonerie L, Bonnet F. A comparison of a single-stimulation lateral infraclavicular plexus block with a triple-stimulation axillary block. *Reg Anesth Pain Med* 2003; **28**:89–94.
4. Neal JM, Hebl JR, Gerancher JC, Hogan QH. Brachial plexus anesthesia: essentials of our current understanding. *Reg Anesth Pain Med* 2002; **27**:402–428.
5. Whiffler K. Coracoid block – a safe and easy technique. *Br J Anaesth* 1981; **53**:845–848.
6. Wilson JL, Brown DL, Wong GY, Ehman RL, Cahill DR. Infraclavicular brachial plexus block: parasagittal anatomy important to the coracoid technique. *Anesth Analg* 1998; **87**:870–873.
7. Rodriguez J, Barcena M, Taboada-Muniz M, Lagunilla J, Alvarez J. A comparison of single versus multiple injections on the extent of anesthesia with coracoid infraclavicular brachial plexus block. *Anesth Analg* 2004; **99**:1225–1230, table of contents.
8. Brown DL. *Atlas of Regional Anesthesia*. Philadelphia: W. B. Saunders Company, 1999. 12 © 2008, International Association for Ambulatory Surgery
9. Kapral S, Jandrasits O, Schabernig C, et al. Lateral infraclavicular plexus block vs. axillary block for hand and forearm surgery. *Acta Anaesthesiol Scand* 1999; **43**:1047–1052.
10. Koscielniak-Nielsen ZJ, Rasmussen H, Hesselbjerg L, Nielsen TP, Gurkan Y. Infraclavicular block causes less discomfort than axillary block in ambulatory patients. *Acta Anaesthesiol Scand* 2005; **49**:1030–1034.
11. Chan VW, Perlas A, McCartney CJ, Brull R, Xu D, Abbas S. Ultrasound guidance improves success rate of axillary brachial plexus block. *Can J Anaesth* 2007; **54**:176–182.

Ambulatory Surgery is the official clinical journal for the International Association for Ambulatory Surgery.

Ambulatory Surgery provides a multidisciplinary international forum for all health care professionals involved in day care surgery. The editors welcome reviews, original articles, case reports, short communications and letters relating to the practice and management of ambulatory surgery. Topics covered include basic and clinical research, surgery, anaesthesia, nursing; administrative issues, facility development, management, policy issues, reimbursement; perioperative care, patient and procedure selection, discharge criteria, home care. The journal also publishes book reviews and a calendar of forthcoming events.

Submission of Articles

All papers should be submitted by e-mail as a Word document to one of the Editors-in-Chief. Anaesthetic papers should be sent to **Beverly K. Philip** and surgical papers to **Doug McWhinnie**. Nursing, management and general papers may be sent to either Editor.

Electronic submissions should be accompanied, on a separate page, by a declaration naming the paper and its authors, that the paper has not been published or submitted for consideration for publication elsewhere. The same declaration signed by all the authors must also be posted to the appropriate Editor-in-Chief.

Doug McWhinnie Division of Surgery,
Milton Keynes Hospital, Standing Way, Milton Keynes,
Buckinghamshire MK6 5LD, UK
Email: dougmcwhinnie@uk2.net

Beverly K. Philip Day Surgery Unit, Brigham and
Women's Hospital, 75 Francis Street, Boston, MA 02115,
USA.
Email: bphilip@zeus.bwh.harvard.edu