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Editorial: More Barriers to the Development of Day Surgery

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Around the world there are many barriers to the growth of day surgery. These can be found in both developed and developing countries. A number are discussed in Chapter 1 of the International Association for Ambulatory Surgery's book "Day Surgery – Development and Practice" [1]. Recent experience in a number of developing countries has highlighted further barriers of a political and/or a funding nature which result in poor healthcare returns from the very limited available funding in these countries.

Amazingly, in many countries the provision of overall government healthcare is not the sole responsibility of a Ministry of Health. For example, in one small country the only secondary/tertiary hospital is independently run and directly funded by the Ministry of Finance. It is not bound by the policies of the Ministry of Health which is responsible for the rest of the country's healthcare system. In another country three different ministries, apart from the Ministry of Health, provide secondary/tertiary care and are allocated separate budgets for this from the Ministry of Finance. There is little or no coordination in the provision of services and facilities with each Ministry trying to build their own power bases of large inpatient hospitals. Consequently there is a duplication of facilities resulting in unnecessarily high capital investment and an over provision of services in some areas and an under provision in others. The very limited national budget for healthcare combined with facility duplication results in poor maintenance, a lack of basic equipment and often an inability to staff units. The above two examples of many highlight the uncoordinated and dysfunctional management of healthcare in certain countries. The result is secondary care empire building with little or no concern for the introduction of cost effective and equitable healthcare provision. In such circumstances, there is no stimulus for the growth of day surgery.

Major international healthcare funders, who loan developing countries money at sub-market rates, and healthcare donors do little to pressurise recipient countries into an efficient use of the finance that they receive. Unified ministerial management of healthcare is not a conditionality of their investment nor often is there proper monitoring of the results of the schemes that they fund. Examples of funded hospitals being built that are, on completion, only partly used because of lack of demand are widespread as is investment being given for a specific agreed project in fact being used for general revenue purposes.

The national advice given on healthcare management by donors often focuses on areas perhaps appropriate to developed countries but not to developing ones. For instance, at present there is a vogue for the introduction of national insurance schemes for healthcare but in developing countries where only a small percentage of the population have taxable incomes one has to question its applicability as the cost of running such a scheme would outweigh any possible benefits.

It is sad that so many major donors do not understand the real needs of the developing countries that they service. Yet if they did and so wished, they could have a powerful influence on the efficient and equitable delivery of healthcare to the populations of their recipient countries. Donors have the potential leverage to discourage the building of large trophy hospitals for local politicians and refocus political vision onto cost effective approaches such as disease prevention, access for all to primary care and basic medication, outreach clinics, a "hub and spoke" approach to secondary care, mobile high cost/high technology equipment, avoidance of duplication of facilities and, of course, a move from inpatient surgery to day surgery. With respect to the last of these, it is essential that the International Association for Ambulatory Surgery and national day surgery associations promote to international and national funding agencies the benefits that day surgery can bring to the provision of healthcare in developing countries.

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Quality Assurance and Benchmarking in Ambulatory Surgery

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Abstract

Aim: To find clinical indicators for benchmarking out of a nationwide quality assurance programme Methods: Data from 153 000 cases of the quality assurance programme AQS1 were electronically analysed for the most frequent procedures in 10 medical specialties.

Results: Hospitalisation rate for the most frequent procedures was below 0.6%. The search gave data for the time of inability to work and operating room time for every procedure. The type of anaesthesia in carpal tunnel syndrome had a measurable influence on induction time and time spent in the recovery room.

Conclusion: Combined questionnaires answered by surgeons, anaesthetists and patients and processed electronically give an excellent overview of the quality performance within the surgical unit especially in comparison to the national average. The expenses of 1.49 Euro per case are well compensated by improved quality, shorter time of operating room occupancy, faster recovery, shorter period of disability and higher patient satisfaction.

Keywords: Quality assurance; benchmarking; Ambulatory surgery; Clinical indicators.

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Purpose

The outcome and the process of surgical procedures should be judged by doctors (surgeons, anaesthetists) and patients using combined questionnaires. The anonymity of patient questionnaires is very important so that patients can freely express their opinion. These data should be processed at low price by an independent agency. The results of each surgical unit concerning certain benchmarks should be comparable with the collective of all participants.

History

Germany has a long tradition of quality assurance in ambulatory surgery. The first quality assurance programme in ambulatory surgery was conducted in Lower Saxony and published in 1988 [4]. The Bundesverband für Ambulantes Operieren (BAO), the national association for ambulatory surgery in Germany, initiated a nationwide programme in gynaecology in 1993 [1].

The professional Quality Assurance System, AQS1, has existed since 1999 [5,8] and in its present form since 2005. Results of the incidence of various ambulatory procedures in different disciplines of surgery and the hospitalisation rate after ambulatory surgery have been published [2,9].

Methods

AQS1 is designed as a combined physician and patient questionnaire to evaluate and analyse the complete process of ambulatory surgery or outpatient operations [5,6]. The part of the paper questionnaire for the physician is characterized by "hard" parameters like the risk factors, the intra-operative complications and an OPS-code (Operationen- und Prozedurenschlüssel [3]) for every procedure. This part is filled out by the surgeon and by the anaesthetist. The other part is answered by the patient to assess the quality of the ambulatory surgery two weeks after his/her surgical procedure and contains more "soft" parameters to evaluate patient satisfaction and the severity of pain. All questionnaires are collected and electronically processed by medicaltex [7]. The results are provided in a standardised quality report either quarterly or yearly.

Results

As of January 2007 a total of 450 surgical units are participating in AQS1 in Germany. The number of all procedures processed until that time was 153,613 cases: gynaecology contributed 45,622 cases, surgery 29,646, orthopaedics 25,341, anaesthesiology 12,399, and ear-nose-throat 3,301 cases (Table 1). Altogether 10 medical specialties are participating. By April 2007 the total number of cases exceeded 200,000.

Table 1 Distribution of cases in different disciplines in the quality assessment system AQS1 (January 2007).

discipline	number of cases
gynaecology	45622
general surgery	29646
orthopaedics	25341
ENT	3136
others	49868
total number of cases	153613

As **clinical indicators** for quality assessment the following five items were selected:

A. Hospitalisation rate

This rate was chosen as a relatively "hard" parameter for unforeseen complications in ambulatory surgery. For the three most frequent procedures in gynaecology, surgery and ENT the hospitalisation rate was under 0.6% except for hernia repair (Table 2).

Table 2 Hospitalisation rate (only the three most frequent procedures).

OPS-code	Procedure	Hospitalisation rate
Gynaecology		
	Excision/destruction, uterus, operative	
5-681	hysteroscopy	0.53%
5-690	dilatation and curettage of uterus	0.37%
1-672	diagnostic hysteroscopy (office procedure)	0.17%
Surgery		
5-530	hernia repair	3.83%
5-812	arthroscopy (cartilage, meniscus)	0.60%
5-056	neurolysis hand, carpal tunnel	0.23%
ENT		
5-214	septum repair, nose	0.25%
5-285	adenotomy	0.00%
5-215	repair turbinate, nasal concha	0.00%

B. Period of disability

The period of disability or inability to work is provided by the patients for every type of procedure. For instance the average disability time is 3.5 days for curettage and 4.6 days for excision/destruction of uterine tissue in operative hysteroscopy. For the three most frequent surgical procedures it is between 12 and 16 days (Table 3).

Table 3 Period of inability to work (only the three most frequent procedures).

OPS-code	Procedure	Days
Gynaecology		
5-681	excision, destruction of uterine tissue	4.6
5-690	dilatation and curettage of uterus	3.5
1-672	diagnostic hysteroscopy	3.5
Surgery		
5-530	hernia repair	12.2
5-812	arthroscopy, meniscectomy	15.7
5-056	neurolysis hand, carpal tunnel	15.7
ENT		
5-214	septum repair, nose	12.8
5-285	adenotomy	2.6
5-215	repair turbinate	3.3

C. Operating room (OR) occupancy of single procedures

The time of operating room (OR) occupancy is of importance for OR organisation and economics. With AQS1 it is possible to calculate this important parameter for every procedure of the collective (benchmarking). For instance in surgery average OR occupancy time is 52.9 min for arthroscopy, 37.8 min for neurolysis and 59.5 min for inguinal hernia repair (Table 4).

Table 4 Operating time (OR occupancy time, cut-suture time).

OPS code	Procedure	Occupancy time min	Cut-suture time min
Gynaecology			
5-681	excision, destruction of uterine tissue	51.1	36.2
5-690	dilatation and curettage of uterus	30.8	18.0
1-672	diagnostic hysteroscopy	38.5	22.6
Surgery			
5-530	hernia repair	59.5	40.3
5-812	arthroscopy, meniscectomy	52.9	30.1
5-056	neurolysis hand, carpal tunnel	37.8	18.7
ENT			
5-214	septum repair, nose	53.4	42.8
5-285	adenotomy	27.3	14.3
5-215	repair turbinate	24.3	16.3

D. Patient satisfaction

Patient satisfaction is another parameter of clinical importance that can be related to each surgical procedure or to the surgical unit. Overall, patients were very satisfied and would, if necessary, again choose ambulatory surgery (Table 5).

E. Types of anaesthesia

Various types of anaesthesia are compared e.g. in carpal tunnel syndrome (OPS: 5-056). Cut/suture time was lowest with intravenous anaesthesia (Table 6). Mask anaesthesia was related to higher infection rate and hospitalisation.

When comparing the post-operative time until discharge from the day clinic and adding the time of induction the iv-block anaesthesia resulted in the shortest time until discharge of the patient (Fig. 1). 8 Fig. 1: Time (min) before and after neurolysis (carpal tunnel repair CTS) (blue = induction time, red = post-operative time until discharge) Discussion The professional Quality Assurance System AQS1 has proven to be a useful tool for quality assessment in ambulatory surgery. Therefore, it was expanded from 2006 to inpatient surgery in hospitals under the name of SQS1. One of the most useful assets of this programme is the input of the patients in the form of structured, anonymous questionnaires. Thus the surgeon gets

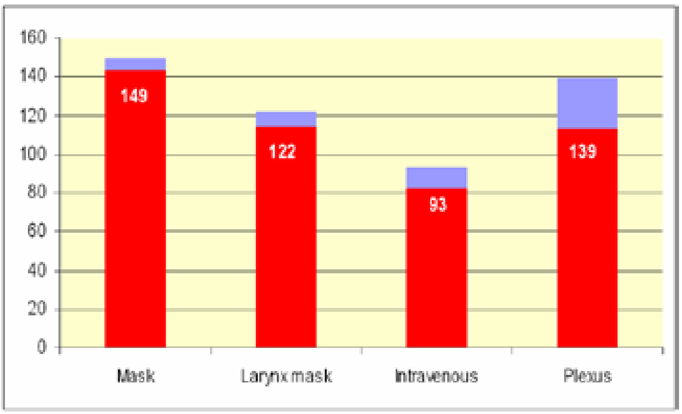
Table 5 Patient satisfaction ("would you choose ambulatory surgery again?").

OPS code	Procedure	Yes
Gynaecology		
5-681	excision, destruction of uterine tissue	98.0%
5-690	dilatation and curettage of uterus	98.4%
1-672	diagnostic hysteroscopy	98.9%
Surgery		
5-530	hernia repair	96.1%
5-812	arthroscopy, meniscectomy	96.8%
5-056	neurolysis hand	99.3%
ENT		
5-214	septum repair, nose	94.3%
5-285	adenotomy	98.5%
5-215	repair turbinate	97.6%

Table 6 Use of various types of anaesthesia in carpal tunnel repair (neurolysis hand, OPS: 5-056).

type of anaesthesia	number of cases	induction time min	induction + recovery-room time
Intubation	188	9	174
Mask	413	6	143
Larynx mask	2581	8	114
Stand By	109	9	59
Intravenous	1452	11	82
Local	402	14	61
Plexus	2496	26	113

Figure 1 Fig. 1:Time (min) before and after neurolysis (carpal tunnel repair CTS) (blue = induction time, red = post-operative time until discharge).



to know complications, length of disability, hospitalisation and patient satisfaction. These data in comparison to the collective of participating physicians (benchmarking) clearly tells the physicians in what fields management has to be improved. "Medicaltex" calculates the quality reports quarterly for every outpatient facility. These reports should be made transparent to all members of the team and discussed in team meetings 9 to improve the quality of the performance within the surgical unit. The costs for this quality programme are reasonable - 1.49 Euro base rate per case. The language of the questionnaires is German; translations into other languages are possible. The combination of several benchmarks appears to be a promising method in clinical research. Thus the combination of the procedure for carpal tunnel with various types of anaesthesia gives hints that intravenous anaesthesia may result in the shortest recovery time and thus be advantageous from the viewpoint of economics, patient satisfaction and complication rates

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The role of local anaesthesia in ambulatory anal surgery

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Abstract

Background: Anal operations may be useful surgical procedures in major ambulatory surgery. The selection of anaesthetic technique may influence the duration of hospital stay. The use of local anaesthesia in anal surgery is supposed to be associated with advantages, such as shorter hospital stay and high satisfaction rates. The aim of this retrospective study is to prove the feasibility of local anaesthesia in anal operations as day cases.

Patients and methods: A total of 218 patients with various proctologic disorders were consented to anal operations under general, spinal or local anaesthesia. The data including anaesthetic technique, postoperative information, duration of hospitalisation and degree of satisfaction, were collected respectively in a computerised database. 71 patients underwent anal surgery under general anaesthesia (group 1), 73 under spinal anaesthesia (group 2), and 74 under local anaesthesia (group 3).

Results: The mean hospital stay for the three groups was 2.5, 3.0 and 0.5 days respectively. The difference in duration of hospitalisation of group 3 in comparison to groups 1 and 2 was statistically significant ($P<0.01$), while the overall satisfaction rate during the post-operative evaluation was not significantly different between the three groups.

Conclusion: Local anaesthesia is a suitable technique for anal surgery with a high degree of acceptance among patients. It can be used in most proctologic procedures and is a simple, fast, safe and easy method, with high satisfaction rates among patients. Local anaesthesia is associated with shorter hospital stay and faster return to full social activities. It seems to be the ideal anaesthetic technique for anal procedures as day cases.

Keywords: Local anaesthesia; Anal operations; Ambulatory surgery; Day case surgery.

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Introduction

Day surgery is becoming more common due to its cost effectiveness as well as patient acceptance. [1] The increase in day case procedures and their complexity is related to improvements in surgical and anaesthetic techniques. [2] Anal operations may be suitable surgical procedures for major ambulatory surgery. Patients suffering from haemorrhoids, anal fistulas, anal fissures, perianal abscesses, pilonidal sinus or even anal carcinomas can be satisfactorily operated on as day surgery cases.[3–5] Although almost all anal procedures can be carried out as ambulatory operations, the selection of anaesthetic technique may be the only factor which excludes the possibility of one day hospitalization.[6] General (GA) and spinal (SA) anaesthesia are considered to be the gold standard anaesthetic techniques for anal surgery.[7], The use of these techniques usually requires more than one day nursing, and have sometimes been associated with various minor or major complications which may lengthen postoperative hospitalization. Only few reports in the literature comment on the role of local anaesthesia (LA) in anal surgery.[8–10]. The use of LA in patients with anal disease seems to be feasible and may be associated with less morbidity, shorter hospital stay and a faster return to full social activities.[11] The aim of this retrospective study was to prove the feasibility of LA in anal operations as day cases.

Patients and Methods

A total of 218 patients (154 men, mean age 54 years, range 21 to 86), with various proctologic disorders were consented to anal operation. 122 of them underwent 2 3 stapled haemorrhoidectomy (SH), 36 Milligan-Morgan haemorrhoidectomy (MMH), 25 perianal abscess revision (AR), 24 subanodermal fistula resection (FR), and 11 anal tumour electrocoagulation (ATE). The patients' data including demographics, anaesthetic technique, postoperative information, duration of hospital stay and degree of satisfaction were collected and studied retrospectively.

The patients were divided into three groups according to anaesthetic technique: (1) general anaesthesia (GA), (2) spinal anaesthesia (SA) and (3) local anaesthesia (LA). GA was used in 71 patients, (34 SH, 14 MMH, 16 AR, 6 FR, and 1 ATE), SA in 73 patients (43 SH, 12 MMH, 6 AR, 10 FR, and 2 ATE) and LA in 74 patients (45 SH, 10 MMH, 3 AR, 8 FR, and 8 ATE) (Table 1).

The selection of anaesthetic technique was the decision of the anaesthetist depending on the patient's age and the presence or not of serious cardiovascular, respiratory or metabolic disease. Especially for LA, an additional selection criterion was painless two finger digital examination.

The degree of satisfaction in all groups was evaluated by means of a visual analogue scale (VAS) in which 0 indicated dissatisfaction and 10 indicated maximum satisfaction (Table 2).

The aim of the study was to detect the impact of the type of anaesthesia on the length of pre-operative and post-operative hospital stay (Table 3).

Also, the influence of the anaesthetic technique on satisfaction rates among patients undergoing anal surgery was determined.

Statistical analysis

Statistical analysis was performed using the Arcus Quick-stat biomedical statistical package (Research Solutions, UK) with the median values for continuous variables 5 6 presented with range in

Table 1 Type of operation and anaesthetic technique.

Operation	Group 1: GA (n = 71)	Group 2: SA (n = 73)	Group 3: LA (n = 74)
Stapled haemorrhoidectomy	34 (47.9%)	43 (58.9%)	45 (60.8%)
Milligan-Morgan haemorrhoidectomy	14 (19.7%)	12 (16.5%)	10 (13.5%)
Perianal abscess revision	16 (22.5%)	6 (8.2%)	3 (4.1%)
Fistulectomy	6 (8.5%)	10 (13.7%)	8 (10.8%)
Anal tumour electrocoagulation	1(1.4%)	2 (2.7%)	8 (10.8%)

GA = General anaesthesia SA = Spinal anaesthesia LA = Local anaesthesia

Table 2 Satisfaction rate in 3 groups by the type of operation.

Operation	Satisfaction rate (VAS score)			P
	Group 1 (n=71)	Group 2 (n=73)	Group 3 (n=74)	
Stapled haemorrhoidectomy	8.5 (±1.8)	8.3 (±1.4)	8.6 (±1.2)	NSD
Milligan-Morgan haemorrhoidectomy	7.9 (±1.4)	8.0 (±1.3)	8.1(±1.2)	NSD
Fistulectomy	8.1(±1.2)	7.9 (±1.4)	8.0 (±1.3)	NSD
Perianal abscess revision	6.8 (±2.5)	6.5 (±2.5)	6.1(±2.7)	NSD
Anal tumour electrocoagulation	7.3 (±1.8)	7.2 (±1.8)	7.0 (±1.8)	NSD
Overall satisfaction rate	7.7(±1.7)	7.6 (±1.6)	7.6 (±1.7)	NSD

Satisfaction rate was scored on a visual analogue scale (VAS) in which 0 indicated dissatisfaction and 10 indicated maximum satisfaction.
NSD: No Significant Difference (P=0.35, Fisher's exact test)

Table 3 Impact of anaesthetic technique on duration of hospital stay.

Hospital stay (days)	Group 1 (n=71)	Group 2 (n=73)	Group 3 (n=74)	P
0.3 – 0.5	0 (0.0%)	0 (0.0%)[c]	62 (83.7%)[a,b]	SD
0.5 – 1.0	0 (0.0%)	0 (0.0%)[c]	10 (13.5%)[a,b]	SD
1.0 – 2.0	16 (22.5%)	16 (21.9%)[c]	1 (1.4%)[a,b]	SD
> 2.0	55 (77.5%)	57 (78.1%)[c]	1 (1.4%)[a,b]	SD

SD: Significant Difference [a] SD between 3 and 1 (P<0.01, two-tailed test)
[b] SD between 3 and 2 (P<0.01, two-tailed test) [c] NSD between 1 and 2 (P=0.35, Fisher's exact test)
Also, the influence of the anaesthetic technique on satisfaction rates among patients undergoing anal surgery was determined.

parentheses. Fisher's exact test and Mann Whitney U test were used as appropriate to compare the groups to each other. $P < 0.05$ (two-tailed test) was considered statistically significant.

Results

Groups 1 and 2 patients were admitted to the hospital 0.5-1 days preoperatively (mean 0.7 d) for anaesthetic evaluation. The post-operative hospital stay ranged from 1-4 days (mean 1.8 d) in group 1, and 1-5 days (mean 2.3 d) in group 2 respectively. Group 3 patients were admitted to the hospital on the day of operation. The postoperative hospital stay ranged from 0.3-2.5 days (mean 0.5 d). 62 patients (83.7%) were discharged within 12 hours (0.5 d) of admission (Table 3).

The impact of the type of anaesthesia on the length of hospital stay is shown in Table 3. Although the difference between groups 1 and 2 was not significant, ($P = 0.35$, Fisher's exact test), if we compare group 3 to group 1 and 2, the difference was significant, ($P < 0.01$ and $P < 0.01$ respectively, two-tailed test). The satisfaction rate during post-operative evaluation was 7.7±1.7 in GA, 7.6±1.6 in SA compared to 7.6±1.7 in LA on the VAS. These differences were not significant, ($P = 0.35$, Fisher's exact test). (Table 2)

Discussion

The aim of day surgery units is a short term hospital stay along with limiting patient discomfort and reducing cost. Its main drawback is the limited time for direct observation of the patient. Thus, it is imperative that the anaesthetic and surgical procedures be safe and effective.[1,2] The optimal anaesthetic technique in day surgery aims to provide excellent operating conditions, fast discharge, low complication rates and a high degree of patient satisfaction.[6]

It is believed that most anal surgery procedures can be carried out as ambulatory operations. The selection of anaesthetic technique may be the only factor which may prevent this – especially if GA or SA is selected. This is because in these cases, patients may have to be admitted to hospital one or two days prior to operation, due to the need for pre-operative anaesthetic evaluation. Local anaesthetic modalities have been proposed as an alternative to GA or SA for anal surgery. [7–12] Although local techniques have not yet been standardized for proctologic operations, few methods have been proposed to provide sufficient relaxation of the sphincters.[6-7] Marti [13] described a posterior perineal block that provided sufficient analgesia for anal surgery. Gabrielli et al [14] performed a posterior block in 400 haemorrhoidectomies. They found their technique to be complete or satisfactory in 94% of the operations performed, while 6% of patients needed supplementation with intravenous analgesics. Nyström et al [8] described a perianal block performed in 30 patients with various proctologic disorders.

Although a lot of papers concerning the type of anaesthesia used in day surgery have been published in the past [5, 7-10, 15], a correlation between the type of anaesthesia and the duration of hospital stay has rarely been reported. Law et al [4] presented 48 patients who underwent ambulatory stapled haemorrhoidectomy. They compared the outcomes following stapled haemorrhoidectomy as an inpatient versus as a day surgery procedure. There were no differences in post-operative complications, pain scores, analgesic requirements, and patient satisfaction scores between the two groups. The total mean hospital stay was significantly shorter for those undergoing 7 8 day surgery stapled haemorrhoidectomy (0.46 versus 1.9 days, $P<0.01$). They concluded that stapled haemorrhoidectomy is a feasible procedure to perform on a day basis.

The aim of our study was to detect the impact of the type of anaesthesia on the length of pre-operative and post-operative hospital stay, and also to prove the feasibility of LA in a wide variety of day case anal operations. We found that the selection of anaesthetic technique plays a predominant role in the length of hospital stay. The duration of hospitalisation in patients operated under LA was shorter than in patients operated under GA or SA, regardless of the type of procedure. These results were significantly different ($P<0.01$) (Table 3). This means that LA is associated with a shorter hospital stay. The overall satisfaction rate during post-operative evaluation was not significantly different among the three groups, (7.7(±1.7) in GA, 7.6(±1.6) in SA, and 7.6(±1.7) in LA on the VAS respectively). This means that LA is accepted as well as GA or SA for anal operations.

Conclusion

LA is a suitable method of anaesthesia for anal surgery with a high degree of acceptance among patients. It can be used in most proctologic procedures. The method is simple, fast, safe and easy to learn. LA is associated with shorter hospital stays, a faster return to full social activities and a high satisfaction rate among patients. It seems to be the ideal anaesthetic technique for day case anal procedures.

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Is it possible to predict list overruns in a NHS day surgery unit?

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Abstract

Aim: To investigate the factors that predict list overruns in a National Health Service (NHS) day surgery unit.

Methods: Multivariate logistic regression was used to investigate the independent influence of operating list size, late starts, individual personnel and session factors on general surgical list overruns.

Results: 30%(627/2092) of all ambulatory general surgical lists performed over a 7 year period overran. Regression modelling revealed that operating list size was the main predictor of overruns in this context($p<0.001$). Individual surgeons($p<0.001$) and late-starting lists($p<0.001$) also influenced whether overruns occurred but to a lesser degree.

Discussion: Reducing overruns in NHS ambulatory centres is desirable. Achieving this through reduced list size requires local prioritisation between opposing operational targets.

Keywords: Overrun; Operating list; Theatre utilisation; Day surgery unit.

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Introduction

Efficient use of allocated theatre time involves the maximisation of list utilisation as well as the prevention of list overruns. Attempts to enhance list utilisation often results in overruns [1,2]. The expense associated with under utilised theatre lists across National Health Service (NHS) Trusts is clear and has been highlighted in a recent Audit Commission publication [3]. Overrunning lists also lead to financial penalties but these are less easy to quantify. Specifically, in the short term overruns can lead to significant staff overtime costs. A recent investigation into day surgery services across the NHS by the Healthcare Commission has found that high levels of overtime are worked in many UK day surgery (DS) units and this is associated with high additional costs [4]. More importantly, staff absenteeism and recruitment difficulties are major problems amongst NHS theatre departments. National shortages of theatre staff were highlighted in both the Audit Commission publication as well as a high profile Modernisation Agency document entitled the *Step Guide to improving operating theatre performance* [5]. Overruns are a commonly cited cause of theatre staff discontent and are a possible contributory factor towards the recruitment problems cited above. A recent investigation into DS staffing levels by the Healthcare Commission determined that one in ten units were using bank or agency nursing to meet more than 10% of its staffing needs [4]. In a minority of units agency staff were being used to meet half of their total staffing requirements.

There may be potential financial and managerial advantages to limiting overruns if this can be achieved without concomitant falls in theatre usage. The true cost of an overrun can only be quantified against the opposing operational goal of maximising surgical throughput. At present little is known about the causes of operating list overruns in the NHS setting let alone their genuine cost to the NHS. An understanding of the aetiology of list overruns in the DS setting might facilitate operational decision makers to limit their occurrence.

Study Aim

The aim of this study was to examine the factors that led to overruns on general surgery operating lists in a London NHS DS unit.

Methods

Data methods

The study data comprised all elective day case (DC) procedures performed at a London Teaching Hospital between April 1997 and April 2004. Prospectively entered theatre data were retrieved from the hospital theatre database (*Surgiserver © McKennon systems*) and aggregated into operating lists. The principal outcome measure was whether a list overrun had occurred. Overruns were defined to have occurred when drape removal from the last patient on the list occurred after the scheduled session finish time. Database variables were consequently recoded into list, session and personnel factors (see below). The latter, in addition to operating list size, represented the overrun predictors investigated in this study.

A scoring system for operating list size

A scoring system was developed from all database procedures to quantify the size of general surgery operating lists. Specifically, *case scores* (units) were assigned to the *Office of Population, Censuses and Surveys - Classification of Surgical Operations and Procedures - 4th Revision (OPCS-4)* codes on the basis of the historical median case duration of all database procedures that had been assigned to the corresponding code. The case score represented the procedure median duration (in seconds) divided by 30. For example, the case score of a day surgery primary inguinal hernia repair was 106 units. This numerical value represented the median duration (in seconds)/30 of all historical database procedures that had been performed in the day surgery department (by all surgeons who had performed this procedure) and coded to the 'Primary Repair of Inguinal Hernia' OPCS code. Operating list size (the list score) corresponded to the sum of the case-scores of constituent list procedures.

Session, personnel and list factors

Operating lists were recoded according to whether they took place on 'morning' or 'afternoon' sessions. Lists were classified according to the theatre suites where surgery took place. The latter variables were termed session factors. Surgical and anaesthetic practitioners were included on an anonymous individual basis if they had performed more than 100 database procedures. Practitioners that had performed less than 100 cases were pooled into separate surgical and anaesthetic personnel categories respectively. List factors describe the extent to which operating sessions started late i.e. after the scheduled start time. Late starts in the day surgery setting were categorised according to the time delay incurred (see Table 1).

Statistical Analysis

Multivariate logistic regression models were used to evaluate the relative influence of list volume, list factors (i.e. late starts), session factors (i.e. session type, theatre suite) and theatre personnel (i.e. surgeons and anaesthetists) on the predisposition of theatre lists to overrun. A binary approach to overruns was employed as the study end point (i.e. no overrun or overrun). The details of how test variables (i.e. list, session and theatre factors) were sub-categorized are described in Table 1. Logistic regression models were constructed by entering influential unifactorial risk factors into the model. Stepwise regression was used to evaluate individual predictors. Criteria were set so that variables were excluded from the model if their probability of influence was low ($P>0.1$). The mean (± standard deviation) and median (Q1-3, n) were recorded for test variables where appropriate. For all tests of significance, $P<0.05$ was considered statistically significant.

Results

Operating list characteristics

Throughout the study period 8,314 operations were carried out on 2,092 general surgery lists in the day surgery (DS) centre. Nearly all (99.2%) procedures were performed on 4-hour sessions. In total, 61.6%, 29.8% and 7.7% of database operations were performed under general anaesthesia, local infiltration and sedation respectively. The descriptive characteristics of the operating lists performed in the DS department throughout the study period are described in Table 1. The sub-categories of list, session and personnel factors are described in accordance with the categories included in the regression analyses.

Theatre list overruns

In the day surgery department 30% (n=627) of all study theatre lists overran to some extent. The median length of list overrun was 25 minutes (42 – 12 minutes, n=627). In total, 3,046 (36.6%)

Table 1 A summary of general surgical operating list characteristics in the DS department between 1997 & 2004.

Operating list factors	Day Surgery (DS)
Operating list volume	
Mean hourly productivity i.e. list score units per hour (SD)	78.48(26.15)
Session factors	
Session type	
Percentage of operations performed on Morning lists (n)	38.2%(3226)
Percentage of operations performed on Afternoon lists (n)	61.1%(5083)
No. of theatre suites	5
Personnel factors	
Surgeons	
Total number of surgeons coded on database	133
No. of surgeons with >100 database procedures	16
Percentage of total cases performed by surgeons with>100 cases (n)	79.3% (6594)
Anaesthetists	
Total no. of Anaesthetists' coded on database	246
No. of anaesthetists with >100 database procedures	10
Percentage of total cases performed by anaesthetists with>100 cases (n)	23. 9% (1983)
List factors	
Late-starts	
Median (Q1-Q3, n) late start in minutes	32 (17-48, 2,087)
n(%). DS operations on lists where Late start <30 minutes	996 (47.61%)
n(%). DS operations on lists where Late start is 30-60 minutes	870 (41.59%)
n(%). DS operations on lists where Late start is > 60 minutes	221 (10.56%)

operations performed in the day surgery department were on lists that overran. Of these operations 1736 (20.8% of total) and 1310 (15.7% of total) cases were on lists that overran by less than 30 minutes and more than 30 minutes respectively. The distribution of degree (time in seconds) of list overruns and underruns for all day surgery cases is illustrated in Chart 1.

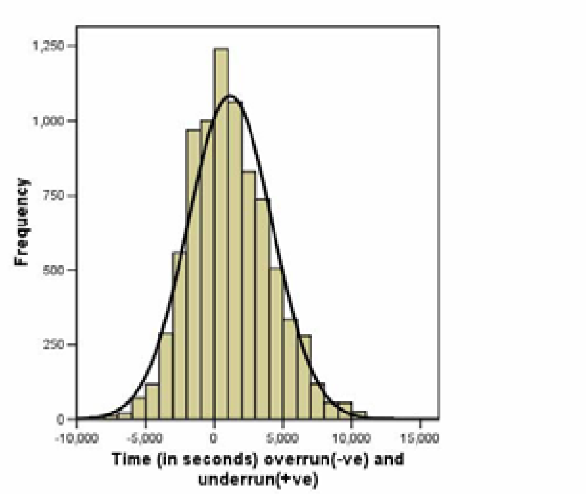

Chart 1 Frequency of theatre list overruns and under runs (in seconds) in the day surgery department between 1997 and 2004.

The multivariate logistic regression model was constructed by entering list size and influential session, personnel and list factor covariates into the model. Table 2 highlights the strength of individual list, session and personnel predictors within the model. The Odds Ratio (OR + 95% Confidence Interval for the OR) is given for each predictor as well as the level of significance of the predictor within the model.

The overall predictive power of the model was 77.1%. The percentage of underruns and overruns correctly predicted by the model was 86.6% and 60% respectively. Analysis of the relative influence of predictors within the model (i.e. the magnitude of the change in –2 Log likelihood statistic when the predictor is removed from the model) revealed that the size of an operating list is the principal determinant of whether it overruns or not (Table 3). Surgeons also demonstrated an independent influence on list overruns. Their ability to predict overruns was greater than that of all factors other than operating list size. With the exception of session type the predictive power of the other covariates within the model was significant but modest.

Discussion

Optimal theatre performance involves the full and productive usage of allocated theatre time without incurring list overruns. In reality the greater the surgical volume that is attempted on a given list, the greater the chance that an overrun will occur [1]. The relative cost, or negative value, attributed to an overrun depends largely on the given operational targets desired by the managers of a specific DS unit. In centres where waiting lists are problematic under used theatre time represents a greater cost than a list overrun. In contrast, in units where overtime costs and staffing problems are significant a greater emphasis on limiting theatre overruns is required.

The results of this study confirm that, within the context of general surgery day case lists, the strongest determinant of whether an overrun occurs is the size of the list that is undertaken. Although this appears obvious, the factors that govern the ultimate size of an operating list can be complex in the setting of an NHS day surgery centre. In NHS DSUs operating lists are mostly scheduled by clerical staff. Many surgeons often have little direct involvement with routine day surgery list planning. The presence of waiting lists presents a surplus of scheduling opportunities. Individual operating sessions are planned through estimation of an appropriate number of cases, taking case complexity and clinical urgency into account. A tendency towards over booking lists can arise for two reasons. Firstly, pressures associated with lengthy waiting lists generate attempts to achieve a greater operative output per session. Also over booking of lists is sometimes carried out by clerical staff in order to compensate for patients who fail to attend for procedures. Where compensatory over scheduling occurs erratic operative list volumes often ensue.

List scoring, as described in this study, is a time based quantification tool that was used as a marker of operative volume. Its potential advantage over the empirical use of total procedure numbers (i.e. case load) or cumulative procedure duration is that it reflects both quantitative as well as complexity aspects of theatre output. The principal weakness of list scoring is that, as it is based on the OPCS-4 procedure classification, some codes are not specific to individual operations. Instead these codes represent categories where related interventions are amalgamated. Arguably some degree of heterogeneity of individual procedure complexity and duration exists within such categories.

Many investigators have noted that historical procedure times can offer practical assistance regarding theatre scheduling. Broka and co-workers determined from a prospective analysis of theatre usage that the recorded occupancy times (ROTs) of theatres correlated strongly with the predicted occupancy times (POTs) that were taken from the historical surgeon specific median procedure durations [6]. When they used the historical procedure data for theatre list planning they demonstrated significant reductions in numbers and duration

Table 1 The model power when significant variables are removed. The strength of individual predictors is denoted by the Change in –2 Log Likelihood statistic of the model when the given predictor is removed from model.

Model variable	Model Log Likelihood	Change in –2 Log Likelihood	df	Sig. Of the Change
Late start	-4224.4	361.9	2	0.000
List volume	-5124.1	2161.3	1	0.000
Theatre	-4067.3	47.7	4	0.000
Anaesthetist	-4100.1	113.2	10	0.000
Surgeon	-4304.5	522.0	16	0.000

Table 2 Multi-factorial logistic regression model for overruns in the day surgery department.
Reference predictor subcategories are denoted by (reference). P-values are included for all covariates.

							95.0% C.I. for OR	
Model constant	**Beta**	**S.E.**	**Wald**	**df**	**p-value**	**OR**	**Lower**	**Upper**
*Constant**	-5.061	0.151	1116.255	1	0.000	0.006		
List volume (list-score)	0.014	0.000	1414.230	1	0.000	1.015	1.014	1.015
Session factors								
Session type categories					NS			
AM list (reference)								
PM list								
Theatre type			47.287	4	0.000			
Theatre 1	-0.631	0.121	26.998	1	0.000	0.532	0.420	0.675
Theatre 2	-0.458	0.088	26.913	1	0.000	0.632	0.532	0.752
Theatre 3	-0.763	0.165	21.468	1	0.000	0.466	0.338	0.644
Theatre 4	0.021	0.155	0.018	1	0.895	1.021	0.753	1.383
Theatre 5 (reference)					1.000			
Personnel factors								
Surgeons			459.942	16	0.000			
Surgeon 1	0.754	0.150	25.172	1	0.000	2.125	1.583	2.852
Surgeon 2	-1.223	0.176	48.478	1	0.000	0.294	0.209	0.415
Surgeon 3	-0.266	0.107	6.228	1	0.013	0.767	0.622	0.945
Surgeon 4	-0.692	0.221	9.820	1	0.002	0.501	0.325	0.772
Surgeon 5	-1.524	0.283	28.994	1	0.000	0.218	0.125	0.379
Surgeon 6	0.003	0.191	0.000	1	0.988	1.003	0.690	1.457
Surgeon 7	-1.808	0.117	239.628	1	0.000	0.164	0.130	0.206
Surgeon 8	-1.116	0.258	18.760	1	0.000	0.328	0.198	0.543
Surgeon 9	-0.754	0.204	13.719	1	0.000	0.470	0.316	0.701
Surgeon 10	-1.240	0.187	44.157	1	0.000	0.289	0.201	0.417
Surgeon 11	-0.473	0.120	15.620	1	0.000	0.623	0.493	0.788
Surgeon 12	0.303	0.130	5.483	1	0.019	1.354	1.051	1.746
Surgeon 13	-0.415	0.131	10.037	1	0.002	0.660	0.511	0.854
Surgeon 14	-0.159	0.250	0.405	1	0.524	0.853	0.523	1.392
Surgeon 15	-0.475	0.142	11.126	1	0.001	0.622	0.471	0.822
Surgeon 16	0.976	0.175	30.996	1	0.000	2.653	1.882	3.741
Surgeon 'others' (reference)					1.000			
Anaesthetists		105.749	10 0.000					
Anaesthetist 1	-0.396	0.231	2.934	1	0.087	0.673	0.428	1.059
Anaesthetist 2	-0.332	0.214	2.402	1	0.121	0.717	0.471	1.092
Anaesthetist 3	-0.247	0.153	2.622	1	0.105	0.781	0.579	1.053
Anaesthetist 4	0.275	0.238	1.329	1	0.249	1.316	0.825	2.099
Anaesthetist 5	0.975	0.163	35.718	1	0.000	2.652	1.926	3.652
Anaesthetist 6	0.861	0.210	16.856	1	0.000	2.364	1.568	3.566
Anaesthetist 7	0.542	0.181	8.993	1	0.003	1.719	1.206	2.449
Anaesthetist 8	-1.285	0.256	25.242	1	0.000	0.277	0.168	0.457
Anaesthetist 9	0.252	0.207	1.474	1	0.225	1.286	0.857	1.932
Anaesthetist 10	-0.622	0.206	9.141	1	0.003	0.537	0.359	0.804
Anaesthetist 'others' (reference)					1.000			
List factors								
Late start categories			341.221	2	0.000			
<30 minutes (reference)					1.000			
30-60 minutes	0.988	0.066	226.310	1	0.000	2.685	2.361	3.054
> 60 minutes	1.650	0.103	256.025	1 0.000	5.210	4.256	6.377	

of list overruns. Franklin Dexter and colleagues from the University of Iowa have published extensively on this issue [7- 10]. They have demonstrated that, despite the error associated with the variability of case duration, mean case length and turnover times offer a practical method of estimating the session duration requirement for a series of elective operations. Although statistical modelling techniques might offer theoretical advantages and have been advocated by some investigators [11,12], Dexter et al suggest that use of simple mean historical times can suffice for managerial decision making even when surgeon specific historical procedure times are not available and generalised historical data is applied instead [7, 13].

Late starting operating lists are common in the ambulatory setting. This problem is certainly not exclusive to theatre units in the NHS [14]. The study finding that late starting lists are significant predictors of list overruns was to some extent expected. The degree of influence that they had on overruns was not anticipated as one might expect a late start to result in a cancellation rather than an overrun. In the context of ambulatory surgery it is possible that staff feel a duty towards list completion when lists are started late, even at the expense of overrunning. Unexplainable factors appear to contribute towards the differing influence of individual personnel such as surgeons and anaesthetists on list overruns. The data suggests large differences in the likelihood of overruns occurring when specific personnel are considered. Some elements of these differences might be attributable to the case mix of individual consultant's operating lists. Differing personality types amongst teams of surgeons and anaesthetists might also account for varying tendencies towards case cancellations where an overrun seems likely. One might expect an excess of overruns to occur on afternoon lists. The principal constraint to overruns on morning lists being that theatre suites need to be vacated in time for the start of the afternoon session. In this study no independent influence was noted between session type and overruns.

The burden of theatre list overruns on theatre staff in the NHS is probably considerable. Future studies will need to attempt to quantify the true cost of list overruns in NHS DS departments. Whilst the pressure to reduce waiting lists persists, achieving high productivity from theatre units will be prioritised and list overruns will remain a secondary consideration. Simple measures directed towards the prevention of late starts and ensuring that listed patients attend for their operations should serve to provide reliable consistent list volumes that offer high list productivity whilst making overrunning less likely.

Conclusion

Overruns are associated with significant financial costs and low staff morale. The true extent of these costs is difficult to define. This study demonstrates that the size of an operating list is the principal determinant of whether it will overrun its allocated duration. Avoidance of overruns is obviously desirable but it could result in a consequent reduction in theatre productivity if list size is limited. Where overruns occur consistently and simple measures, such as the avoidance of late starts, has failed to limit this problem, conflict arises between opposing operational aims. Under these circumstances decision-makers need to prioritise between achieving a higher service output and the relevant local costs associated with overruns.

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Long term outcomes following discharge from shoulder surgery in an ambulatory setting

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Abstract

Purpose To describe patients' recovery following discharge from shoulder surgery in an ambulatory setting.

Methods Pain and function were measured preoperatively, at 48 hours, 7 days, and 1 month postoperatively. Pain was measured on a scale of 0-10. The Quick DASH (Disabilities of the Arm, Shoulder and Hand) questionnaire was used to measure function at baseline, 7 days and 1 month.

Results Based on 93 patients, with 86 patients who completed all three follow-ups. Pain score was highest at 48 hours, had begun to lessen at day 7, and was below baseline at 1 month. DASH scores had not returned to baseline at 1 month. The number of patients who had resumed daily activities such as returning to work or engaging in household routines was 47% at 7 days, and 84% at 1 month. Patients in the rotator cuff repair group had significantly more pain, a significantly higher DASH score, and 40% were still using opioids at 1 month.

Conclusion The chief finding of this study was that the majority of patients (84%) recovered rapidly, required minimal opioids for pain control and regained full function within one month. As expected, recovery tended to be longer in elderly patients and those having complex procedures. Patient recovery appeared to be influenced by the type of surgery rather than the analgesic method used.

Keywords: Ambulatory shoulder surgery, pain and function, long term outcomes.

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Introduction

Improvements in surgical and anesthesia techniques over the past several years have led to an increase in the number and types of surgeries being performed in outpatient settings. Seventy percent of all surgical procedures performed in the United States are currently done on an ambulatory or 23 hour observation stay basis [1]. With the emphasis now on early discharge, long-term outcome data is needed to improve postoperative care and to better educate patients on what to expect after discharge.

Orthopedic procedures have been shown to be amongst the most painful procedures performed in an ambulatory setting [2]. Nearly half of all orthopedic patients experience moderate to severe pain 24 hours after surgery [3], and limited function can still be a problem seven days after discharge [4]. They are also shown to have a high rate of unanticipated readmissions due to pain [5]. Orthopedic patients are the largest group who undergo peripheral nerve blocks [6], which provide excellent anesthesia during surgery, but gradually diminish within 24 to 48 hours. While a continuous infusion of local anesthetic using a disposable elastomeric infusion device [7] providing analgesia up to 48 hours is used in some centers, it is not widely available and its clinical utility has not yet been fully established.

A review of the literature shows that several studies have examined immediate postoperative pain, nausea and vomiting following ambulatory surgery. Some studies have focused on the first 24 and/or 48 hours [2,3,8-10] after surgery, while others have extended their follow up to seven days postoperatively [4,11-13]. However, there are currently no studies assessing long-term pain and function up to one month. Patient observation is needed beyond 4 seven days to assess long-term recovery and to determine how much time is needed to resume normal daily activities.

The purpose of our study was to describe patients' long-term recovery after ambulatory shoulder surgery by reporting their pain, function, resumption of daily activities and opioid use up to one month after discharge.

Methods

The Massachusetts General Hospital (MGH) Institutional Review Board for Studies on Human Subjects approved this prospective study.

Patients 18 years of age and above who were scheduled to undergo ambulatory shoulder surgery in the Same Day Surgery Unit at MGH were approached the morning of surgery. All patients who agreed to participate signed a consent form. Patients were excluded if (1) they had chronic pain not related to their shoulder problem requiring opioid therapy, or (2) they anticipated being admitted after surgery for up to 48 hours. Anesthesia and postoperative analgesia were chosen without any restriction by the anesthesia and surgical teams.

Two surgeons, JW and TG, performed all surgical procedures. Only one surgeon inserted a pain catheter for postoperative pain. It involved the placement of a small catheter into the surgical wound which provided a continuous infusion of 0.25% Bupivacine at 6cc/ hour over 48 hours

Data were collected over a 12-month period from September 2004 to August 2005. Prior to surgery, patients rated their pain on a 0-10 scale and completed the Quick DASH outcome measure. This is a shortened version of the DASH (Disabilities of the Arm, Shoulder and Hand) Outcome Measure, a self-report questionnaire designed to measure physical function 5 and symptoms in persons with any or multiple musculoskeletal disorders of the upper limb. Quick DASH has 11 questions, which gives a 0-100 score, 0 indicating least disability and 100 indicating most disability (Appendix)

Postoperative follow-up assessments were performed at 48 hours, seven-days, and onemonth via telephone interviews. At all time periods, patients were asked to rate their pain, and to name the type and dose of opioid analgesia used during the previous 24 hours. Analgesic doses were converted to standard morphine equivalents [14]. Patients were also asked if they had symptoms of nausea, vomiting, drowsiness, and fatigue, and if so, to rate how bothersome they were.

At the seven-day and one-month follow-up period, patients again completed the Quick DASH questionnaire. We also asked if they had resumed daily activities such as returning to work or engaging in household activities. Patient records were used to collect details on the type and length of surgery, type and length of anesthesia, immediate postoperative pain and other symptoms or complications.

Surgical procedures were categorized into three groups based on the length of time the shoulder was in a sling and the time to start rehabilitation exercises.

Group A included procedures such as Bankart repair and Superior Labral tear from Anterior to Posterior (SLAP) repair. These procedures are usually done for recurrent shoulder instability or dislocation and affect the younger age groups. Rehabilitation for patients in this group includes a shoulder sling for six weeks, plus activity within a limited range of motion during this period.

Group B consisted of patients who received rotator cuff repair. The patient population depends on the mechanism of injury such as degeneration due to aging or repetitive overhead 6 movements. Rehabilitation guidelines include an abduction brace for six weeks. No movement is allowed during this period except for passive range of motion exercises by a physiotherapist.

Group C included procedures such as subacromial decompression, distal clavicular excision, and acromioclavicular excision. Diagnoses in this group include subacrominal impingement syndrome and acromioclavicular joint osteoarthritis which are common painful conditions among middle age to elderly populations.

Statistical Analysis

Continuous data were summarized with mean and standard deviation except for skewed data, which were summarized as median and interquartile range. Repeated measures analysis of covariance (RM-ANCOVA) was performed to determine changes in pain and DASH scores. Factors, which may have influenced postoperative pain and function, were selected and used as covariates. The effect of the following factors on postoperative pain and DASH scores were independently evaluated as a single covariate in RM-ANCOVA: age, gender, if surgery was on dominant side, if patient had previous surgery on the same site, the type of surgery as categorized above (group A, B or C), if the procedure was arthroscopy or open surgery, if a pain catheter was used postoperatively. The factors that were found to be associated ($p<0.1$) were then included as covariates of the final RM-ANCOVA. The type of surgery, if open or arthroscopy surgery, and the use of a pain catheter were included for the analysis of pain. In the analysis of DASH, age, the type of surgery, and if open or arthroscopy surgery were included.

Results

One hundred and forty five patients were approached and informed about the study. Thirty-six patients refused. Four patients were not eligible as they were using opioids for chronic pain. After obtaining consent, four patients had surgery cancelled, seven patients did not return phone calls at the 48-hour follow up, four patients at the seven-day follow up, and four patients at the one-month follow up.

We only included patients who completed the quick DASH questionnaire preoperatively and at seven days and one month in our analysis. The study results are therefore based on 93 patients, with 86 patients who completed all three follow-ups and seven patients missing the 48- hour follow-up. With the exception of one patient who was admitted for 48-hours due to a frozen shoulder, all patients were discharged to home the same day of surgery. No patients were readmitted to the hospital.

Patient Details

Table 1 shows demographic and surgical details. The age range of patients was 22-72 years and the majority was Caucasian (94%). Surgeries were done by arthroscopy except for seventeen patients who had open shoulder surgery. Since most patients received regional anesthesia combined with general anesthesia (80% n=74), we were unable to look at the effect the choice of anesthetic may have had on long-term outcome. Fifty patients received a pain catheter for postoperative pain.

Table 1 Demographic and Surgical Data.

Age (mean±SD)	47.9±13.0
Male (n, %)	n=61, 66%
Type of surgery (n, %)	Type A (19,20%) Type B (39,42%) Type C (35,38%)
Previous surgery on the same site (n, %)	n=26, 28%
Surgery on dominant side (n, %)	n= 57, 0.61
Duration of surgery (mean±SD)	131.4±29.1
Duration of anesthesia (mean±SD)	68.1±24.1
Arthroscopic surgery (n, %)*	n=76, 82%
Pain catheter inserted (n, %)$	n=50, 53%

*The remaining patients had open shoulder surgery.
$Pain Buster Reservoir contained 0.5% Bupivacaine delivering 4-6cc every hour over a 48-hour period.

One patient was admitted for 48 hours due to a frozen shoulder. This patient, a 59-year old female, underwent arthroscopic capsular release and subacromial decompression (Group C) 8 with combined regional and general anesthesia. Management included a brachial plexus catheter and passive range of motion for 48 hours as an inpatient. After discharge this patient was able to resume her normal daily activities within one week.

Pain and Function

Figures 1 and 2 show changes in pain and DASH scores for all patients at each follow up period.

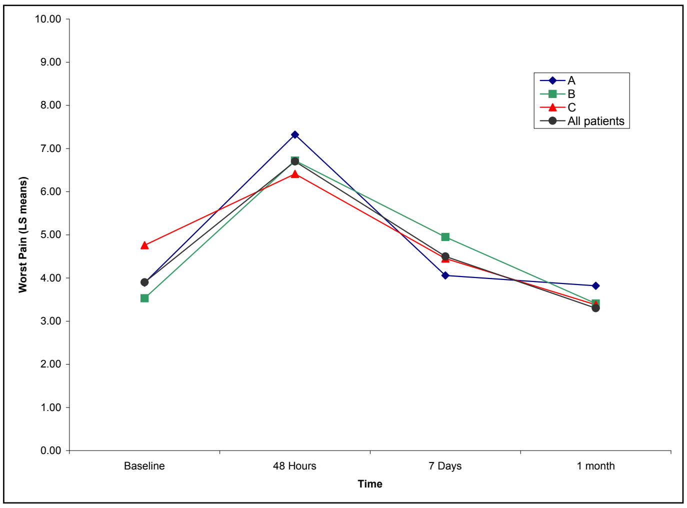

Figure 1 Changes in pain score for all patients and each surgical group.

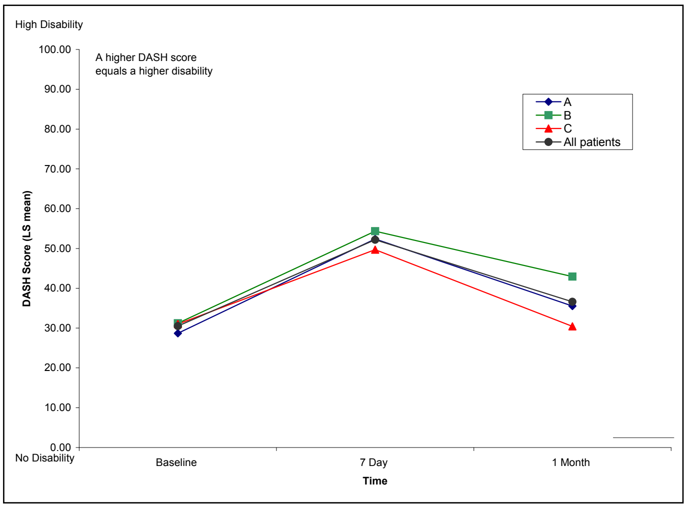

Figure 2 Changes in DASH score for all patients and each surgical group.

At baseline (preoperatively) mean worst pain was 3.9 ± 2.6 on a scale of 0-10. Prior to discharge patients' pain was well controlled (range 0-2). Patients' pain score was highest at 48 hours but had begun to lessen by postoperative day seven. By one month the mean pain score was below baseline (RM-ANCOVA [F (3, 79) = 6.06, p<0.01]).

Prior to surgery, the mean DASH score was 30.5 ± 17.2. At seven days functional disability had increased, mean score 52.2 ± 13.9. By one month the DASH score had improved but had not returned to preoperative levels, mean score 36.6 ± 15.8 (RM-ANCOVA [F(2, 87) = 15.6, p<0.01])

The following factors were included as covariates in RM-ANCOVA to see if they may have influenced postoperative pain and function: age, gender, if surgery was on dominant side, if patient had previous surgery on the same site, the type of surgery as categorized above (group A, B or C), if the procedure was arthroscopy or open surgery, if a pain catheter was used postoperatively. In the analysis of pain the type of procedure (arthroscopy or open) was found to have a significant effect after adjusting for the other factors (RM-ANCOVA [F(3, 79) = 15.6, p=0.04]). Pain was higher at both 48 hours and 7 days for patients who had open surgery, but this difference had disappeared by one month (Figure 3). None of the covariates were found to 9 be significantly associated with postoperative DASH scores after adjusting for the above factors (data not shown).

Analgesic Use

Table 2 shows postoperative opioid analgesic usage and the incidence of nausea, fatigue and drowsiness at each follow up period. During

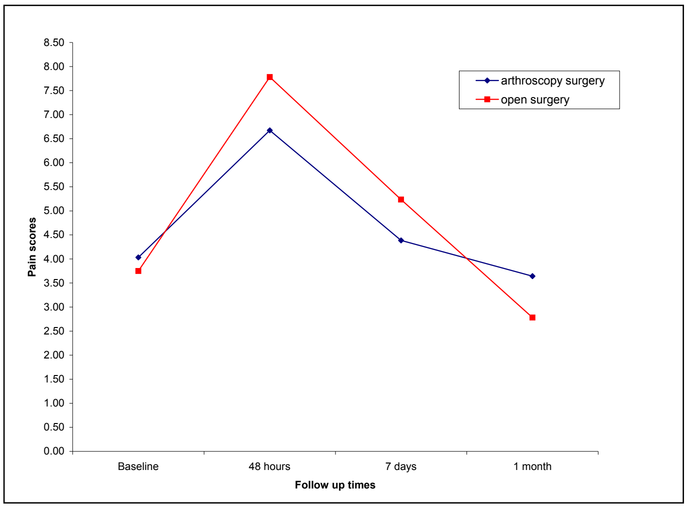

Figure 3 Comparison of pain scores with arthroscopy and open surgery.

Table 2 Opioid Usage and Side Effects at each follow up period.

	48 Hour (n=86)	7 Days (n=93)	I month (n=93)
Patients using opioid (n, %):	n=84, 98%	n=55, 59%	n=16, 17%
controlled released oxycodone (n)	53	7	1
oxycodone (n)	11	7	3
oxycodone and acetaminophen (n)	50	32	6
hydrocodone and acetaminophen (n)	16	13	6
hydromorphone (n)	2	1	0
dose of opioid* (mg, median with			
interquartile range)	53 (30-70)	15 (5-25)	10 (5-19)
Side Effects:			
nausea (n, %)	n=31, 36%	n=15, 16%	0%
fatigue (n, %)	n=65, 76%	n=58, 62%	n=28,30%
drowsiness (n, %)	n=69, 80%	n=45, 48%	n=12, 13%

* morphine equivalent dose

the initial postoperative period (prior to discharge) 65% (n=60) of patients received opioid medication for pain regardless of whether they had a pain catheter placed during surgery. While the number of patients experiencing nausea decreased as patients stopped using opioids, fatigue and drowsiness were prevalent at all follow-ups. Comparisons among surgical groups showed no difference in the proportion of patients using opioids, or in the mean opioid dose (morphine equivalence). There was no significant association between the use of a pain catheter and opioid use at each time period (data not shown).

Time to Resume Activities

At 7 days 47%(n=44) of study patients had resumed daily activities such as returning to work or engaging in household routines. By 1 month that number had increased to 84% (n=78). Of the 78 patients who had resumed activities at this time period, the mean duration was as follows: group A 12 ± 1.4 days, group B 12 ± 1.6 days, and group C 8 ± 1.3 days (n.s.). When compared between open and arthroscopy surgery, the mean duration was 10 ± 2.0 days and 11 ± 0.9 days, respectively (n.s).

Fifteen patients (16%) had not resumed normal daily activities at the 1-month follow up. When compared with patients who had resumed activities, these patients had a significantly higher DASH score (mean 50 ± 14.3 v 34 ± 14.9) and significantly more pain (mean 4.3 ± 2.0 v 1 0 3.1 ± 2.2, $p<0.05$). The proportion of these patients still on opioids at one month was also significantly higher (40% v 13%, $p<0.05$).

Discussion

The purpose of our study was to assess the quality of recovery in patients discharged from same day surgery. Our results showed that the majority of our patients actually did well with minimum opioid requirements at home and a return to functionality in a short period of time

We followed 93 opioid naïve patients up to one month after ambulatory shoulder surgery. Although pain was well controlled prior to discharge, most patients (83%) had moderate (pain score 4-6) to severe (pain score 7-10) pain two days after surgery. While pain started to lessen by day seven, there were still patients experiencing severe (30%) and moderate (36%) pain. However, 35% of the moderate pain patients reported at the seven-day follow up that they were no longer using opioids to treat their pain. In addition patients who reported adverse effects to the opioid medication at 48 hours (36% complained of nausea had chosen by day seven to switched to over the counter medication.

Fatigue and drowsiness were prevalent at all follow-ups. While this is to be expected within the first few days (at 48 hours 76% and 80% complained of fatigue and drowsiness, respectively), this symptom can persist up to one month following surgery. In our study, more than half of the patients still had fatigue (62%) and 48% had drowsiness at the seven day follow up. At this time period patients reported they found these symptoms bothersome.

We measured perioperative disability using the QuickDASH questionnaire. This questionnaire consists of function and pain related questions, and questions related to role function and social activities. The results of our study were similar to known group comparisons of being able to work (average score 27.5) versus unable to work (average score 52.6) due to an upper limb problem [15]. At one month patients who had resumed their daily activities had a mean DASH score of 34, versus 50 for patients who had not. This shows that Quick DASH was able to distinguish between the two groups, and was sensitive enough to evaluate functional outcomes in our patient population.

At one month 15 patients had yet to resume their daily activities. These patients had higher pain and DASH scores at this time period and six of them were still using opioids. However, 12 of these patients were part of group B, rotator cuff repair. As patients in this group tended to be older and had a longer rehabilitation protocol, this result is not surprising. Three of the 12 patients also had open surgery, which was shown to significantly increase pain at 48 hours and seven days, further delaying a resumption of activities.

The limitations of this study (non random design and the small number of participants) prevented us from making any solid conclusions on which factors may have influenced longterm pain and function. In our study, it appeared patient recovery was influenced by the type of surgery rather than the analgesic method used. However, the number of patients who received open surgery was small, and the decision to use a pain catheter was based on surgeon preference. Since most patients received general anesthesia combined with regional anesthesia we could not assess the effect of anesthetic methods on long-term outcomes. Future randomized control studies may be needed to determine if a pain catheter and/or the choice of anesthetic method influences patient long term recovery.

Conclusion

The results of our study confirm that patients overall do well after ambulatory shoulder surgery, and most regain full function within one month with minimal opioid requirements. In patients whose recovery was longer it appeared their recovery was influenced more by the type of surgery rather than the analgesic method used. While it was not possible to draw conclusions about the influence of anesthetic choice, future studies assessing alternative choices to GA with brachial plexus block will need to show an improvement over the present results.

Acknowledgement

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*Quick*DASH

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. Open a tight or new jar.	1	2	3	4	5
2. Do heavy household chores (e.g., wash walls, floors).	1	2	3	4	5
3. Carry a shopping bag or briefcase.	1	2	3	4	5
4. Wash your back.	1	2	3	4	5
5. Use a knife to cut food.	1	2	3	4	5
6. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	1	2	3	4	5

	NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
7. During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbours or groups?	1	2	3	4	5

	NOT LIMITED AT ALL	SLIGHTLY LIMITED	MODERATELY LIMITED	VERY LIMITED	UNABLE
8. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	1	2	3	4	5

Please rate the severity of the following symptoms in the last week. *(circle number)*	NONE	MILD	MODERATE	SEVERE	EXTREME
9. Arm, shoulder or hand pain.	1	2	3	4	5
10. Tingling (pins and needles) in your arm, shoulder or hand.	1	2	3	4	5

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	SO MUCH DIFFICULTY THAT I CAN'T SLEEP
11. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand? *(circle number)*	1	2	3	4	5

*Quick***DASH DISABILITY/SYMPTOM SCORE** = $\left(\left[\frac{\text{sum of n responses}}{n}\right] - 1\right) \times 25$, where n is equal to the number of completed responses.

A *Quick*DASH score may not be calculated if there is greater than 1 missing item.

The Effects of Stellate Ganglion Block on Intraoperative Hemodynamics and Postoperative Side Effects in Laparoscopic Day-Case Surgery

Jeong-Yeon Hong

Abstract

The objective of this study was to evaluate intraoperative hemodynamics and side effects following preoperative unilateral SGB in patients undergoing day-case laparoscopy. Before the anesthesia, the patients in the SGB group (n = 22) received right SGB using 8 mL of 1% lidocaine, and an equal dose of lidocaine was injected intramuscularly to the patients in the control group (n = 23). As the results, preoperative SGB could not only alleviate the hyperdynamic responses of blood pressures and heart rates after tracheal intubation and gas insufflation with head-down position, but also decrease the incidences of postoperative nausea and analgesic requirements.

Keywords: Hemodynamics; postoperative side effect, stellate ganglion block.

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Introduction

Hemodynamic changes observed during laparoscopy result from combined effects of peumoperitoneum, patient position, and anesthesia. Peritoneal gas insufflation to intraabdominal pressures more than 10 mmHg induces significant alterations of hemodynamics. The disturbances are characterized by decrease of cardiac output, elevations of arterial pressure, and increases of systemic and pulmonary vascular resistances. [1,2] This increase in afterload can be considered to be a reflex sympathetic response to decreased cardiac output. [3] The increase in systemic vascular resistance is also affected by patient position. Cadaver studies show that when the needle is correctly placed, and the agent is injected into the correct fascial plane, 10 mL of injectate spreads from the upper part of the C5 to the T3. [4,5] It will, therefore, interrupt sympathetic and visceral afferent and efferent pathways to the head and neck, upper limb, and thoracic viscera. [6,7] We hypothesized that if pneumoperitoneum with head-down position for the laparoscopic surgery facilitates sympathetic response, then stellate ganglion block (SGB) might suppress the cervicothoracic sympathetic nerves with alleviation of the hemodynamic disturbance. However, no study examined the hemodynamic response to the surgical procedure after SGB.

The objective of this randomized, controlled, and single-blinded study was to evaluate the intraoperative hemodynamics and the postlaparoscopic side effects following preoperative unilateral SGB in patients undergoing day-case diagnostic laparoscopy.

Methods

After approval from the hospital's institutional review board and signed informed consent, 50 female ASA physical status I patients scheduled for laparoscopic surgery in day-case infertility clinic were enrolled. A power analysis using an α-value of 0.05, and power of 0.9 was performed to determine sufficient sample sizes required to establish a significant difference in the systolic and diastolic blood pressures and incidences of postoperative side effects based on the results of preliminary study. The calculated sample size was at least 43 of the two groups. They were randomized into two groups using a computer generated block number put inside a sealed envelope. No premedication was given.

Ten minutes before the induction of anesthesia, with the head hyperextended and under aseptic condition, 8 mL of 1% lidocaine without epinephrine were injected after locating the transverse process of the right sixth cervical vertebra in the SGB group (n = 22). In the control group (n = 23), an equal dose of lidocaine was injected intramuscularly into the deltoid muscle on the ipsilateral side. A sympathectomy was diagnosed by the presence of an ipsilateral Horner syndrome and an increase in temperature of the affected extremity of at least 1°C. The skin temperature was taken from the thenar area (Temp M1029A; Agilent, Boeblingen, Germany) before the SGB as a baseline and at 5 min intervals thereafter. The patients were excluded from the SGB group if a skilled anesthesiologist had difficulty identifying either the osseous landmark of the sixth cervical vertebral tubercle. The managements of anesthesia during the surgery and postoperative care in the recovery room were done by an anesthesiologist blinded to the preoperative procedure.

All patients were monitored with continuous electrocardiographic monitoring (lead II 4 and V5) and pulse oximetry. Autonomic noninvasive blood pressures and heart rates were measured before the block as a baseline value (T0), after induction of anesthesia (T1), after tracheal intubation (T2), after CO_2 gas insufflation (T3), after head-down position with peumoperitoneum (T4), after neutral position with exsufflation (T5), and in the recovery room (T6). Anesthesia was induced with propofol 2 mg.kg-1, and maintained by sevoflurane 2-4 vol% with oxygen-nitrous oxide and recuronium 20-30 mg for the muscle relaxation. No opioids were administered.

At the end of surgery, the nitrous oxide and sevoflurane were stopped abruptly without tapering; the patients then received 100% oxygen at the same flow rate. Emergence time was evaluated by recording the time from the end of surgery until the patient was able to open their eyes, and be fully oriented as to the time and place. The patients were assessed regularly to establish their readiness for discharge, stable vital sign, pain controllability, ability to walk without side effects, and ability to retain oral fluids. Discharge time was the time from the end of surgery to the discharge.

Each patient was asked to report the pain experienced using the visual analogue pain score (VAS from 0 to 10), 30 minutes and 1 hour after the procedure, at discharge and 24 hours after procedure. Postoperative side effects including nausea, vomiting, dizziness, headache, shoulder pain, epigastric pain, back pain, wound pain and the analgesic use were observed until the discharge, and 24 hours after surgery via telephone interview by another anesthesiologist not involved in the intraoperative procedures. Meperidine 25-50 mg intramuscularly was allowed at a patient's request and after evaluation by an investigator. Metoclopramide 10 mg was administered for treatment of severe nausea or vomiting.

All results are expressed as the mean ± SD or the number of patients with percentage. 5 Student t-test and Mann-Whitney U-test where appropriate were used for the patients' variables. Repeated measured ANOVA was performed to compare the changes of intraoperative hemodynamics. Chi-square and Fisher's exact test were applied to the variables of postoperative assessments. A p-value < 0.05 was considered statistically significant. Statistical analysis was performed using SPSS 10.0.

Results

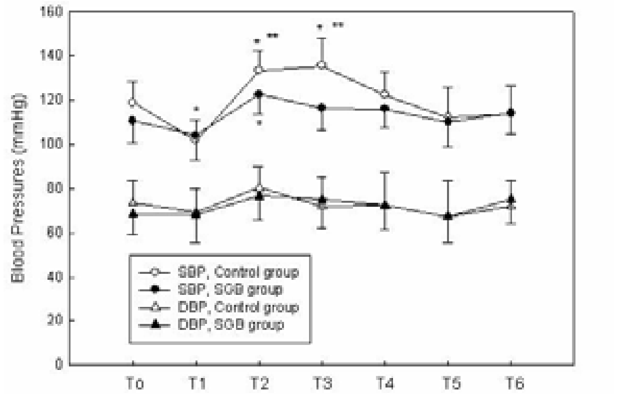
Table 1 shows no significant differences in the demographic data, duration of surgery, and recovery profile between the two groups.

Table 1 Characteristics of patients receiving stellate ganglion block (SGB) or control. Values are mean (SD).

	Control group (n = 23)	SGB group (n = 22)
Weight; kg	54.7 (5.2)	51.1 (4.5)
Height; cm	161.0 (3.7)	160.0 (3.8)
Age; years	32.2 (3.9)	32.6 (3.9)
Duration of surgery; min	29.3 (8.9)	27.9 (9.0)
Emergence time; min	9.7 (2.1)	9.9 (2.6)
Discharge time; min	141.5 (54.2)	140.0 (33.5)

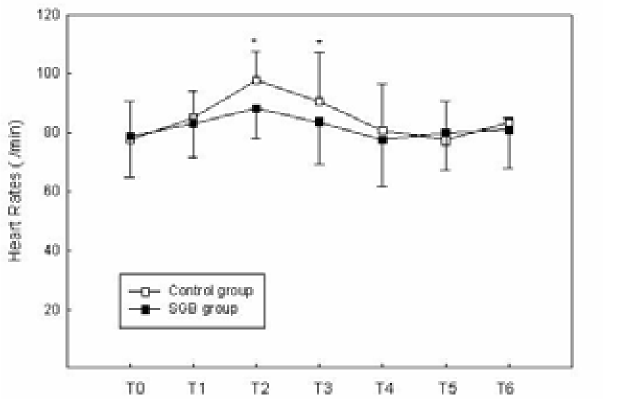
There is no statistical difference between the two groups.

There were significant differences of systolic blood pressures after induction of anesthesia, after tracheal intubation, and after pneumoperitoneum with head-down position comparing to the baseline values in the control group but not in the SGB group (Fig. 1). There were significant differences in the systolic blood pressures between the two groups. In the SGB group, the changes of systolic blood pressures showed more stable course comparing to the control group. Heart rate after tracheal intubation and gas insufflation increased significantly compared to the baseline value in the control group, but not in the SGB group (Fig. 2). The postoperative pain scores were lower in the SGB group than in the control group, but these were not statistically significant (Fig. 3). However, we noticed that more than 30% of patients in the control group requested analgesics for postoperative abdominal pain, but none in the SGB group ($P < 0.05$).



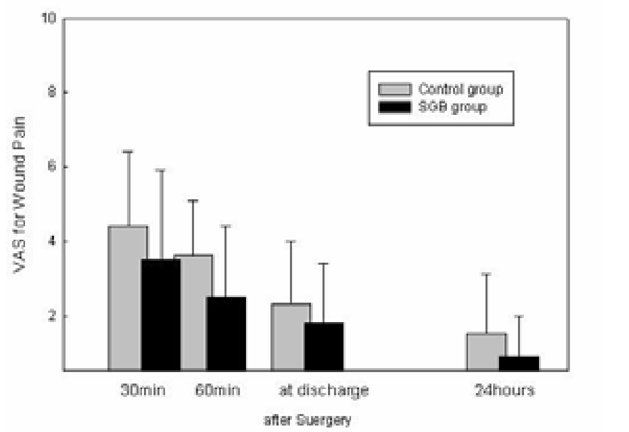
T0: baseline value, T1: after induction of anesthesia, T2: after tracheal intubation, T3: after CO2 gas insufflation, T4: after head-down position with peumoperitoneum, T5: after neutral position with exsufflation, T6: in the recovery room.
The changes of systolic blood pressures showed more stable course in the SGB group comparing to the control group.
* $P < 0.05$ compared to the baseline value. ** $P < 0.05$ compared to the SGB group.

Figure 1 Systolic and diastolic blood pressures after SGB.



T0: baseline value, T1: after induction of anesthesia, T2: after tracheal intubation, T3: after CO2 gas insufflation, T4: after head-down position with peumoperitoneum, T5: after neutral position with exsufflation, T6: in the recovery room.
Heart rates after gas insufflations and after head-down position in the control group increased significantly compared to the baseline value. However, there are no significant differences between the two groups. * $P < 0.05$ compared to the baseline value.

Figure 2 Heart rates after SGB.



The postoperative pain scores were lower in the SGB group than in the control group, but these were not statistically significant.

Figure 3 Intensity of Postoperative Wound Pain.

The incidences of postoperative side effects of two groups are presented in Table 2. The incidence of nausea in the SGB group was significantly lower than in the control group, although the incidences of vomiting requiring treatment were similar. The number of patients complaining of dizziness, headache, and shoulder pain postoperatively was not different between the two groups.

Table 2 Postoperative Complications of patients receiving stellate ganglion block (SGB) or control. Values are number (proportion).

	Control group (n = 23)	SGB group (n = 22)
Nausea	9 (39.1%)	1 (4.5%)*
Vomiting	2 (8.7%)	0 (0%)
Dizziness	5 (21.7%)	3 (13.6%)
Headache	2 (8.7%)	4 (18.2%)
Shoulder Pain	13 (56.5%)	15 (68.1%)
Epigastric pain	2 (8.7%)	0 (0%)
Back Pain	1 (4.3%)	2 (9.1%)
Analgesics	7 (30.4%)	0 (0%)*

* $P < 0.05$ compared to the control group.

Discussion

There are some reports in which SGB influence the hemodynamic conditions via the sympathetic nerve system. [6-8] In addition, this block has been shown to prevent perioperative hypertension induced by increased sympathetic activity. [9,10] We found the blunting effect on the hemodynamics and the superior analgesic effect of unilateral SGB before laparoscopic surgery compared to the control. These findings might suggest that unilateral SGB with 8 mL of 1% lidocaine suppress activated sympathetic nervous system due to head-down position with pneumoperitoneum, although we did not demonstrated any direct evidence. Further studies including catecholamines are needed to prove this.

We could not determine how SGB alleviated the postoperative nausea. Unfortunately, there is no published report on this. Some studies have reported the lower incidences of nausea after sympathetic block in cancer patients compared to the pharmacologic therapy patients; however, that may be due to the decrease of opioid use rather than the effects of sympathetic block itself.[11] We believe that in the present study, SGB may suppress the excitation of the cervicothoracic sympathetic nerve governing the pathway related to the postoperative nausea, although there is lack of direct evidence.

Postoperative analgesic use for wound pain in the control group was significantly higher than the SGB group in which no one requested analgesics. A possible mechanism may explain this interesting result. Surgical trauma and pain cause endocrine response that increases the secretion of cortisol, cathecholamine, and other stress hormones. [12,13] Yokoyama et al. reported that SGB influences the blood levels of catecholamines. [14] These findings might suggest that sympathetic nerve fibers and nodes regulate neuroendocrine activity and can reversely influence the 8 postoperative pain systemically.

In the present study, although one skilled anesthesiologist carefully performed SGB in the patients without any complications, SGB is not a recommended daily practice. Because there have been potential serious complications associated with block including vertebral artery puncture, subarachnoid or epidural injections, recurrent laryngeal or phrenic nerve block, and pneumothorax. We sometimes experience the hyperdynamic response to gas insufflation or head-down position, even with increments of anesthetics and narcotics. Preoperative SGB might be a useful procedure to prevent the hemodynamic fluctuations in selective cases.

In conclusion, unilateral SGB could alleviate the hyperdynamic response in the laparoscopic surgery. SGB decreased the incidences of postoperative nausea and analgesic requirements for wound pain. Although this is not a recommended routine clinical practice because of uncomfortness and risks, however, the present results might hold some vital clues to the positive effects of SGB on the intraoperatiove hemodynamic response and postoperative side effects.

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Perioperative thermoregulation in ambulatory anaesthesia and surgery

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Abstract

Thermoregulation is essential during ambulatory surgery because hypothermia increases the incidence of complications and delays recovery. The role of preoperative factors in the development of hypothermia has not been studied in ambulatory surgery. This retrospective study evaluated the impact of preoperative temperature on perioperative hypothermia and the effect of hypothermia on haemodynamics, oxygenation and recovery. The results showed a 32% rate of preoperative hypothermia, with no effect on the development of perioperative hypothermia. Obesity and warm air blanket were associated with less hypothermia. The effects of mild hypothermia were modest in ambulatory surgical patients because they are relatively healthy.

Keywords: Ambulatory surgery, Complications, Hypothermia, Temperature.

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Introduction

Perioperative thermoregulation is an important aspect of the anaesthetic management of ambulatory surgery patients. Perioperative hypothermia increases the incidence of cardiac morbidity, sympathetic over-activity, wound infection, increased surgical bleeding, prolonged hospitalization, intensive care unit admission, impaired immunity, abnormal drug metabolism, impaired wound healing, thermal discomfort and shivering [1, 2, 3]. Hypothermia may delay recovery from anaesthesia, with prolonged stay in the postanaesthesia care unit or the ambulatory surgery unit [4]. It may also delay the discharge of ambulatory surgery patients with cost implications on hospital beds, surgical operating schedule and other resources. Risk factors that may contribute to perioperative hypothermia include old age, general anaesthesia, central neuraxial anaesthesia, endocrine or metabolic disease, American Society of Anesthesiologists (ASA) physical class 3 or above, prolonged duration of surgery, open thoracic surgery, open abdominal surgery, burns, cold infusions or transfusions, massive haemorrhage and low operating room temperature [1, 4, 5].

The role of preoperative factors, such as the patient's initial temperature or preoperative hypothermia, in the development of perioperative hypothermia has not been fully elucidated in ambulatory surgical patients. The aim of this study was to evaluate the prevalence of preoperative hypothermia in patients presenting for ambulatory anaesthesia and surgery, predisposing factors for preoperative hypothermia and the role of preoperative temperature in the development of perioperative hypothermia. A secondary aim was to examine the effect of perioperative hypothermia on oxygenation, haemodynamics, postoperative discharge, and early postoperative complications.

Methods

This was a retrospective review of the perioperative record of patients who underwent outpatient or ambulatory surgery and anaesthesia at the main adult hospital of the University of Michigan Health System. We analyzed perioperative data from our electronic patient records, including the Centricity anaesthesia information system (Centricity, GE Technologies, Waukesha, WI). The data covered a period of two years, from July 2003 to July 2005. The patients underwent minor to moderate ambulatory surgery under general or regional anaesthesia. None of the patients underwent open abdominal surgery, open thoracotomy or major surgery. Preoperative and postoperative core temperature values were recorded from the tympanic membrane. Intraoperative core temperature values were recorded via oesophageal, nasopharyngeal or bladder catheter thermistors. Hypothermia was generally defined as core temperature ≤ 360C and mild hypothermia was specifically defined as core temperature of 34-360C [6].

The data collected included patient demographics, body mass index (BMI), ASA physical status class, type of surgery and surgical specialty. The preoperative physiological variables analyzed included temperature, respiratory rate, heart rate, non-invasive blood pressure and oxygen saturation. The intraoperative data collected included oxygen saturation, maximum temperature, duration of surgery, use of warm air blanket and the use of intravenous fluid warmer. Postoperative physiological variables analyzed included temperature, respiratory rate, heart rate, non-invasive blood pressure, and oxygen saturation. Postoperative complications recorded in the post-anesthesia care unit were also analyzed. These included shivering, nausea, vomiting, uncontrolled pain, urinary retention and prolonged stay. Data analysis was performed using the SPSS program version 13 (SPSS Inc, Chicago, IL). Bivariate analysis was performed using the Student's t-test and the Levene's test. Differences between groups were compared using the Pearson's Chi-square test and the Fisher's Exact test. A P value <0.05 was considered statistically significant.

Results

A total of sixteen thousand and seventy-two ambulatory surgical patient perioperative records were obtained from our anaesthesia information system for the two year period. After excluding 4,972 case records because of incomplete data, the remaining 11,100 cases were examined and analyzed. The age range of patients was 13 to 92 years; comprising adolescents (4%), adults (76%) and elderly (20%).

The patients were ASA physical status class I to III and underwent minor or moderate ambulatory surgery.

Thirty-two percent of the ambulatory surgical patients presented to the operating department with mild hypothermia, but there was no significant correlation with body mass index or age. Preoperative hypothermia did not have a significant effect on preoperative haemodynamics or oxygen saturation (Table 1). In addition, preoperative temperature did not have a significant effect on intraoperative and postoperative temperature (Table 2). Intraoperative temperature was not significantly affected by the ASA physical status class, type of ambulatory surgery or duration of surgery. The duration of surgery ranged from 20 to 290 minutes. The intraoperative use of a warm air blanket was associated with a significantly lower prevalence of intraoperative and postoperative hypothermia (Table 2).

Table 1 Preoperative hypothermia and patient variables.

	Temp≤36	Temp>36	% of total	p-value
BMI ≤ 30	n=2721	n=5603	75%	0.92
BMI > 30	n=918	n=1858	25%	
SpO2≥94%	n=2344	n=4982	66%	0.93
SpO2<94%	n=1256	n=251	8 34%	
SBP≤150	n=2620	n=3929	59%	0.96
SBP>150	n=1774	n=2777	41%	

Temp=Temperature BMI=Body Mass Index SpO2=Oxygen saturation
SBP=Systolic Blood Pressure in mmHg

Table 2 Factors affecting intraoperative hypothermia.

	Temp≤36	Temp>36	p-value
Warm air blanket	38%	62%	0.007
No warming	59%	41%	
Preop temp≤36	33%	67%	0.929
Preop temp>36	32%	68%	

Preop=Preoperative Temp=Temperature

With regard to the postoperative phase, obese patients (BMI > 30) showed a lower prevalence of postoperative hypothermia (Table 3). Postoperative hypothermia had no significant effect on oxygen saturation or haemodynamics (Table 3). The data on postoperative complications in the post-anaesthesia care unit was unreliable and thus was excluded from the final analysis.

Table 3 Postoperative hypothermia and patient variables.

	Temp≤36	Temp>36	% of total	p-value
BMI ≤ 30	n=5160	n=3164	75%	0.001
BMI > 30	n=1148	n=1626	25%	
SpO2≥94%	n=1578	n=7191	79%	0.2
SpO2<94%	n=372	n=1969	21%	
SBP≤150	n=4033	n=1073	46%	0.09
SBP>150	n=4855	n=1139 5	4%	

Temp=Temperature BMI=Body Mass Index SpO2=Oxygen saturation
SBP=Systolic Blood Pressure in mmHg

Discussion

The perioperative implications of hypothermia are far-reaching. It is detrimental to ambulatory surgery patients, causes peri-anaesthesia problems, and delays patient discharge from the post-anaesthesia care unit or ambulatory surgery unit. There are many risk factors for developing perioperative hypothermia, including preoperative patient factors. Our study showed a thirty-two percent prevalence rate of preoperative mild hypothermia in patients presenting for ambulatory anaesthesia and surgery. This prevalence rate seems high and may be due to inadequate warm clothing or exposure to cold during the journey to the hospital. It may also be related to preoperative fasting, the lack of thermogenesis or specific dynamic activity of feeding and reduced energy metabolism. Endocrine diseases such as hypothyroidism may also play a limited role in the development of preoperative mild hypothermia. The data limitations of our retrospective study did not allow the analysis of the possible influence of these factors. Contrary to previous beliefs or reports [1, 5], our study showed no correlation between preoperative hypothermia and body mass index or age. However, low body mass index or old age may predispose to preoperative hypothermia in patients with other negative factors such as trauma, burns, fluid loss or hypovolaemia.

Preoperative hypothermia did not have a significant influence on the development of intraoperative or postoperative hypothermia in our patients, mainly because the hypothermia was mild. Severe preoperative hypothermia in emergency patients or hospital inpatients undergoing major surgery has been shown to be a major risk factor or causative factor for the development of perioperative hypothermia [2, 5]. The nonseverity of the preoperative hypothermia in our patients may also be the reason for the 7 lack of significant effect on preoperative respiratory rate, haemodynamics and oxygen saturation. However, mild hypothermia is known to cause thermal discomfort which is physiologically stressful and leads to adrenergic activation, hypertension and tachycardia [7]. It is important to prevent preoperative hypothermia in ambulatory surgical patients by encouraging warm clothing and preoperative cutaneous warming.

Intraoperative temperature was not significantly affected by the ASA physical status class because the patients were relatively healthy ambulatory surgical patients of mainly ASA I and II class. Similarly, intraoperative temperature was not significantly affected by type or duration of surgery because the ambulatory surgical procedures were not major surgery. The practice of using intraoperative warm air blanket for relatively long cases may be responsible for the lack of association between intraoperative temperature and duration of surgery. Intraoperative warm air blanket significantly reduced the prevalence of perioperative hypothermia in our patients, as previously reported by other authors [8].

The relationship between obesity and perioperative hypothermia is controversial. Our study showed a lower prevalence of postoperative hypothermia in obese ambulatory surgical patients. Obese patients usually experience less perioperative heat loss because of their protective layer of fat. However, they have less muscle mass and higher surfaceto- mass ratios which may also predispose them to significant heat loss after prolonged exposure to a cold environment [4]. This implies that it is important to prevent heat loss and ensure adequate active warming in obese patients who are undergoing relatively prolonged ambulatory surgery.

Hypothermia is a major cause of postoperative morbidity. It markedly increases adrenergic activity, impairs thermal comfort and causes shivering with increased oxygen consumption [1, 3, 4, 9]. However, our study revealed that mild postoperative hypothermia does not have significant effects on oxygen saturation, haemodynamics and respiratory rate in ambulatory surgical patients. This supports the finding of a previous study which reported that the effects of mild hypothermia on postoperative oxygen saturation, blood pressure, respiratory rate and heart rate are modest in relatively healthy patients [9]. Ambulatory surgical patients are usually relatively healthy and thus can compensate for hypothermia-induced haemodynamic or respiratory derangements. The initial autonomic thermoregulatory response to hypothermia is peripheral vasoconstriction with resultant hypertension and this is usually followed by shivering [9, 10]. Postoperative shivering occurs in half of hypothermic patients [4, 9]. It involves increased tone and involuntary contractions of skeletal muscles, with consequent increased thermogenesis and oxygen consumption. Thus, it is imperative to administer supplemental oxygen to hypothermic ambulatory surgical patients, in order to prevent hypoxia and oxygen debt.

This retrospective study had limitations of data which prevented valid analysis of the effect of hypothermia on postoperative complications and discharge. Every effort was made to limit the impact of data inadequacy and errors. In conclusion, our study revealed a relatively high prevalence of mild preoperative hypothermia in ambulatory surgical patients, with no significant effect on intraoperative or postoperative temperature. The effects of mild hypothermia are modest in ambulatory surgical patients because they are relatively healthy. The logical approach to perioperative hypothermia is prevention.

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