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Editorial: New Beginnings

Beverley K. Philip

This December 2007 edition concludes Volume 13 of Ambulatory Surgery, thefirst volume published by the International Association for Ambulatory Surgery.

With this new beginning, we continue to advance knowledge in the field of day surgery in all its related disciplines. This edition is an excellent example.

We have articles on operating theatre efficiency, research in nursing practice, vein-stripping anaesthesia techniques, tonsillectomy surgical techniques, discharge assessment and national anesthesia practice. The manuscripts represent researchers from around the world: Hong Kong, Netherlands, Sweden, Italy and the United Kingdom.

Ambulatory Surgery continues to be the international journal-of-first-choice for the publication of high quality papers in the field of day surgery. We invite international manuscripts for peer review in all related ambulatory surgery fields, and we invite you to return as a reader.

Beverly K. Philip, MD
Editor-in-Chief

Measuring General Surgical Workload in the Day Surgery Unit

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Abstract

Introduction A reliable complexity-adjusted measure of operative workload could facilitate monitoring of service delivery in day surgery units (DSUs).

Methods A complexity-adjusted scoring system -the Operative Score of Complexity Index(OSCI)- was developed and used to measure changes in theatre workload, case complexity and session productivity over a seven year period at an ambulatory centre.

Results OSCI scores correlate well with caseload markers of performance (i.e. counts of operations performed) when case mix is consistent. This relationship fails however when case-mix is broad. The OSCI system was able to detect changing case complexity over time as well as large differences in list productivity on individual consultant surgeons' sessions($p<0.001$).

Conclusions – The OSCI system potentially offers an easily developed tool that could facilitate operational decision making and service monitoring in ambulatory centres.

Keywords: General surgery; Day case; Day surgery unit.

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Introduction

The number of patients waiting for National Health Service (NHS) operations has, until recently, exceeded one million [1]. The current government have set ambitious targets regarding the reduction of inpatient hospital waiting lists to a maximum wait of 6 months by the end of 2005 and then to 3 months by 2008 [2]. The principal mechanism by which the government intends to limit the elective surgical burden placed on inpatient hospital resources involves a promotion of elective day surgery [3]. However, a recent national survey carried out by the Healthcare Commission cites that the transfer of appropriate elective patients from inpatient to day centre settings has, so far, achieved only limited success [4].

In order to estimate the genuine progress of the government's intended day surgery plans a reliable method of quantifying the workload and productivity rates achieved by day surgery units (DSUs) is fundamental. Historically, qualitative measures of theatre time usage, such as utilization, have been used as descriptive markers of theatre performance in addition to providing estimates of apparent residual system capacity. The recent Healthcare Commission audit suggested that across NHS DSUs, 'end utilisation' rates averaged only 55% [4]. As such it was suggested that significant existing day surgery capacity is currently under-employed. It is essential to note that utilization measures convey no information regarding the actual 'output' or workload achieved by a given day surgery (DS) theatre unit. In the case of slow procedure completion it is possible for theatres to be well utilized but unproductive. Quantitative methods of measuring workload and productivity in ambulatory centres are essential if genuine changes in local and national DS service performance are to be evaluated. Recent government plans to move away from historical block funding mechanisms towards performance related reimbursement [5] further emphasises the need for accurate quantification of service delivery.

The need to adjust for case mix complexity represents the principal barrier to effective quantification of operative workload. Use of case load measures (i.e. counts of operations) for service performance estimation in the DSU is routinely carried out for managerial purposes but its reliability in this context has not been verified. When applied to inpatient procedures the use of case loading has proven an inaccurate measure of workload due to its failure to adjust for heterogeneous case mix complexity [6,7]. Various systems have been used to attempt to overcome this problem. Firstly, a crude weighting system that distinguishes between local and general anaesthetic day case procedures was used by the Healthcare Commission to quantify DSU workload. The latter tool detected a significant fall in monthly workload between 2000 and 2004 amongst DSU's where direct comparison was possible [4]. The most widely applied case mix adjusted methods of surgical workload quantification are the Intermediate Equivalent (IE) [8-11] and, more recently, the Healthcare Resource Group (HRG) systems [12]. The former is based historically upon operative private sector fees and the latter upon the hospital resource consumption associated with specific procedures. Importantly, neither of these systems are reliant upon operative procedure time as a marker of complexity. In fact, attempts to validate the IE system against operative procedure time demonstrated a tendency towards underestimation of workload when the IE's have been applied to measure complex general surgical procedures [13].

Aims

The principal aim of this study was to develop a complexity adjusted scoring system that would enable quantification of DS general surgical theatre workload on the basis of operative procedure time. The secondary aims of the study were to use the scoring system to retrospectively investigate quantitative changes in annual departmental ambulatory workload carried out over a seven-year study period and to analyse differences in the productivity rates associated with specific consultant surgeons' operative sessions.

Methods

Data sources

The Kings College Hospital theatre database (Surgiserver © McKesson HBOC), pertaining to all elective general surgical operations carried out in the DSU between 1st April 1997 and 1st April 2004, was used for this study. Key procedure timings, participating personnel and Office of Population Census and Statistics (OPCS-4) procedure codes for all study operations were entered onto the database prospectively at the time of each patient's theatre journey. The theatre data were transferred to Excel 2002 (Microsoft Corporation, USA) and SPSS ("Statistical Package for the Social Sciences" version 12, Chicago, Illinois, USA) formats for subsequent data handling and statistical analysis respectively. Individual operations were amalgamated into theatre lists. The latter were coded according to consultant surgeon and their respective sub-specialties. Consultant surgeons were afforded an individual code if more than 100 database procedures had been assigned to them. Operations where no consultant code was assigned were amalgamated into a miscellaneous category. Procedure time represented the combined anaesthetic and surgical time utilized for a given operation. The procedure time was defined as the time between the start of anaesthesia and the removal of the surgical drapes at the end of the operation.

Developing the Operative Complexity Index in order to quantify theatre output and productivity

Operations had been assigned OPCS-4 codes in 79.1% of all database procedures. The latter procedures were coded to 79 respective OPCS-4 procedure categories in the database. A case score represents a term that was given to the complexity-adjusted 'size' of a given procedure. The numerical calculation of a case score (OSCI units) was performed by dividing the median duration (in seconds) of all database operations coded to a specific OPCS-4 category by 30. The latter calculation was performed to simplify and reduce the numerical score to a tangible figure. As such, a case score represents a complexity adjusted score that is based upon the historical time taken to perform a procedure when all database surgeons performing that procedure in the DSU were considered . The size of individual operating lists was consequently determined by summing the case scores of constituent list procedures. The latter score was termed a list score and was similarly measured in OSCI units. On lists where a case lacked an OPCS-4 identifying code the median procedure score for all database procedures was assigned to it in order to permit the calculation of a list score. The median procedure time (score) for all database procedures was 26 minutes (52 case score units). Theatre list productivity was calculated by quantifying the list score achieved per hour of allocated theatre list time (i.e. OSCI units per hour).

Study outcomes

The potential use of case scoring, as a complexity adjusted descriptive marker of annual DS theatre performance, was compared to annual case load and cumulative total departmental procedure time measures of theatre activity. Differences in productivity rates between consultant surgeons' DS operating sessions were investigated.

Statistical analysis

Data were described as mean values (+/- standard deviation, n) for parametric data distributions. One-Way ANOVA was used to determine significant differences between theatre workload and productivity rates across the study years and consultant general surgeons' sessions. Spearman's correlation was used to investigate the relationship between session case load and session list score markers of workload. $P<0.05$ was considered statistically significant.

Results

Patient and database characteristics

In total, 8,314 general surgical operations were performed on 2,092 operating lists in the DSU between April 1997 and April 2004. At the time of operation the median patient age was 44 years (34-58years, n=8,073) and a marginal excess (50.2%) of females was observed (4171/8283 cases) in the study group. Nearly all (99.2%) general surgical lists carried out in the day surgery department were 4 hour operating sessions.

A) Measurements of complexity adjusted general surgical theatre workload in the DSU (See Table 1)

Analysis of trend changes over the study period suggested that increases in the annual provision of operating lists to the general surgery department were generally accompanied by concomitant proportional increases in the annual numbers of procedures (case load) performed. However, in Year 2 a greater number of procedures were carried out than in Year 6 despite the provision of a similar number of operating sessions. The latter is suggestive of a changing case mix towards more complex operating throughout the study period The disproportionately high total annual departmental procedure time consumed in Year 6, compared with the relatively similar number of cases performed in the earlier study years, further corroborates the probability of changing case mix.

In this study the use of the OSCI as a method of quantifying complexity adjusted general surgical DSU theatre output was investigated. Table 1 illustrates the annual cumulative departmental workload achieved throughout the study period expressed in terms of OSCI units. Comparison of the latter scores with annual caseload indices confirmed some discrepancy in apparent performance. When

Table 1 Markers of annual General Surgical DSU theatre performance.

Year	No. of lists	No. of Procedures	Total Procedure time (hours)	Cumulative OSCI scores (units)
1	389	1250	705	80,400
2	329	1431	820	94,400
3	262	1118	725	79,700
4	290	1185	743	85,400
5	291	1143	763	83,900
6	326	1172	856	87,700
7	305	1015	764	78,800

the performance measures of the first two study years were combined and compared to those of the last two years, falls in caseload and OSCI scores of 18.4% and 4.7% were noted respectively (Table 1).

The latter disproportionate drop in workload, as measured by case load markers, confirmed an increase in operative complexity throughout the study period. At the same time some genuine diminution of general surgery theatre output from the DSU also occurred.

A trend towards increasing case mix complexity was further confirmed when mean procedure case scores were plotted against study year (Figure 1).

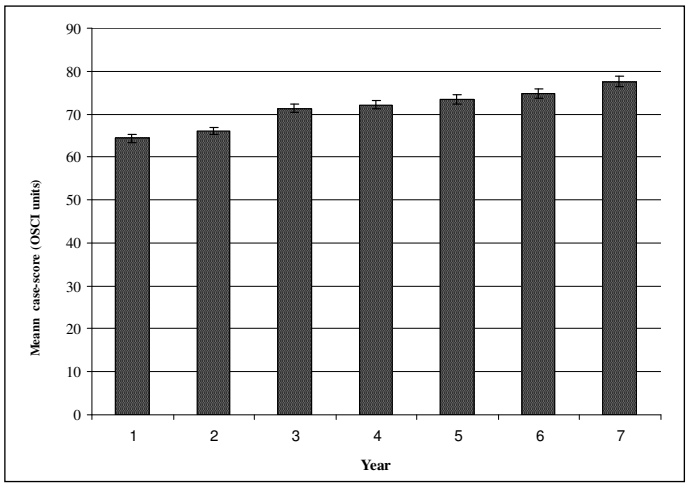

Figure 1 Mean procedure case score (OSCI units) +/- standard error per study year.

Average procedure complexity in Year 7 was significantly higher than the average complexity recorded in the first four study years (One-Way ANOVA, $p<0.05$). One significant factor contributing towards the increasing operative complexity noted above was the phasing out of endoscopy procedures in the DSU over the study period. Endoscopies were performed under sedation in the day surgery department in the early study period but were later transferred to a dedicated endoscopy unit. This change is visible, in part, by the complete absence of procedures performed under sedation (Table 2) in the second half of the study. In consequence, case mix shifted towards operative procedures requiring general anaesthesia in the later study years.

Table 1 Type of anaesthesia in the early and late study years

	Years 1 & 2		Years 6 & 7	
	No. of operations	%	No. of operations	%
General anaesthesia	1200	44.76	1637	74.85
Local anaesthesia	803	29.95	538	24.60
Sedation	639	23.83	0	0.00
Regional anaesthesia	39	1.45	12	0.55
Total	2681	100.00	2187	100.00

Overall, the case-load on general surgical lists carried out in the DSU correlated well with the list-scores (OSCI units achieved per corresponding session, Spearman's correlation, $r = 0.580$, two-tailed significance < 0.01 level). A scatter plot of session case load versus list scores (with lowess curve insertion) demonstrated that the correlation between the two markers approximated best on lists where the case load was 4 operations or fewer (Figure 2).

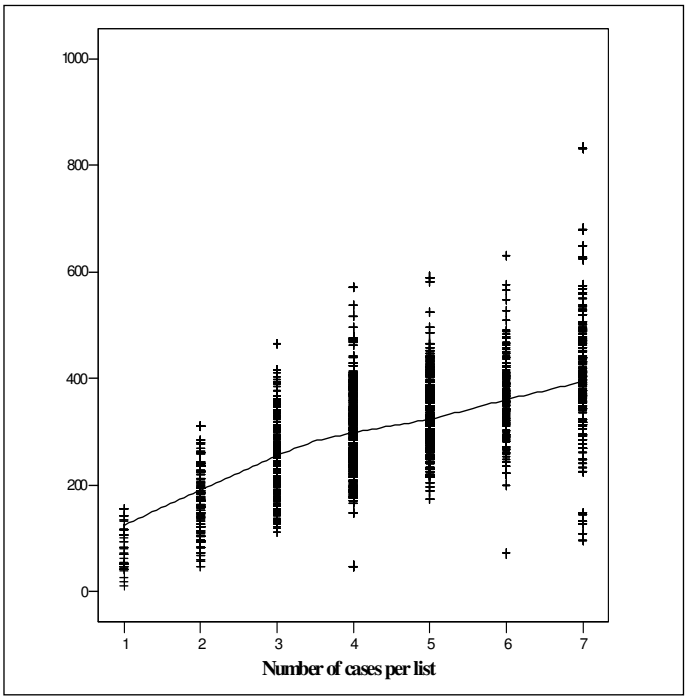

Figure 2 Scatter plot of the number of cases per DS operating session (x-axis) versus the list scores measured in OSCI units (y-axis) achieved per session (with lowess curve fit)..

Beyond this operative volume a visible plateau of the curve occurred. The latter is highly suggestive of differing case mix between small and high case load sessions respectively. Importantly, the operating lists where extremely high numbers of procedures were carried out all represented sessions performed either under local anaesthesia or sedation. As such, due to the lower procedure complexity of cases on high case-load sessions a proportionate increase in list scores achieved on these sessions was not observed.

ii) Operating session productivity in the day surgery department

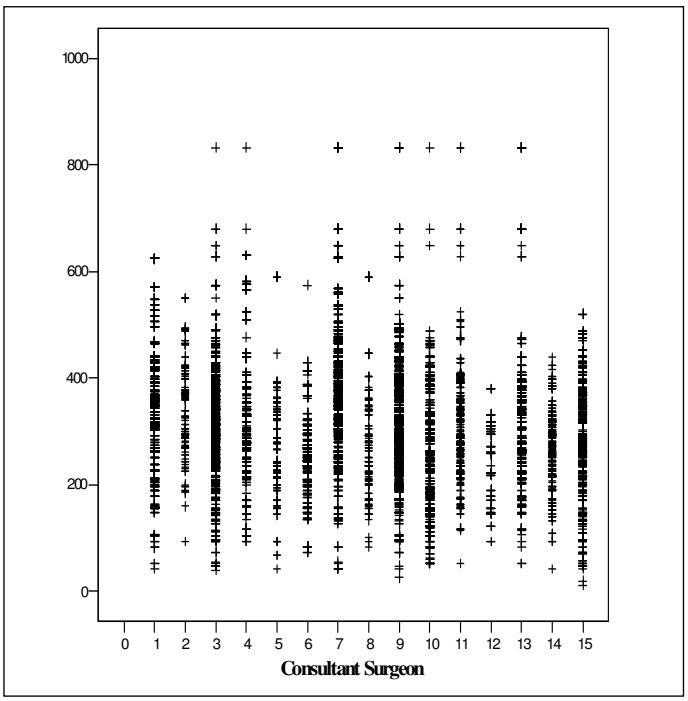

Figure 3 Operating list output i.e. list-scores in OSCI units per 4 hour session (y-axis) in the DS unit according to Consultant Surgeons operating session (x-axis) between 1997 and 2004.

Operating lists were classified according to individual consultant general surgeons. Figure 3. illustrates the workload (in OSCI units) achieved on the individual consultant surgeon's day surgery operating lists throughout the study period. Obvious differences and wide variation in output achieved between respective surgeon's operating sessions were observed. Figure 4. illustrates the mean hourly productivity rates of each individual consultant surgeon's day surgery operating list when all database procedures were considered. Significant differences were noted between consultant surgeon's respective list productivity rates (One-way ANOVA, F:79.351, $p<0.001$). Specifically, the mean OSCI score per hour of the most effective session (that coded to Breast & Endocrine Surgeon 2) was over 50% more productive than the least effective (that coded to Colorectal Surgeon 4).

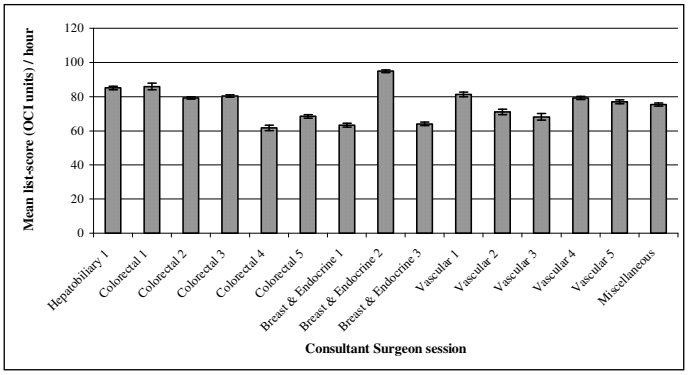

Figure 4 Mean productivity (list scores in OSCI units per hour of allocated session time) +/- standard errors on Consultant Surgeons' operating lists in the day surgery department between 1997 and 2004.

Discussion

Throughout the study period a small genuine decrease in the operative workload carried out by the general surgery department in the DSU was observed. Caseload estimation significantly overestimated this reduction in workload due to its failure to adjust for an increase in case mix complexity that occurred throughout the study period.

Previous investigators have noted the potential use of historical procedure times for operating list planning [14]. This study demonstrated that historical procedure times could also be used effectively to quantify operative complexity and consequently to develop a local tool that enabled accurate case mix adjusted measurement of DS service delivery.

For general surgery procedures performed in the DSU case load estimation of workload can offer a broad indication of performance where case mix is uniform. Certainly, a positive correlation between session case load and complexity adjusted session OSCI scores was observed in the study when similar lists were compared. Importantly, departments where heterogeneity of operative case mix is broad should expect significant inaccuracy from case load measures of activity. Reliance on the latter marker will consequently fail to meaningfully convey changes in the workload achieved by the department or individual clinician.

Two principal factors underlie the increasing average case complexity that occurred throughout the study period at our centre. In the first instance the removal of endoscopy sessions represented a major contributor towards finding greater average complexity amongst the residual procedures. In addition the successful implementation of the day surgery agenda [3] has resulted in the transfer of an increasing number of intermediate complexity patients from inpatient waiting lists to the DS unit. Recognition of this changing case mix throughout the study period would not have been possible without the application of the OSCI scoring system.

The finding that large differences exist between the productivity rates of individual consultant surgeons requires caution in its interpretation, especially at a managerial level. Firstly, without correlation to clinical outcomes, quantification of service delivery lacks clinical meaning. Certainly, the benefits of a 'low productivity' session, where clinical excellence and training are offered, are not captured by pure quantification of service delivery. In addition, many factors unrelated to the surgeon almost certainly determine the productivity achieved in a given session. Caution should be exercised in the managerial interpretation of individual consultant's session productivity rates. Furthermore, extreme clinical risk might result from attempts to enhance surgical productivity in specific sessions. Despite this, estimation of productivity rates might have significant practical uses for list scheduling and planning if consultant specific list optimisation, as opposed to enhancement, is intended. It is acknowledged that the latter assertion requires further investigation.

A complexity adjusted tool that is based upon historical procedure time, such as the OSCI system described in this study, represents an easily developed local method for measuring operative output and detecting changes in operative complexity. Examples of the specific operational uses of such a system might include measurement of the annual departmental (or surgeon) contribution towards total ambulatory activity, benchmarking for appropriate session activity within specialties and even the application of incremental economic analyses to determine which procedures to favour regarding financial reimbursement. Importantly, in some healthcare systems eliciting genuine differences in performance could result in incentivisation of individual personnel or departments. In addition to the described managerial applications of the OSCI system, potentially it could also facilitate clinical audit. Specifically the quantification of an individual surgeon's operative output could serve to add relevance to markers of poor clinical performance such as wound infection rates, return to theatre and failed discharge rates where numbers of specific operations are too small for meaningful analysis. As such, poor performers in the ambulatory environment might be identified more easily. Prospective validation of the OSCI system for the managerial and clinical purposes described above is required and these studies are underway to determine the full remit of its practical efficacy.

Conclusions

Case mix adjusted markers of DS operative activity are necessary to accurately quantify workload, productivity and to detect changes in case mix complexity over time. Tools that estimate complexity adjusted workload in ambulatory centres could faciliate operational and strategic decision making through optimisation of list scheduling and improved clinical and managerial service monitoring respectively.

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Intrapersonal randomized controlled trial comparing bipolar Scissors and conventional cold tonsillectomy

P-O. Haraldsson, P. Attner, L. Fredelius

Abstract

Objective: To evaluate bipolar scissors tonsillectomy by comparing it with traditional cold dissection tonsillectomy in the same patients, utilising one technique on either side.

Study design: Randomized controlled trial.

Setting: ENT Daycare unit of the Karolinska University Hospital at Danderyd Hospital, Stockholm.

Patients: Fifty patients of which 49 were eligible (M/F 20/29), mean age 14.3 (4-41) years and included in the study. Thirty-one patients were operated due to upper airway obstruction and 18 for chronic tonsillitis. OUTCOME MEASURES: (1) Intraoperative bleeding, (2) operative time, (3) postoperative pain, and (4) complication rates, including primary and secondary hemorrhage.

Methods: Cold technique; cold scissors, Henke tonsil elevator, bipolar diathermia. Hot technique; bipolar scissors (Ethicon, set on 20 W), bipolar diathermia if needed. Each side was completed separately. Blood loss and total operative time on each side were registered. Pain was evaluated daily on a visual-analogue scale, VAS (0-100 mm) in patients from 10 years of age.

Results: Mean operative time for the conventional cold technique was 11.6 SD +/- 8.5 (range 1.0-55 min) and for the hot technique 3.1 SD +/- 3,1 min (range 0.5-8.5 min) (Wilcoxon-test $p<0.001$). The corresponding median values were 3 and 1.9 min respectively. The mean blood loss was 43.2 SD +/- 41.7 ml (range 7-225 ml) vs 3.0 SD +/- 4.7 ml (range 0-25 ml) (Wilcoxon-test $p<0.001$). The corresponding median values were 30 and 1 ml, respectively. No early or late haemorrhages requiring surgical intervention occurred. There was no difference in pain.

Conclusions: Tonsillectomy with bipolar scissors was mean 4 (median 3) times faster and the blood loss mean 14 (median 30) times less than on the side operated with the conventional cold technique, whereas no difference in morbidity was found.

Parts of the study were presented at the 7th. World Congress on Sleep Apnea in Helsinki, Finland in 2003 (abstract 047)

Keywords: Tonsillectomy; Bipolar scissors; Pain; Bipolar diathermy; Henke; "Hot technique"; "Cold technique"; Intrapersonal.

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Introduction

The first known tonsillectomy was performed by Celsus 2000 years ago using blunt digital dissection [1]. Snaring and "giljotining" the tonsils (i.e. tonsillotomy) was introduced in the 19th century and the use of elevators at the turn of that century. Only 50 years ago patients were often operated on in a sitting position under local anaesthesia.

The more common use of general anaesthesia with intubated patients made it possible to perform complete tonsillectomies with the patients in a supine position, which was more convenient for both the patient and the surgeon. The standard technique is still cold steel dissection but hot techniques have evolved during the last 40 years like monopolar and bipolar diathermy, laser and more recently also the ultrasonic scalpel and coblation. The refinements of surgical and anaesthetic techniques have made it possible to treat patients on a day-care basis [2]. In our ENT day-care centre, day-care tonsillectomies have been performed since 1996. Previous investigations indicate that tonsillectomy performed in day surgery may be considered cost effective and safe [3, 4].

Conventional tonsillectomy is performed with cold scissors and a tonsil elevator. Earlier, bleeding was stopped by ligatures or vessel strangulation by deep sutures in the tonsillar bed. The latter measure infrequently caused life threatening injury to the branches of the external carotid artery [5]. These procedures have therefore been replaced by monopolar or bipolar diathermy.

Bipolar scissors technically combine bipolar diathermy with the scissors. They are thereby replacing the tonsil elevator, scissors and usually the bipolar diathermy. There are indications that the bipolar scissors allow faster intervention than the conventional cold steel techniques [6, 7].

In the present trial the patients were subjected to a hot or a cold technique on either side, in a randomised and single blinded manner. The outcomes were the operative time at the table, per-operative blood loss, post-operative pain and complications related to each technique.

Material and methods

Patients

Fifty consecutive patients booked for day-care surgery (ASA I) were, after informed consent, subjected to bilateral tosillectomy (TE) in a randomised controlled trial using bipolar scissors on one side and the conventional cold technique on the other side. Patients with a history of quinsy were excluded. One male did not disclose his history of quinsy until after surgery and was then excluded from the study. Forty nine patients (M/F 20/29), mean age 14.3 (4–41) years could be included. Thirty-two of these patients were operated due to upper airway obstruction and 17 were operated due to chronic tonsillitis.

Surgery

The patients left sides were randomised either to conventional cold tonsillectomy or to the hot technique with bipolar scissors immediately prior to surgery in the operating theatre. The right side automatically fell into the other group. Surgery was performed

by the two senior consultants (POH/LF) on one side at a time and considered finished when full haemostasis was achieved, always beginning with the left side.

The conventional cold technique used cold Metzembaum scissors and a Henke tonsil elevator (Fig.1). Bleeding was stopped with compression and/or bipolar diathermy. The hot technique used Power-Star bipolar scissors (Ethicon) set on 20 W (Fig.1). They consist of a pair of modified 18 cm Metzembaum scissors where the cutting blades have a partial ceramic isolation in order to act as electrodes in the bipolar instrument (7). Vessel bleeding was usually stopped by the bipolar scissors but if necessary with the more effective bipolar diathermy forceps.

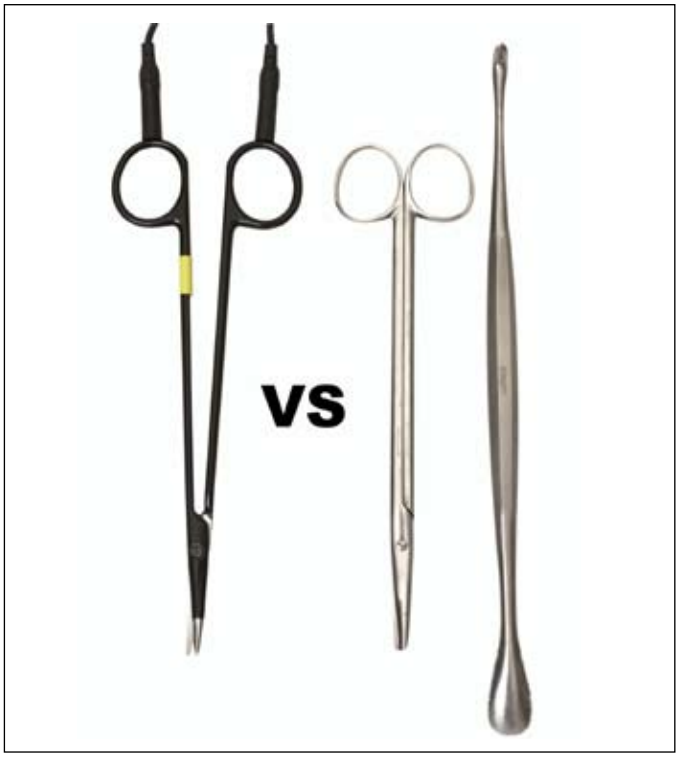

Figure 1 Bipolar scissors vs Henke tonsil elevator.

Parameters

Registered operation time comprised the time for elevation and haemostasis for each side using a chronograph. Per-operative bleeding from each side was simultaneously measured. Primary haemorrhage was defined as haemorrhage occurring within the first 24 h after the operation and secondary haemorrhage occurring between 24h and 28 days. Pain was self reported on a visual-analogue scale (VAS 0–100 mm) at noon every day on patients from 10 years of age. Maximum pain in millimeters and total pain duration in days were registered.

Post-operative analgesia

All patients were injected with local analgesia in the tonsillar bed using 5 ml of bupivacaine hydrochlor. (2.5 mg/ml) in children and 5 ml of bupivacaine hydrochlor. (5 mg/ml) in adults (> 50 kg), respectively. No epinephrine was used during the study. The patients were treated with morphine (0.1 mg/kg) i.v during the first 2 h at the hospital. At home the smallest children < 40 kg were given Citodon minor® suppositories (paracetamol 350 mg + codeine 15 mg) 4 times daily whereas children > 40 kg and < 50 kg were given suppositories diclofenac 25 mg 3 times daily and paracetamol 4 times daily. Adults were given Citodon® (paracetamol 500 mg + codeine 30 mg) 4 times daily and diclofenac 50 mg 3 times daily.

Statistics

Data are given as median, mean, standard deviation SD, or min-max range, or the combination of these. Wilcoxon test was used to compare the mean values for pain, bleeding and time for the total surgical procedure. X2 -test was used for comparison of rate of complications. Statistically significant difference was defined as $p<0.05$. The estimation of the required sample size obtaining 80% power and alfa 0.05 for the main outcomes operation time, per-operative bleeding and pain on VAS was performed from a pilot study including 10 patients. The required sample size was 6, 10 and 47 respectively. The sample size for post-operative bleeding could not be calculated.

The study was approved by the local Ethical Committee at the Karolinska Institutet, Stockholm (D-nr 03-238)

Results

Total surgical time

Mean surgical time was more than 3 times longer for the conventional cold technique compared to the hot technique; 11,6 SD +/- 8.5 min (range 1 - 55 min) vs 3,1 SD +/- 1.9 min (range 0.5 – 8.5 min) ($p < 0.001$) (Fig. 2). The corresponding median values were 10.0 vs 3.0 min.

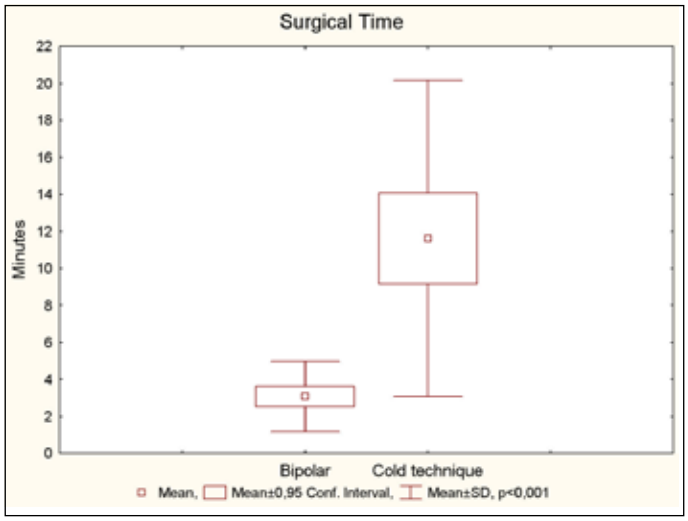

Figure 2.

Blood loss

Mean blood loss was 14 times greater for the conventional cold technique compared to the hot technique; 43.2 SD +/- 41.7 ml (range 7 - 225 ml) vs 3.0 SD +/- 4.7 ml (range 0 - 25 ml) ($p < 0.001$) (Fig. 3). The corresponding median values were 30 vs 1ml.

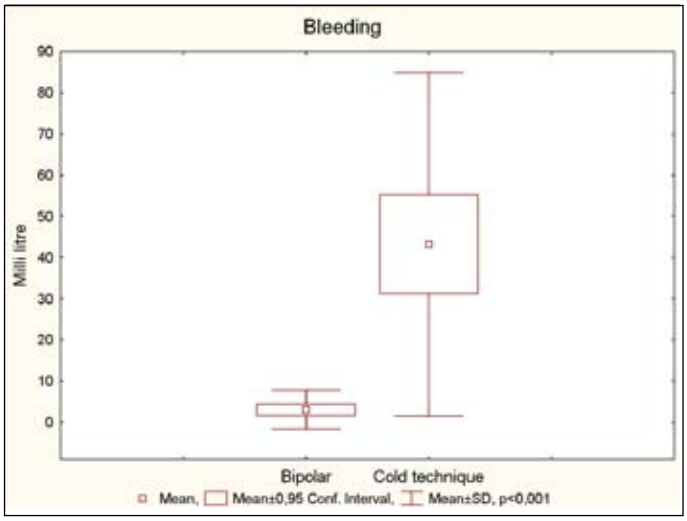

Figure 3.

Pain

Only 18/26 (69%) patients aged 10 years or more completed the VAS procedure.

Maximal pain

Mean VAS value for the conventional cold technique was 52.4 SD +/- 26.7 mm (range 11–97 mm) vs 52.0 SD+/- 27.4 mm (range 8–97 mm) for the hot technique (Fig.4).

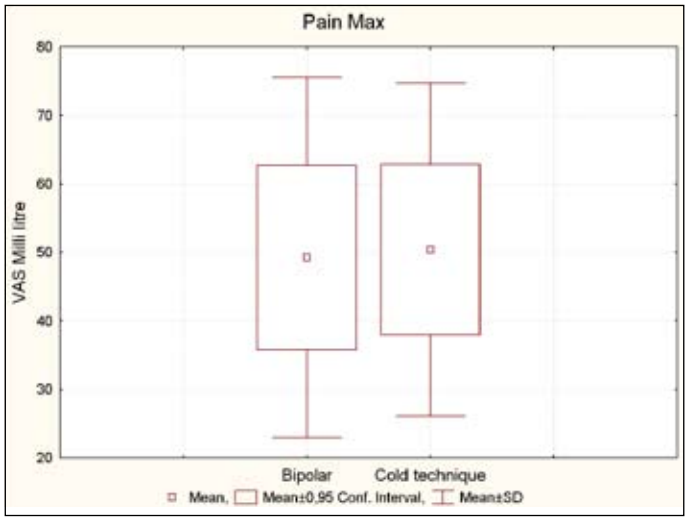

Figure 4.

Pain Duration

Mean pain duration for the conventional cold technique was 9.1 SD +/- 2.3 days (range 6-14 days) and 9.4 SD +/- 2.3 days (range 6–14 days) for the hot technique (Fig. 5).

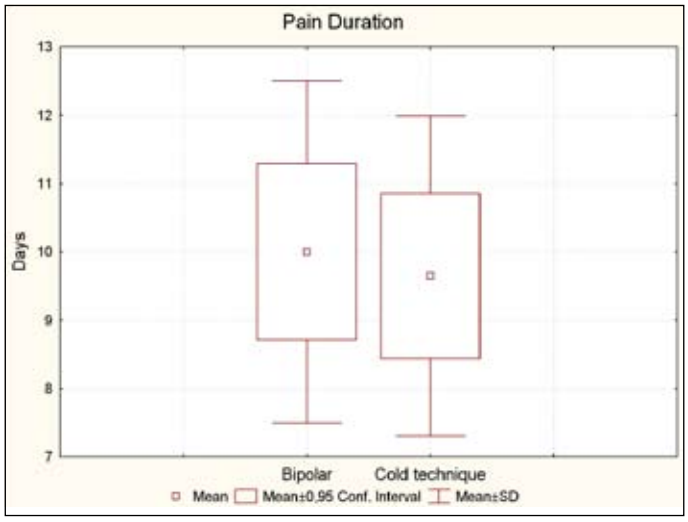

Figure 5.

Early and late complications

No primary haemorrhage occurred. No accidental burn from the use of the bipolar scissors was seen. Transient small conservatively treated secondary haemorrhages were reported by 5 patients after 3-5 days; two patients bleeding on the "cold" side and three patients from the "hot" side (ns). No surgical intervention was required. One patient was treated for a general throat infection. No posto-perative taste disturbance was reported.

Discussion

In the present randomised controlled trial a hot and a cold technique were employed for tonsillectomy in a novel way. Both techniques were utilized simultaneously in the same subjects for a more precise comparison of per-operative blood loss, surgical time and postoperative pain.

Surgical time was much in favour of the hot technique (Fig. 2). This may not only shorten the time under general anaesthesia but also increase the turnover in the operating theatre. It may facilitate the waiting list being shortened and be more cost effective for healthcare providers.

The difference in blood loss between the two methods used was significant (Fig.3). This might be of importance especially in small children susceptible to blood loss and for patients with haemostatic disturbances. The five patients with substantial bleeding (>100 ml) on the conventionally operated side altogether had a mean blood loss of only 3.5 ml on the side operated on with bipolar scissors. Only plain bupivacaine hydrochlor. was injected in the tonsillar bed during the comparative study to minimize external impact on the results and to minimize the risk of late per-operative haemorrhage. The use of epinephrine in the local anaesthesia would probably have decreased the per-operative bleeding even more, at least on the conventionally operated side [8].

A number of life threatening or lethal injuries have been reported after tonsillectomy [5, 9]. The lingual, facial and internal maxillary arteries are the main suppliers of the tonsillar region. There may even exist some collaterals between these branches from the external carotid artery to the internal carotid artery. The lingual and the facial arteries often pass in the close vicinity of the inferior tonsillar bed, and are at special risk of being traumatized by deep sutures. Pulsations in the inferior tonsillar bed may be caused by a tortuous internal carotid artery or by aberrant lingual and/or facial arteries [5]. The glossopharyngeal nerve passes external to the superior pharyngeal constrictor to which the tonsillar bed may be attached after peritonsillitis. The lingual branch of the nerve passes between the superior and middle pharyngeal constrictors close to the inferior tonsillar bed. Nerve injury causes taste disturbances [10].

By using the bipolar scissors it is possible to elevate the tonsils with minimal bleeding and thus to perform the operation with better visual control as compared to traditional cold techniques. Furthermore, diathermy usually makes the blind and dangerous deep strangulating sutures superfluous. A small number of transient post-operative haemorrhages occurred in both groups, none needing any surgical intervention. No taste disturbances were reported.

Pain assessment was performed with a VAS-scale suitable for adolescents and adults but not for small children. Still it is difficult to compare VAS interpersonally as it may depend on the individual pain references and the mood, but it might be feasible for intrapersonal evaluation. For small children secondary assessment of eating and behaviour is usually performed but it was not possible with the current method. Two thirds completed and returned the VAS formulas. No significant differences were registered for maximal pain and pain duration between the bipolar and cold techniques as previously indicated by others [11, 12].

Patel et al [13] found that tonsillectomy with bipolar scissors did not cause more postoperative pain or post-operative haemorrhage than when operating with the bipolar forceps. The latter was not infrequently used in the present study to stop bleeding, even when cold instruments were used, in accordance with the present tradition at the department to shorten operative time and blood loss. This may, however, have contributed to the similarity in the pain experienced by the two groups.

The main purpose of the present randomised controlled study was to detect if the bipolar scissors have per-operative advantages compared to traditional cold technique for tonsillectomy. We found that the

bipolar scissors significantly decreased surgical time and blood loss. No difference in complication rate was seen in this limited sample, but the conclusion of the British National Prospective Tonsillectomy Audit, when comparing postoperative haemorrhage after hot and cold techniques in thousands of patients was that hot techniques like diathermy and coblation still lead to an increased risk of post-operative bleeding [14]. If these haemorrhages will be found less harmful than those after cold techniques with suture ligatures the hot techniques most likely will dominate still in the future.

Conclusions

Bipolar scissors significantly reduced the operating time and the per-operative blood loss without increasing the post-operative morbidity when compared to conventional cold tonsillectomy in a limited sample of patients. Acknowledgements to Björn Strander for data collection and to Mikael Eriksson for valuable statistical support.

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Nursing research into modern day surgery: a literature review

M. Mitchell

Abstract

Aim: The aim of this review is to examine the present scope and direction of nursing research into day surgery in order to gain insight into possible future surgical nursing intervention in a rapidly changing healthcare environment.

Background: Elective surgical healthcare is changing rapidly. This process has witnessed modern surgical nursing being progressively replaced by devolved medical practices with little or no implementation of interventions based solely upon nursing evidence. Without nursing research into ambulatory surgery and the subsequent knowledge it can provide, such a bias towards the adoption of devolved medical practices will inevitably continue. A review of research activity undertaken by the nursing profession regarding day surgery was therefore required to aid the promotion and development of nursing based evidence in modern, elective surgery.

Method: Relevant literature was gained from topical bibliographic databases (MEDLINE, CINAHL, British Nursing Index and Archive, Applied Social Science Index, Cochrane Library and PsychInfo) and cross-referencing.

Findings: Forty research papers were examined from which two main themes emerged based upon the broad area of study and recommendations for clinical practice - physical experiences (pain and post-operative nausea and vomiting) and psycho-educational experiences (satisfaction, information provision, anxiety and recovery).

Conclusions: Based upon the nursing literature focusing specifically upon patient experiences of day surgery the direction in which modern, surgical nursing should progress may be centrally located with issues concerning the physical and psycho-educational experiences of modern surgery/ anaesthesia. Future nursing studies into modern day surgery should therefore strongly consider the relevant transitory physical care and continuing psycho-educational care. Transitory physical care as such aspects are commonly very brief and succinct whereas psycho-educational care more continuous and ideally spanning several days. However, the implementation and evaluation of such recommendations remains vital.

Keywords: Day surgery; Ambulatory surgery; Patient satisfaction/ anxiety/ information/assessment; Nursing intervention; Nursing care.

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Introduction

The amount of ambulatory surgery undertaken on a global basis is increasing and will continue to do so for many years.[1] Although day surgery was first undertaken in 1909 [2], it is only within the last two decades that it has developed so vigorously. In the United States of America and Canada the amount undertaken currently stands at 84% and 87% of all elective surgery, respectively, with the Scandinavian countries having the highest percentage in Europe.[3, 4]

A prominent feature for the nursing profession in this rapidly changing surgical environment is the continued adoption of devolved medical practices such as the pre-assessment nurse, anaesthetic nurse, nurse surgeon, laparoscopic nurse, etc.[5-10] Nursing knowledge, although available, is rarely formally employed and has therefore contributed very little to the success of day surgery.[11, 12] One possible explanation for the adoption of devolved medical practices is the decline in the physical nursing interventions once required by patients undergoing traditional surgery. With minimal access surgery (inherent in day surgery) the physical assault on the body is considerably reduced.[13] The need for the physical nursing care once associated with traditional surgery is therefore rapidly disappearing or at best becoming a minor part of the nursing picture, being largely replaced by transferable medical practices to help expedite the ambulatory surgery process. While the adoption of such tasks may be vital to ensure safe and efficient day surgery in the limited time available,[14-18] it detracts somewhat from the utilisation of nursing based evidence. To help fill this void and provide an alternative to the stream of transferable medical practices, robust, evidence-based nursing knowledge is required to provide modern day surgery nursing with new directions. Without such new evidence what knowledge will inform future surgical nursing?

If this trend continues the nursing profession may be destined to follow in the wake of medical advances alone, accumulating devolved tasks and re-labelling them as surgical nursing intervention with little or no discrimination. This cannot therefore continue if nursing is to make a valued and lasting contribution to the future of modern surgery. Reliable research evidence, fit for the modern day surgery environment, is required to help demonstrate the contribution nursing can offer. Two recent literature reviews have been undertaken regarding the nursing role in day surgery. A detailed review was undertaken by Rhodes et al [19] although this was restricted solely to qualitative studies, did not focus specifically upon nursing research and only embraced a total of 5 studies. Gilmartin and Wright [20] examined 21 papers although not all were research studies undertaken by nurses. A more comprehensive review of the literature regarding nursing research into day surgery was therefore required. Common areas of interest emerging from a broader review of the literature may help to indicate where the future of surgical nursing intervention may arise. While this may not illuminate all possible directions, examining studies which evaluate patients' views/ experiences of day surgery will provide a firm, contemporary base upon which to build.

Aim

To review the present scope and direction of nursing research into day surgery in order to gain insight into possible future surgical nursing intervention in a rapidly changing healthcare environment.

Methods

Only studies between 1990 and 2007 were considered as day surgery has grown so rapidly during this period that to examine studies outside this time frame might prove somewhat futile. The review encompassed studies employing patient perspectives (only), aged over 18 years, undergoing nonlife threatening surgery in day surgery or 23 hour units. Studies that gathered data solely from patients experiencing medical investigations or studies where such patients were incorporated into the sample were excluded. Also, excluded were studies with a patient/ staff mix and in-patient/ day surgery patient mix in order to solely examine the day surgery patient experience. All papers had to be published research examining an aspect of ambulatory surgery and the primary researcher had to hold a clinical, research or educational post in nursing. Finally, dental day surgery, ophthalmic day surgery, patients with possible malignancies or studies in which such patients were incorporated into the sample were further excluded as such patients were deemed to experience unique concerns. The keywords utilised were day surgery, day case surgery, ambulatory surgery, patient satisfaction/ anxiety/ information/ assessment/ nursing intervention, nursing care. The bibliographical databases employed were MEDLINE, CINAHL, British Nursing Index and Archive, Applied Social Science Index, Cochrane Library and PsychInfo (accessed between February 2006 and April 2007).

The inclusion and exclusion criteria led to a substantial number of sources being identified (n=596). 482 were excluded as the prime researcher was a member of the medical profession. Of the 114 papers remaining the criteria put forward by Avis [21] and Hawker et al [22] was employed to ensure further scrutiny, that is, issues concerning the sample, quality of data and validity of conclusions. A further 5 papers were identified as nursing textbooks, 9 were literature reviews on various aspects of day surgery, 32 were descriptive or audit papers, 1 paper had no clear aim and 30 papers employed a sample not meeting the inclusion criteria. With these 77 further exclusions, the final number of papers was n=37. Three papers Dewar et al [23], Swan et al [24] and Gilmartin [25] were reported twice therefore an actual total of n=40 papers were included. The majority of studies originated (primary author) from the United States of America followed by the United Kingdom (Table 1). When considering studies from the United States of American and Canada (some also from Australia) it is common for patients to remain in hospital for 23 hours and be classified as day surgery patients. This issue will be discussed later in more depth.

From a critical review of each paper two main themes emerged based upon their broad area of study and the suggested recommendations for clinical practice - physical experiences (pain and post-operative nausea and vomiting) and psycho-educational experiences (satisfaction, information provision, anxiety and recovery).

Findings

Physical Experiences

Pain Management

In an early survey by Firth [26], 25% of patients stated they were awake the first night in pain and only 31% of patients achieved partial or no relief from their analgesia. The majority had not purchased analgesia as they thought the hospital would provide it. A more informed drug policy was therefore recommended, as 95% were not given analgesia to take home. In a similar study by Codd [27], almost 50% of patients stated they required analgesia immediately on arrival home. Approximately 80% complained of pain in more than one area and found analgesia was needed for 3 days.

Watt-Watson et al. [28] contacted laparoscopic cholecystectomy, shoulder or hand surgery patients post-operatively. "Although severe pain decreased across the week, almost a third of hand patients and over half of the shoulder patients reported severe pain on the seventh day." (p.159). Patients expected some pain but were surprised by its intensity. However, it was revealed that half of the patients had ceased taking their analgesia after 72 hours (despite moderate pain) for fear of adverse effects. Reluctance to take the prescribed medication was also uncovered by Older et al.[29]The desire to maintain mental control and endure pain without analgesia was a source of pride for a number of patients. Improved education and discussions with patients regarding pain management was recommended.

In a quasi-experimental study, Dewar et al (2003) assigned patients into i) an experimental group to receive a pamphlet regarding pain management, a 10–15 minutes pre-operative discussion, a post-operative telephone call each day for 3 post-operative days, and a request to keep a 'pain diary' for 4 days, and ii) a control group who received no additional intervention but were requested to keep a 'pain diary' for 4 post-operative days. The study concluded that, "Patients appear to benefit significantly from telephone advice about how to manage their pain following day surgery." [23 p.85]. Although it could be argued the intervention group was better prepared because of the clear attention bias, the study does highlight the need for verbal interaction regarding care following surgery. Attention bias refers to the additional consideration provided to one group in comparison with the other. This extra time/ attention alone can exert a positive influence.

In a second reporting of this study by Dewar et al [30], the data originating solely from the telephone interviews was examined. This data again demonstrated that patients held many misconceptions regarding pain management (pain is to be endured, addiction may result, utilising less analgesia than prescribed to endure pain). Also, some patients were too poorly to remember information at discharge and many questions developed. Again, improved communication 7 concerning pain management was recommended. Following a survey by Coll and Ameen [31] the need for adequate information regarding pain management was emphasized as differing surgical procedures may generate differing pain patterns. For example, patients who underwent hernia repair experienced a significantly higher level of pain over a 3 day period in comparison to other surgical procedures. In a further quasi-experimental study, Hulme et al [32] assigned patients to receive i) standard post-operative analgesia plus 5 minutes of foot massage or ii) standard post-operative analgesia. The experimental group reported significantly less pain 10 minutes after foot massage and until discharge although no significant difference was established with analgesia intake. The clinical utility of foot massage is briefly discussed although, again, the role of attention bias cannot be ignored.

Post-operative Nausea and Vomiting (PONV)

Fetzer et al (2004) surveyed 190 patients to gauge the effectiveness of a PONV assessment scale. "Three items 'length of nausea, number of vomiting episodes and amount of vomitus' were strongly related to the distress expressed by participants in the study." [33 p.79]. Further study into differing populations was recommended although the assessment scale has a central problem in that it will not identify susceptible patients prior to surgery. In a quasi-experimental study,

Anderson and Gross [34] assigned participants into three groups i) aromatherapy with isopropyl alcohol, ii) oil of peppermint, and iii) saline (placebo) gauze pad inhalation, to determine if aromatherapy was effective in treating PONV. All patients who entered the study were already experiencing PONV but volunteered to experience an 'alternative treatment'. Nausea scores decreased, but there were no significant differences between the groups. The most effective remedy for PONV could not be substantiated, that is, the treatment groups or additional attention. In a further study, Fetzer et al [35] again surveyed patients regarding post-discharge nausea and vomiting (PDNV) and uncovered the most commonly reported cause of PDNV to be the prescribed analgesia. As a result, 73% of patients reported they did not complete their prescribed medication. Such a high proportion not completing their medication clearly has implications for continued pain management.

Psycho-educational Experiences

Patient Satisfaction

The most prominent theme within this review concerns patient satisfaction. Donoghue et al [36] indicated that female patients with young children might find day surgery somewhat challenging. Such patients desired day surgery although caring for young children prior to admission and following discharge presented problems for recovery. In a study by Stevens et al [37], although pain, anxiety and privacy were concerning issues, childcare was again a strong theme. Barthelsson et al [38] echoed this childcare theme as it was very difficult for mothers to care for children immediately following surgery. However, the majority of mothers felt that returning home the same day was a positive experience although, again, information provision was insufficient.

Cox and O'Connell [39] interviewed patients post-operatively and analysed diaries kept for 4 post-operative days. It was revealed that insufficient time was given on the medical certificate provided for convalescence. Consequently, patients thought they were experiencing problems longer than the doctors had expected. The majority were satisfied with the information provided although 50% accessed other healthcare professionals for further advice following discharge. Horvath (40) also uncovered that patients received unrealistic information regarding recovery. Patients were informed pre-operatively that they would be able to resume 'normal activities' on the 3rd day although only 58% stated this was achieved - pain being the main barrier. The study therefore recommended that patients undergoing laparoscopic gynaecological surgery should be informed that it might take at least 5 days to return to their normal activity level. In a survey by Kleinbeck [41], patients were interviewed to help validate a post-operative recovery scale. The study suggested that self-reported health, activity level, fatigue, work ability and personal expectations all to be highly relevant for a good recovery. Accurate information concerning expectations of recovery and the course of recovery were therefore deemed very important.

In an earlier study, Thatcher [42]) highlighted the role of carers, that is, the social, emotional and financial cost. It was discovered that carers assumed considerable responsibility during the immediate post-operative phase. It was therefore recommended that "Carers must be involved in pre-discharge discussions, and information should include diet, elimination, activity and rest, as well as other usual post-surgical information." (p. 32). Majasaari et al [43 determined that half of all patients desired a family member to be present in hospital and "Nervousness, fatigue, insomnia and financial difficulties were reported to be the most common effects of the patients' illness on family members." (p. 1036). Swan et al [24] also highlighted the social cost of surgery. "The major finding from this study suggests that although the provider 'cost' may have been reduced with the 10 transition to ambulatory surgery, a significant portion of the cost or impact of this care may have been merely shifted to the patient and family." (p. 744).

Satisfaction and information provision were frequently inextricably linked. Fitzpatrick et al [44] revealed that 90% of patients received sufficient information. However, the study states that information regarding expected duration of recovery was lacking. A mixed methods study by Williams et al [45] revealed a general level of satisfaction in the quantitative element but the qualitative element indicated some negative features, that is, lack of privacy, sitting in a public area in a gown and slippers, inaccurate or confusing information and general lack of information. In the survey of 31 patients by Donoghue et al. [36] a lack of adequate education was uncovered. "Many of the participants reported that there were experiences they had not anticipated, surprises that they did not welcome and things that they would have liked to have known before the operation" (p.173). Costa [46] interviewed patients on the day of surgery and 1 week following surgery. The main themes to emerge were 'fear', 'knowing' and 'presence'. Fear manifested as anxiety regarding anaesthesia, loss of control and being cut. Knowing related to the lack of information and presence - the value of a nurse or relative being close. The brief clinical recommendations suggested the importance of the physical presence of a nurse and the utility of effective communication although it provided little insight into the clinical application of such important facets of care.

Hammond and Smith [47] conducted a survey into patients' perceptions of the day surgery environment. It was revealed they were largely unconcerned with mixed sex wards and conversations being overheard. "More surprisingly, we found that approximately half of our patients actually thought that overhearing conversations was a good thing, by making the experience more of a shared one." (p.93). For some patients, such brief social interactions may be of some therapeutic value although this requires more rigorous evaluation as this data was only taken from one day surgery unit. Finally, Gilmartin [25] interviewed patients 7–10 days following surgery. Four themes emerged 'interpersonal skills of the nurses', 'actual assessment of suitability', 'information provision' and 'problems of cancellations'. The study suggested that while the preassessment visit was effective, information provision and psychological care were somewhat lacking.

Information Provision

In a quasi-experimental study, Coslow and Eddy [48] assigned patients into i) individual 20 minute structured programme 1 to 2 weeks prior to surgery, tape-slide demonstration, 6-page information booklet, answers to questions and a knowledge test, or ii) brief information 1 hour prior to surgery. The only significant differences between the groups were increased requests for and consumption of analgesia, indicating decreased pain experience for the experimental group. Although the clinical recommendations were limited and experimental bias highly evident, the study did recognise patient education should be a nursing responsibility. In a further quasi-experimental study, Hering et al [49] assigned patients to receive i) instructions on how to access an information website or ii) routine care only. No significant difference in anxiety was established between the two groups although the experimental group was significantly more knowledgeable regarding surgery. The control group appeared not to want to extend their pre-assessment visit to be shown how to access the website and thereby may not have desired the extra information. Moreover, being knowledgeable regarding pending surgery only determines that some people desire more information and not that more informed people are less anxious.

Mitchell [50] hypothesized that patients who desired additional information would possess a greater internal health locus of control whereas patients with a greater external health locus of control would prefer less information. This theory is based upon the

assumption that 'internals' have a greater belief in their ability to shape their own destiny whereas 'externals' feel more influenced by luck, fate and powerful others [51]. No such relationship was established although it was determined that patients preferred a choice of information. Young and O'Connell [52] compared patients undergoing laparoscopic cholecystectomy in an 8 hour and a 23 hour facility. The only difference between the two groups was the quality of information. "All carers of day surgery patients stated they were given sufficient discharge information while only 55.6% of carers of patients who stayed in hospital overnight stated they received sufficient information." (p.6). In an early study by Otte [53] patients unanimously recognised that they received insufficient information. One of the conclusions stated "Providers of health care must develop a culture which promotes the principles of empowerment and which permeates the entire organisation to increase patient responsiveness." (p.1236). This lack of information, especially regarding discharge has been recently echoed [54]. Most patients considered discharge planning to be well organised although there were deficits related to verbal information provision. It was recommended that relatives be present to listen to the discharge information. Finally, in a study by Barthelsson et al [55] it was revealed that the majority of patients received insufficient information. Although this was problematic, all patients were happy to undergo day surgery. Limited information was tolerated for the convenience of undergoing day surgery.

Anxiety

In a quasi-experimental study, Steelman [56] assigned patients undergoing surgery and local anaesthesia into i) music via headphones pre- and intra-operatively, and ii) no music but given routine distraction by the nursing staff. A fall in post-operative blood pressure (diastolic pressure) at a greater rate than the control group was the only significant difference to be established. On this basis the use of intra-operative music was recommended. However, what constituted 'routine' distraction was not detailed. Augustin and Hains [57] hypothesized that listening to music of choice while waiting for surgery would significantly reduce anxiety. Forty-two patients were randomly assigned into groups i) pre-operative instructions plus music listening, and ii) pre-operative instructions only. Although there was a significant decrease in the physiological measures for the experimental group, the clinical utility of wearing headphones immediately prior to surgery is somewhat questionable. Moreover, no nursing intervention is put forward to help manage the increased anxiety in the patients identified as anxious - just the wearing of headphones. Mitchell [58] investigated the relationship between differing levels of information provision and anxiety. Patients were contacted pre-operatively by telephone and randomly assigned into groups to receive i) an extended information booklet, or ii) a simple information booklet (both mailed preoperatively). Additionally, participants completed a coping style questionnaire to determine their possible informational requirements, that is, vigilant coper (much information required) or avoidant coper (little information required) [59–61]. However, nurses rated all participants in receipt of the extended information as significantly less anxious irrespective of coping style. Although there was a trend for vigilant copers to require additional information ($p<0.076$), it was concluded that the extended level of information was beneficial for all.

Recovery

In an early study of patients and carer's by Frisch et al [62], data were collected by postal questionnaire and telephone interview. The carers' reports generally matched the patients' with the most frequent complaints from patients being weakness and fatigue. Approximately 40% of patients stated their pain was worst on the first day and more than 30% required assistance with bathing and dressing. The study also states that greater attention should be given to the psycho-educational aspects of care. In pursuit of this Vogelsang (1990) asserted that patients who experienced sustained contact with a familiar nurse on the day of surgery would be less anxious and more satisfied. In this study patients were randomly assigned into groups i) telephone discussion 1–3 day prior to admission, pre-operative contact with same nurse on the day of surgery for 5–10 minutes and postoperative contact with same nurse for 60–85 minutes, or ii) telephone discussion 1–3 day prior to admission, pre-operative contact with the same nurse on the day of surgery for 5–10 minutes only. All patients were telephoned post-operatively and "Nursing care was reported as 'excellent' by 80% of the subjects in the continued contact group and by 40% of the subjects in the control group." [63 p.318]. Continued contact with a familiar nurse was recommended although the clinical utility of this in a demanding day surgery unit may be somewhat restrictive. In a second reporting, Swan [64] surveyed patients to ascertain the most effective patient perceived nurse caring behaviours. Patient awareness of nurse caring behaviours was predominantly limited to the post-operative recovery room. One can only speculate that patients may have been too anxious prior to surgery to comprehend the care provided. Nevertheless, pre-operative behaviours such as teaching did not carry the same significance as post-operative physical care and attention.

Fetzer and Huot [65] conducted a study concerning reduced body temperature during surgery as low body temperature was deemed to possibly delay discharge. They noted patient body temperature on three occasions - pre-operatively, at the beginning of Phase II recovery and prior to discharge. No significant differences were established and it was concluded that temperature loss could not be considered as a possible cause of delayed discharge. Finally, in a study by Kleinbeck and Hoffart (1994) to determine recovery progress patients were telephoned twice during the postoperative phase. It was uncovered that 'getting back to normal' was a central concern for the majority of patients. Patients defined recovery as having no symptoms and being back to their usual activity level. However, "Patients felt vulnerable after leaving the hospital where nurses were readily available to answer questions." [66 p.397]. Additionally, much trial and error recovery was undertaken at home because of the lack of relevant information. Telephone calls to aid information provision plus the employment of more pragmatic information for home recovery were thereby recommended.

Study Limitations

The main limitation in this review, previously mentioned, concerns the mixing of research papers reporting on participants from both day surgery units and 23 hours units. The utilisation of 23 hour stay is not widely practiced throughout Europe as the international definition of day surgery is more broadly followed. While the number of 23 hours units is increasing in the United Kingdom [67], subtle differences could be reflected in data from global studies where 23 hour units are included. For example, some participants may have experienced an extended opportunity to interact with the healthcare professionals. This could have had a positive influence upon information provision or patient ability to manage post-operative issues such as pain. Conversely, such differences could have a negative impact on patients admitted to a 23 hour unit as they may experience differing problems. For example, discharge information from day surgery units is frequently evaluated as superior to 23 hour units. It is suggested that patients in 23 hour units may experience an increase in co-morbidities and thereby require greater attention/ information. "The United States and Canada currently lead the world (*in amount of day surgery*) and are unquestionably accepting sicker patients than most other countries." [68 p135].

Discussion

From a critical examination of the literature, focusing specifically upon patient experiences of day surgery, the direction in which modern, surgical nursing should progress may be centrally located in brief physical aspects of care and more comprehensive aspects of psychological care. Many nurse researchers are acutely aware of the shifting emphasis away from aspects of physical care to more psycho-educational care as none of the studies uncovered examined any physical issues beyond post-operative pain management or management of nausea and vomiting, that is, wound care, mobility, hygiene, nutrition. Future nursing studies and nurse interventions in modern day surgery should examine issues concerning transitory physical interventions and continuing psychoeducational interventions more closely. Transitory, as the physical care is commonly very brief and succinct, whereas psycho-educational care more continuous, ideally spanning several days. In such a dynamic healthcare environment such issues remain a base from which to continue to expand and explore contemporary issues in modern, elective surgical nursing.

Transitory Physical Interventions

Both immediate pain management and its management following discharge have been identified as requiring further consideration. Patients who have experienced poor pain management immediately following surgery have also experienced poor management following discharge. This can result from insufficient/ ineffective analgesia, limited information and patients' attitudes towards analgesia consumption. It is evident that effective pain assessment must be a strong consideration prior to discharge. In this way, patients who may require additional/ more appropriate analgesia can be identified. Discussion regarding pain management is also required prior to the day of surgery to help eliminate misconceptions such as pain is to be endured, addiction may occur, utilising less analgesia than prescribed and the unnecessary adoption of a stoical attitude regarding pain management. Furthermore, it is evident that pain management advice should be more widely considered via the telephone during the first few days following surgery. Further research into pain management both before and after surgery is required to help augment the repertoire of care available when conversing with patients in the post-operative period.

Post-operative nausea and vomiting (PONV) has also been recognised as problematic and requiring additional consideration. Again, the early assessment of PONV has helped to identify susceptible patients although a more proactive approach would bring greater benefit. The early assessment of patients experiencing PONV is vital to identify susceptible patients and initiate the appropriate action. Further research is required to determine if differing forms of alternative therapy or other simple techniques during the immediate post-operative phase can be of benefit, such as, deep breathing, aromatherapy or increased physical presence of the nurse. Additionally, post16 discharge nausea and vomiting (PDNV) has become problematic for a number of patients and thereby requires greater scrutiny. For example, the journey home, increased movement and additional activities once home are all aspects requiring further investigation.

Continuing Psycho-educational Interventions

A strong element throughout the review was the need for improved psychological aspects of care, in particular information provision. Firstly, some studies have gained modest success in anxiety management with distraction techniques such as music, communication and continued contact with a familiar nurse. However, such claims are somewhat simplistic or lacking in clinical utility. Nursing must seek more formal procedures beyond the simple provision of music. For example, during communication the precise aspects of intervention which provide the most support for patients remain unclear. Research concerning more formal, tangible aspects of psychological management is required to advance the repertoire of interventions available. Such issues were echoed in both recent literature reviews highlighted earlier [19, 20]. Such interventions may also help embrace the most prominent theme in the review - patient satisfaction. Increased patient satisfaction was associated with effective pain management, decreased nausea and vomiting, low anxiety and the provision of adequate information. Adequate time was required prior to admission to assess informational needs and provide the desired level of written/verbal information.

It is broadly recommended that the information should also be appropriate for carers and patients to reach an informed decision should an aspect of their recovery become problematic, that is, wound healing, pain, nausea and vomiting, mobilising, hygiene. Further studies are required to help examine methods by which information provision can be more formally presented at the desired level, with the required content and at the most appropriate time.

Conclusion

Many evolving nursing practices in modern elective day surgery have their roots in medical knowledge. If nursing is to help shape the future of modern surgery, contemporary nursing knowledge is vital. While examining papers which only consider patients' subjective experiences of day surgery may not identify all possible directions, such perceptions are client centred and therefore can provide the stimulus for further studies/ clinical debate regarding the practical utility of the recommendations. Further studies may therefore wish to examine the formal, timely provision of accurate pre-operative information, tangible aspects of anxiety management on the day of surgery, provision of information more appropriate for a home recovery and communication with patients during the first few days following discharge. Furthermore, educators of nurses must recognise and react to such changes in order to continue to develop programmes which accurately reflect this modern, surgical environment.

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Table 1 Included evidence.

	Source	Origin	Research Method	Aim of Study	Sample & Data Collection
23	Dewar *et al* (2003).	Canada.	Quasi-experimental design.	To determine if a nursing intervention pre-operatively with post-operative follow up would improve pain management.	Control group n=135, experimental group n=87. All patients self-rated anxiety level and pain prior to surgery, pain diaries for 4 post-operative days returned via mail. Experimental group also telephoned each day for 3 days post-operatively to gauge pain & PONV. All patients telephoned on day 5 to gauge pain level.
24	Swan *et al* (1998).	USA.	Survey.	To examine the relationship of pre-operative and post-operative patient-perceived nurse caring behaviours to symptom distress.	n=100 participants invited to complete a General Symptoms Distress Scale, Functional Status questionnaire, and Caring behaviours Inventory. Interviews were undertaken via telephone on post-operative days 1, 4, and 7.
25	Gilmartin (2004).	UK.	Phenomenological.	To elicit patients' perceptions of the pre-assessment preparation.	n=30 interviewed at home 7-10 days following surgery. Interviews lasted approx. 1 hour and questions were directed at understanding the participants' experience of pre-assessment.
26	Firth (1991).	UK.	Survey.	To uncover post-operative pain experiences.	Postal questionnaire returned by n=813 patients. 13-item self-reported questionnaire concerning pain experience and management.
27	Codd (1991).	UK.	Survey.	To discover whether patients found it necessary to take analgesics following discharge.	Questionnaire provided on day of surgery and a repeat questionnaire for return by mail n=37. Questionnaire concerned level of pain, discomfort and PONV. Clinical Questionnaire also provided to anaesthetists to rate level of patient anxiety.
28	Watt-Watson *et al* (2004).	Canada.	Survey.	To examine the post-operative pain, pain-related interference with usual activities and analgesia used.	n=214. Self-reported pain inventory and analgesia taken measured pre-operatively then on post-operatively on day 1, 2, 3 and 7. Possible side-effects from analgesia and adequacy of pain management information measured.
29	Older et al (2007)	UK.	Qualitative.	To gain an insight into the patient experience after day case surgery, particularly focusing on patients actual analgesic practice, and factors influencing the use of a multimodal analgesic regime.	n=21 participants interviewed via telephone using a tape recorder 3 days following surgery. Interviews lasted approx. 15 – 20 minutes and semi-structured questions focussing on the experience of pain and how they felt about analgesia.
30	Dewar et al (2004) 2nd reporting.	Canada.	Qualitative.	To describe the nurse's experience of using the telephone to follow up with patients and to advise on how to manage pain.	n=222 diaries returned therefore all these patients telephoned. Data collected from notes taken during post-operative telephone conversation plus diaries. Patients telephoned 1st post-operative day.
31	Coll & Ameen (2006).	UK.	Survey.	To examine the pain profile of three types of day surgery operation.	n=578 completed 5 self-reported pre & post-operative questionnaires concerning dimensions of health, social support health locus of control and VAS for pain.
32	Hulme *et al* (1999).	UK.	Qualitative and quantitative.	To examine the effects of foot massage on patients' perceptions of care.	Control group n=29, experimental group n=30. Self-reported measures of pain on several occasions during immediate post-operative period. Questionnaire provided for self-reported pain, comfort and analgesia intake during 1st post-operative week.
33	Fetzer *et al* (2004).	USA.	Survey.	To evaluate a PONV Inventory.	n=133 patients telephone 24 hours following discharge. Level of PONV rated using patient response to an 8-item Inventory.
34	Anderson & Gross (2004).	USA.	Quasi-experimental design.	To determine if aromatherapy is effective in treating post-operative nausea.	n=33 randomly allocated into 3 experimental groups. Visual Analogue Scale (VAS) to measure degree of nausea on several occasions during Phase I and II recovery.

	Source	Origin	Research Method	Aim of Study	Sample & Data Collection
35	Fetzer *et al* (2005).	USA.	Survey.	To evaluate what self-care activities are used for post-discharge nausea and vomiting & if they are effective.	Telephone survey n=190. Level of PONV experienced once home following surgery.
36	Donoghue *et al* (1995).	Australia.	Qualitative and quantitative.	To report women's experience of laparoscopic surgery.	n=31 patients interviewed on 3 differing occasions using semi-structured method and questionnaire. n=11 interviewed 1st post-operative week, n=10 interviewed 2nd post-operative week and n=10 interviewed 3rd post-operative week.
37	Stevens *et al* (2001).	Australia.	Qualitative.	To build theory about the day surgery experience by examining the perceptions of a group women undergoing same-day surgery.	Tape-recorded telephone interviews conducted 1 week after surgery with n=13 participants. Participants were encouraged to talk about their experiences of day surgery.
38	Barthelsson *et al* (2003a).	Sweden.	Phenomenological.	To explore patient's experiences of this type of day surgery.	n=7 participants interviewed 1 week post-operatively using a tape-recorder. Questions were directed at ascertaining experiences of day surgery.
39	Cox & O'Connell (2003).	Australia.	Qualitative and quantitative.	To investigate women's experiences of recovering at home following surgery.	n=80. Post-operative diary completed for first 4 days. Patients also telephone to relay experiences from day 5 - 10.
40	Horvath (2003).	USA.	Survey.	To measure pain, fatigue, and functional limitations affecting home recovery.	N=91 returned via mail a with 6-page home recovery log mainly focusing upon pain, fatigue, and functional ability every afternoon for 6 post-operative days.
41	Kleinbeck (2000).	USA.	Quantitative.	To describe the development and initial testing of a self-reported measure of recuperation.	N=59 participants interviewed at home using 15-item recovery scale which focused upon health, activity, fatigue, work ability and expectations.
42	Thatcher (1996).	UK.	Phenomenological.	To investigate the nature of patients' experiences following discharge.	n=6 participants interviewed in their home 4 – 6 days following surgery. Participants were encouraged to talk about their experiences of day surgery.
43	Majasaari *et al* (2005).	Finland.	Survey.	To determine patient's perceptions of emotional support and information provided to family members.	Questionnaire provided on day of surgery for return by mail n=60. 36-item questionnaire concerned patient/ carer support and satisfaction with hospital care.
44	Fitzpatrick *et al* (1998).	UK.	Survey.	To determine patient experience of pain, PONV and wound healing.	Telephone interview of n=30 patients. 30-item questionnaire mainly examining patient's experience of pain, its management, PONV and wound healing.
45	Williams *et al* (2003)	Australia.	Survey.	To assess patient satisfaction with day surgery.	n=107 participants responded to a mailed questionnaire 1 week after day surgery. Questionnaire mainly concerned satisfaction with admission, operation, environment, discharge and general satisfaction rating.
46	Costa (2001).	USA.	Phenomenological	To explore patient's perceptions and views of the peri-operative experience.	13 women and 3 men. 1 week post-operative tape-recorded interview. Participants asked to recall how they felt the night prior to surgery, on the day and if expectations were met.
47	Hammond & Smith (2004).	UK.	Survey.	To seek the opinion of patients on day surgery ward design.	N=304 questionnaires completed on day of surgery prior to discharge. Items mainly concerned privacy, mixed ward facility, pre and post-operative patient mix.
48	Coslow & Eddy (1998).	USA.	Quasi-experimental design.	To identify optimal methods of preparing patients for surgery.	Control group n=15, experimental group n=15. BP, pulse, respirations, self-rated pain, requests for analgesia, PONV, length of stay in Phase I & II and patient satisfaction.
49	Hering *et al* (2005).	USA.	Quasi-experimental design.	To determine the impact of a website on patient education and satisfaction with anaesthesia care.	Control group n=39, experimental group n=25. Self-rated anxiety levels and scores on an anaesthesia quiz.

(Table 1 continues overleaf)

	Source	Origin	Research Method	Aim of Study	Sample & Data Collection
50	Mitchell (1997).	UK.	Survey.	To establish the relationship between choice of preparatory information and perceived health locus of control.	Questionnaires concerning completed on the day of surgery by n=150 patients. Questionnaires examined health locus of control beliefs and desired level of information provision.
52	Young & O'Connell (2001).	Australia.	Quasi-experimental design.	To determine patients' and carers' experiences convalescing from laparoscopic cholecystectomy at home after being discharged within 8 hours and 23 hours.	Control group n=14 (23 hours stay) and experimental group n=14 (8 hour stay). Post-operative symptom diary completed for 4 days (tiredness, mobility, pain, eating & drinking, PONV, elimination, wound management and information provision. Both patient and carer completed a diary each. Telephone interview on day 10 covering same aspects.
53	Otte (1996).	UK.	Qualitative.	To examine patients' experiences and views of day surgery.	n=8 participants interviewed using a tape recorder in their homes 3 weeks following surgery. Interviews lasted approx. 45 minutes and questions were directed gaining experience of being a day-case patient, observations, expectations and involvement in decisions.
54	Gilmartin (2007) 2nd reporting.	UK.	Phenomenological.	To explore and reveal patients' perceptions of discharge arrangements and recovery following day surgery. Introduction.	n=30 interviewed at home 7-10 days following surgery. Interviews lasted approx. 1 hour and questions were directed at understanding the participants' experience of discharge preparation.
55	Barthelsson *et al* (2003b).	Sweden.	Qualitative.	To explore patient's experiences of this type of day surgery.	n=12 participants interviewed 1 week post-operatively using a tape-recorder. Questions were directed at ascertaining experiences of living with gallstone disease, pre & post-operative care and recovery at home.
56	Steelman (1990).	USA.	Quasi-experimental design.	To evaluate the effects of intra-operative tranquil music on patients' anxiety and blood pressure.	Control group n=22, experimental group n=21. Pre-and post-operative self-rated anxiety questionnaire and intra-operative blood pressure.
57	Augustin & Hains (1996).	USA.	Quasi-experimental design.	To evaluate the effectiveness of music in reducing patient pre-operative anxiety.	Control group n=21, experimental group n=21. BP, pulse, respirations and self-rated questionnaire all to monitor level of anxiety.
58	Mitchell (2000).	UK.	Quasi-experimental design.	To establish the relationship between choice of preparatory information and vigilant & avoidant coping.	Group 1 extended information n=46 and group 2 simple information n=41. Pre-operative self-reported measures of anxiety, health locus of control, self-efficacy, information requirements and coping style.
62	Frisch *et al* (1990).	Canada.	Survey.	To obtain a preliminary picture of patients' and helpers' experience of ambulatory surgery and recovery at home.	n=41 patient-helper pairs. Parallel questionnaires for patients and helpers mainly examining anxiety, post-op symptoms and care-giving activitie4s. Completed on day 1, 2 and 7 in post-operative period and returned via mail.
63	Vogelsang (1990)	USA.	Quasi-experimental design.	To investigate the impact continued contact with a familiar nurse, from pre-admission procedures through post-operative awaking to consciousness in the PACU, had on women's post-discharge evaluations of surgery.	Control group n=20, experimental group n=20. Post-operative telephone questionnaire 3 – 5 days concerning discharge time and satisfaction with care.
64	Swan (1998) 2nd reporting.	USA.	Survey.	To describe peri-operative changes in symptom distress and functional status experienced by patients undergoing ambulatory surgery.	n=100 participants invited to complete a General Symptoms Distress Scale, Functional Status questionnaire, and Caring behaviours Inventory. Interviews were undertaken via telephone on post-operative days 1, 4, and 7.

	Source	Origin	Research Method	Aim of Study	Sample & Data Collection
65	Fetzer-Fowler & Huot (1992).	USA.	Survey.	To describe the post-operative temperatures from admission to Phase II recovery through to discharge home.	Tympanic temperature of n=101 patients recorded at 3 times - pre-operative admission, post-operatively at beginning of Phase II recovery and at the end of Phase II recovery.
66	Kleinbeck & Hoffart (1994).	USA.	Qualitative.	To determine what symptoms/ events patients experience when recovery occurs away from the hospital and how these are managed.	N=19 participants interviewed via telephone on 2nd and 5th post-operative day. Both interviews were tape-recorded. Initial questions concerned managing problems, difficulties and length of recovery time.

Evaluation of patients' perception against the Modified Postanaesthetic Discharge Scoring System for home readiness after ambulatory surgery

K.K. Leung, J.M.J.A. Lim, K.Y. Chiu, C.M. Koon, T.S. Lan, June, S.L. Ying

Abstract

Objective: To determine if the patients' or their guardians' perception of their home readiness compares with the Modified Postanaesthetic Discharge Score System (MPDSS).

Methods: Not less than one hour after discharge from the post anaesthetic care unit, the patient or patients' guardian was given a set of questions that he/she answered. The questions asked if the patient felt fit enough to be discharged. The investigator, unaware of the answers, assessed the patient using the MPDSS. Patients with MPDSS score 9 were considered fit for home discharge with escort. Both admission and readmission were recorded.

Results: Data from 119 patients showed good correlation between the patients' perception of need to stay longer and the MPDSS ($p<0.001$). Similarly both patients' prediction and MPDSS indicated the need for admission ($p<0.001$ and $p=0.003$ respectively).

Conclusions: Both patients' perception and MPDSS were indicative of fitness of discharge. A number of patients did not feel the need to stay longer despite having discomfort. Some patients would have preferred to see an anesthetist before being discharged. This was more common in paediatric cases.

Keywords: Ambulatory surgery, Home readiness, Patient's perception, Modified Postanaesthetic Discharge Scoring system.

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Introduction

With the use of fast-track anaesthesia and recent advances in surgical technique, more surgical procedures are now completed on an ambulatory basis. About 70-80% of all elective cases in North America nowadays are performed as day surgery [1]. Other countries are aiming for similar figures as well. The advantages of ambulatory surgery include cost reduction and the efficient use of resources. With the ever increasing patient demands and government financial pressures, cost containment in the healthcare industry is a worldwide concern. However, to ensure early discharge without compromising safety, patients usually need to be assessed by a nurse or an anaesthetist before going home. This is labour intensive and sometimes inefficient.

Appropriate discharge of the ambulatory patient is a multifactorial problem. Efficiency has to be balanced with patient safety, especially in the increasingly litigious society [2]. A number of studies have been conducted to ensure early and safe discharge. Tests include simple reaction time (SRT), choice reaction time (CRT), critical flicker fusion time (CFFT), digital symbol substitution test (DSST) and perceptive accuracy test (PAT) [3]. However these tests have not been validated. One efficient method is to use the modified postanaesthetic discharge scoring system (MPDSS) to assess home readiness. This scoring system has been validated by Marshall et al [4]. However, a patient could still be detained unnecessarily despite adequate recovery as a result of waiting to be assessed. It would thus be advantageous if the patients had a means of deciding their own discharge readiness. Moreover, a patient participating in his own discharge decision would be less likely to instigate litigious proceedings. It has been shown that patients who have an active role in decision making have increased patient satisfaction [5]. A search through the Medline database from 1966 to date did not reveal any investigations comparing a patient or guardian's perception of his/her own home readiness with the postanaesthetic discharge scoring system. We therefore proposed a prospective cross-over study to address this point.

Methods

Following ethical approval from the local Research Ethics Committee, 119 patients admitted for ambulatory surgeries from 1-11-04 to 31-1-05 were invited to participate in this study. Informed consent was obtained from all patients. Those who refused to participate or required inpatient stay due to intra-operative complications were excluded from this study.

Postanaesthetic recovery was divided into 3 stages [6]: Stage I recovery was from discontinuation of anaesthesia until patients have recovered their protective reflexes and motor function. This took place in the post anesthesia care unit (PACU) with suitably trained nursing staff. Stage II recovery was the immediate clinical recovery to home readiness. Patients were coordinated and ambulating. This took place in an ambulatory surgical unit (ASU). Stage III recovery occured after patients were discharged when they undergo full physical and psychological recovery at home. In our study, we concentrated on Stage II. Readmission was arbitrarily defined as admission to hospital within 48 hours after discharge due to a complication of surgery or anaesthesia. Patients undergoing day surgical procedures followed standard hospital procedure. After the surgery, the patients were transferred to the PACU. The patients were discharged from the PACU when deemed suitable by the attending anaesthetist. On discharge from the PACU, the patient returned to the ASU.

Patients were assessed for discharge using the Modified

Postanaesthetic Discharge Score (see Appendix I) by an independent investigator not less than one hour after arrival to ASU. On arrival of the investigator, the patient or guardian was given a set of questions (see appendix II) that he/she filled on his own, or with assistance should he/she be illiterate. The investigator, unaware of the results of a questionnaire, then assessed the patient using the MPDSS. In pediatric cases, the guardian assumed responsibility for the patient. Patients with an MPDSS score greater or equal to 9 were considered fit for home discharge with escort.

Data collected included age, sex, type of procedure and anaesthesia, duration of anaesthesia, time in PACU, time in ASU, end of anaesthesia to actual discharge time, complications (nausea, vomiting, excessive sedation, respiratory depression, excessive pain or bleeding) and unplanned admission and readmission.

Statistics

To detect a difference of 10%, alpha value of 0.05 and power of 0.9, a sample size of 112 was required. To allow for an attrition rate of 5%, we elected to survey 119 4 patients. Categorical data was analysed using the Pearson's Chi Square test. We examined the association between the MPDSS discharge criteria with the patients' perception of fitness for discharge using the Phi coefficient.

Results

1119 patients were studied (Table 1). Among them, 7 would have required admission using the MPDSS scoring system and 13 patients felt the need to stay longer. 6 patients were finally admitted. A 2x2 contingency table consisting of MPDSS for admission and patients' perception for need to stay is shown in Table 2. Results showed there was good correlation between the patients' perception for discharge and the MPDSS (Phi=0.485, $p<0.001$).

Table 1.

Number of Patients	119
Mean Age in years (range)	36 (1-75)
Gender (M: F)	49:70
Mean anaesthesia duration in minutes (range)	38.7 (5-150)
Anaesthesia technique GA:SA:PVB	96:21:2

GA= general anaesthesia, SA=spinal anaesthesia, PVB=paravertebral block

Table 2. Comparison of patients' perception of need to stay by MPDSS discharge score.

	Number of patients who felt no need to stay longer	Number of patient who felt the need to stay longer
MPDSS>9	104	8
MPDSS≤9	2	5

A Contingency table comparing the with that of the actual unplanned admission is shown in Table 3 and a contingency table for patients' need to stay longer and actual unplanned admission is shown in Table 4. Both MPDSS and patients' perception were indicative of the need for admission (Phi=0.269, $p=0.003$ and Phi=0.472, $p<0.001$ respectively).

Table 3. Comparison of patients discharged vs. admitted by MPDSS discharge score.

	Number of patients discharged	Number of patient admitted
MPDSS>9	108	4
MPDSS≤9	5	2

Table 4. Comparison of patients discharged vs. admitted by perceived need to stay longer.

	Number of patients discharged	Number of patients admitted
Number of patients who felt no need to stay longer	105	1
Number of patient who felt the need to stay longer	8	5

The incidence of unplanned admission in this study was 5% (6 out of 119). Two patients were young women suffering from postoperative nausea and vomiting (PONV) after laparoscopic surgery. One patient suffered from dizziness after staple haemorrhoidectomy. Two patients were admitted for acute retention of urine after spinal anaesthesia for inguinal hernia repair. One patient was admitted for social reasons. The readmission rate was 1.7% (2 out of 119 patients). Both of them were admitted for surgical complications after staple haemorrhoidectomy.

One patient did not feel need to stay longer at the time of assessment but was finally admitted. He achieved a full MPDSS score in the assessment and did not complain of any discomfort in the ASU. However, he developed dizziness and hypotension while waiting to be discharged. The reason for the hypotensive episode was unknown. No medication was given apart from intravenous fluids and all investigations were normal. He was discharged the next morning uneventfully.

8 patients felt the need to stay longer yet finally were discharged. 5 out of these 8 patients complained of various degrees of physical discomforts (pain, dizziness and PONV). All symptoms improved in later assessments after bed rest. Only 2 patients required medication to treat their physical discomfort.

38 of the patients felt some discomfort but did not feel they needed to stay longer. 8 patients wanted to see an anaesthetist although they did not need to stay longer.

Discussion

The weakest link in ambulatory surgery is often the discharge of patients [7]. Many patients are detained unnecessarily despite fulfilling the discharge criteria. Most of these delays are due to non-medical reasons. Waiting to be reassessed by nurses, transport, and escort account for most of the non-medical reasons. Persistent discomfort is uncommon and only accounts for about 4 % of delay [8].

Most patients who have an ambulatory surgery procedure recover in 2 hours time [8]. If patients had a reasonable perception of their physical condition, the discharge process could be initiated by them. By taking up an active role in determining their discharge readiness, the lag time between full physical recovery and home discharge could be reduced.

A number of scoring systems have been used to help discharge patients after ambulatory surgery. To improve efficiency, it is possible to bypass the PACU and transfer patients directly from the operating room to the ASU. Song et. al. showed that bypassing the PACU after short ambulatory procedures could significantly decrease recovery time without compromising patient satisfaction; however, the overall nursing workload and the associated cost were not significantly affected [9]. Chung's Modified Post-Anaesthetic Discharge Scoring System is validated and commonly used to assess home readiness after the patient arrives in ASU [4]. It assesses patients' vital signs and common postoperative symptoms.

In our questionnaire, we asked for symptoms of physical discomfort such as pain, dizziness and PONV as these are common medical causes of Stage II recovery delay [10]. 48 patients (40.3%) complained of discomfort after surgery but only 10 (8%) of these felt they needed to stay longer. This correlates with other surveys suggesting patients continue to suffer from a variety of discomfitures after discharge from the ASU [11]. This may be related to patients' attitude toward postoperative care. In general, patients prefer to be at home if their discomfort can be tolerated [12]. Hong Kong is a small place with convenient transportation. Most patients do not need to travel long distances to access to public and private hospitals. In cases of emergencies, an ambulance service is usually available within 12 minutes [13]. This helps explain why some people prefer resting at home instead of in hospital for mild discomfort.

Some patients would have liked to see a doctor before being discharged home. In our study, 8 patients wanted to see an anaesthetist although they did not need to stay. Half of them were from the paediatric patient cohort although the numbers were too small 8 to suggest significance. None of the patients ended up with unplanned admission or readmission. Pamphlets have traditionally been used to provide patients with basic information about the surgery and anaesthesia. However, they have not been shown to be particularly useful [14] and have had problems of lack of precision, complicated jargon and difficult comprehension [15]. The use of a preanaesthetic video had been shown to be effective in educating and reducing anxiety in parents whose children underwent paediatric ambulatory surgery [16].

Unplanned hospital admission after ambulatory surgery could be used as an index for patient morbidity. Reported incidence varies between 0.1% and 5% [8], depending on individual units' discharge criteria. PONV was a significant contributor to the unplanned admission rate. This is consistent with observations that PONV is one of the leading reasons for delayed discharge and unanticipated admissions [2]. acute retention of urine after spinal anaesthesia was another reason for unplanned admission after inguinal hernia repair. There have been suggestions that patients could be discharged safely after spinal or epidural anaesthesia [17]. Surgical complications after stapled haemorrhoidectomy also contributed.

In conclusion, there was no significant difference between the patients' perception of their need to stay longer and the MPDSS score. Using patients' perception to indicate discharge would be a good alternative to reduce the length of stay. As maintaining the personnel running a ward constitutes the major expense in the health care, discharging patients efficiently helps reduce manpower need and so reduce surgical cost. Further studies on the impact of discharge time and cost after using patients' perception to aid discharge is warranted.

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Appendix I

The Modified Postanaesthetic Discharge Scoring System is a modified version of Chung's Post-Anaesthetic Discharge Scoring System for home readiness after ambulatory surgery. It has been employed in our hospital to aid ambulatory surgery discharge since 2002.

DAY SURGERY UNIT

Modified Postanaesthetic Discharge Scoring System (MPADSS)

1. Vital sign	**Score**
Within 20% of preoperative value	2
20-40% of preoperative value	1
40% of preoperative value	0
2. Ambulation	
Steady gait/no dizziness	2
With assistance	1
None dizziness	0
3. Nausea/Vomiting	
Minimal	2
Moderate	1
Severe	0
4. Pain	
Minimal	2
Moderate	1
Severe	0
5. Surgical Bleeding	
Minimal	2
Moderate	1
Severe	0

The total score is 10

Patients scoring _ 9 considered fit for discharge to home with escort

Appendix II
Day surgery discharge form

Date:

Operation:

Anaesthesia:

Time:

a. End of Anaesthesia:

b. Duration of Anaesthesia:

c. Discharge from PACU:

d. Discharge from ASU:

e. Time of assessment in ASU:

1. Is patient discharge less than 1 hour after discharge from PACU? YES/NO
2. Do you have any discomfort (nausea, vomiting, dizziness or pain)? YES/NO
3. Do you feel the need to see an anaesthetist? YES/NO
4. Do you feel you need to stay longer in hospital? YES/NO
5. Are you going home alone? YES/NO

If the answer is YES to any question 1-5, an anaesthetist or anaesthetic nurse would be referred before discharge.

Deep sedation and local anaesthesia: a safe and suitable association for outpatients undergoing vein stripping

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Abstract

Varicose veins of the lower extremity is a common disease surgically treated on ambulatory basis. We describe an easy and safe anaesthetic technique to perform vein stripping in a day surgery freestanding unit.

1259 patients were studied. A deep sedation was induced and maintained with propofol and alfentanil while the surgeons infiltrated the groin and anywhere they need to perform the phlebectomies with ropivacaine 0.5%.

Patients were manually ventilated only for two brief periods: before the injection of the local anaesthetic and during the stripping of the saphenous trunk. All patients had a prompt awakening and none of them required postanaesthesia care unit. The postoperative complications rate was generally low. All patients but two were discharged the same day of the surgery and none of them was readmitted. Light general anaesthesia coupled with local anaesthetic infiltration is a simple and reliable technique to perform vein stripping for day surgery patients.

Keywords: Ambulatory anaesthesia, anaesthetic techniques, vein stripping.

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Introduction

Nowadays, vein stripping surgery is performed mostly in a day surgery setting because it is a simple and relatively painless procedure [1]. Day-case surgery has several potential benefits over hospitalbased surgery, including cost containment and convenience for patients. Thousands of patients are treated every year for this pathology and it is important to examine the impact of anaesthetic techniques on the recovery process after ambulatory surgery because the choice of anaesthetic technique can affect postoperative morbidity at home. In addition, we must remember that customer satisfaction is the basic concept in any industry, including the healthcare industry and patient satisfaction is improved when the procedure is associated with a small incidence of side effects. The main aim of this study was to evaluate the reliability and safety of the combined use of propofol and alfentanil for light general anaesthesia in outpatients undergoing high ligation and stripping of the greater saphenous vein.

Methods

We reviewed the flow charts of one thousand two hundred forty-five ASA physical status I and II outpatients, aged 18-76 yrs, scheduled for high ligation, long saphenous vein stripping and Muller's hook phlebectomy operated between 2002 and 2005. Patients with clinically significant respiratory, cardiovascular, renal, hepatic diseases and active gastrointestinal reflux were excluded from partecipating. In addition, patients with a history of drug or alcohol abuse or morbid obesity (e.g. BMI > 35) were also excluded.

In the preoperative waiting area, an i.v. catheter was placed in the arm for the administration of fluids and i.v. medications. Baseline measurements included blood pressure and heart rate. Ketorolac 30 mg for preemptive analgesia and dexamethasone 4 mg for postoperative nausea and vomiting (PONV) prophylaxis were given twenty to thirty minutes before the induction of anaesthesia. Patients were then transferred to the operating room where a pulse oximeter, automated blood pressure cuff, and lead II electrocardiogram were placed.

All patients were premedicated with 2 mg of i.v. midazolam, about ten minutes before the beginning of the operation. Anaesthesia induction was obtained with propofol, 1-2 mg kg^{-1} i.v. and alfentanil, 1000 mcg i.v. For anaesthesia maintenance, i.v. propofol infusion was varied between 50 and 150 μg kg^{-1} min^{-1} to maintain a light level of anaesthesia. Soon after the induction of anaesthesia, the surgeon injected ropivacaine 0.5% in the groin and anywhere in the leg he needed to perform the Muller's hook phlebectomies.

A face mask was positioned to deliver 3-4 L min^{-1} of oxygen, and patients were manually ventilated for a few minutes until spontaneous breathing resumed, while the surgeon performed the high ligation of the saphenous vein at the groin. Just before the stripping of the saphenous trunk, another small bolus of propofol (0.5^{-1} mg kg^{-1}) was made. Most patients were actively ventilated again for a 4 few minutes and then they were left to resume their spontaneous breathing till the end of the operation, while the surgeon completed the procedure performing the Muller's hook phlebectomies as needed. Propofol infusion was stopped just before the skin suture, that is about ten minutes before the end of the surgical procedure.

When the procedure was over, if an Aldrete score > 9 was observed in the operating room, the patients were transferred directly to the ward. If this score was not achieved in ten minutes, patients were transferred to PACU. In the postoperative period we gave all the patients two tablets of paracetamol 500 mg and, if they felt pain we administered them ketorolac 30 mg i.v. as rescue drug. The incidence of any episode of PONV, or any other postoperative side effect such as pain, restlessness, confusion or shivering was recorded. The patients were considered ready for discharge when they had stable vital signs, were oriented, were able to ambulate unassisted, had no intractable

nausea or vomiting and had well controlled pain. All patients received 6 tablets of paracetamol 500 mg for the same evening and the day after the operation.

In a standardized postoperative telephone interview on the evening of the same day of the operation and on the morning of the first postoperative day, all the patients were asked to evaluate their level of pain on a four-point descriptive scale (0= none, 1 = mild, 2 = moderate, or 3 = severe). Moreover they were asked about nausea, vomiting, headache and other adverse events after their discharge from the day-surgery unit.

Data were presented as mean ± SD or median (range).

Results

Demographic and operative data are presented in Table 1.

Table 1 Patient Demographics and Intraoperative Data.

Male:female	337/922
Mean age, yr (range)	50.5 (20-76)
Mean weight (range)	70.7 (40-125)
Mean surgery duration, min (range)	48 (15 – 146)
Mean propofol, mg (range)	464 (150 – 1400)
Median hospital stay, min (range)	195 (60 – 472)

Data are presented as mean or median (range).

All patients reached an Aldrete score ≥9 in the operating room [2] and were transferred directly to the ward. Twenty-six patients were withdrawn from the study because we did not find them when we phoned them after discharge. The incidence of postoperative complications was generally low. In particular PONV occurred in few patients (Tables 2,3)

Table 2 Complications before discharge.

	Patients n = 1259
Nausea	11 (0.87 %)
Vomiting	12 (0.95 %)
Headache	5 (0.4 %)
Pain (rescue ketorolac)	24 (1.9 %)
Gastric pain	10 (0.8 %)

Data are presented as number (%).

Table 3 Complications after discharge.

	same day of operation patients n=1259	**next morning patients n=1259**
Nausea	10 (0.8 %)	3 (0.24 %)
Vomiting	7 (0.55 %)	3 (0.24 %)
Headache	18 (1.43 %)	8 (0.63 %)
Pain (mild)	22 (1.7 %)	48 (3.8 %)
Pain (moderate)	8 (0.6 %)	13 (1.1 %)
Pain (severe)	0	2 (0.16 %)

Data are presented as number (%).

The need for rescue analgesia [with ketorolac] before discharge was very low (1.9 %, Table 2). All patients were sent home with well-controlled pain and without intractable nausea or vomiting. Only two patients was admitted overnight and were withdrawn from the study. The first felt a heavy pain in the epigastrium associated with hypertension and sweating while she was in the step-down unit. An electrocardiogram and some laboratory exams were performed to exclude a cardiac ischemic attack. They were all normal and the following morning she was discharged. The other patient complained an atrial fibrillation during the operation.

Discussion

In Italy, day surgery practice may be considered a novelty. Hospitals have been developing programmes to carry out surgical procedures in ambulatory settings only recently. Vein stripping surgery is a common procedure that is well suited for outpatient surgery because it is a relatively painless operation, it lasts just an hour more or less, it causes only minimal blood loss and it does not need any neuromuscolar blockade.

Many anaesthetic techniques have been described for this surgical procedure. Among them, spinal anaesthesia is a very good alternative to the general anaesthesia but many patients are concerned about the complications that spinal anaesthesia may give. Even though they are told that the most severe complications related to this regional block are very rare, most patients usually prefer to choose another anaesthetic technique. Femoral and genitofemoral nerve block represents another option for this operation but it is somewhat more variable in response and sedation is often required to complete the procedure; moreover, the distribution of the anaesthesia in the groin is incomplete [3]. Tumescent anaesthetic technique may be another choice for stripping of the long saphenous vein in the office setting. It is safe and reliable [4] but it is time- consuming and less comfortable because it requires multiple injections of local anaesthetics, the anaesthesia may be incomplete and a supplementary sedation is frequently required [5]. The combination of propofol and alfentanil is widely used in outpatients [6] because these drugs have favourable pharmacokinetic characteristics and a synergistic interaction with regard to sedation and analgesia [7]. Moreover, the administration of a small dose of midazolam at the onset of the propofol infusion results in increased sedation, anxiolysis and amnesia [8].

Our vascular surgeons are very skilled and the surgical technique they use works well with the anaesthesiologic technique we have described. In our study the mean operating time was 48 minutes and the use of postoperative sclerotherapy avoided extensive phlebectomies. Consequently the 8 whole procedure was relatively short and painless. No patient underwent a bilateral vein stripping procedure but only one leg at a time was treated. As a result the postoperative pain was mild and well-controlled.

The short duration of surgery meant that forms of airway support more invasive than a face mask were not required. Usually patients were actively ventilated only for two brief periods: soon after the induction of anaesthesia and during the stripping of the greater saphenous vein when the plasma levels of propofol were higher. These episodes may represent brief periods of general anesthesia. During the other phases of the operation the patients could breathe spontaneously with oxygen supplementation.

As shown in Tables 2 and 3 the PONV rate was very low as well as the incidence of other common complications such as pain and headache. PONV incidence was probably so low for four reasons. First of all because vein stripping procedure does not belong to those surgical procedures like middle-ear, nose, throat or major breast procedures,

strabismus surgery, laparoscopies and laparotomies that may trigger this complication [9]. Secondly because when using alfentanil the incidence of PONV in the postoperative period may be less frequent with respect to fentanyl and sufentanil [10]. A third explanation may be represented by the prophylactic administration of dexamethasone [11] and last but not least because the pain was well controlled in nearly all the patients. It is well known that a strong pain is an important cause of PONV [12,13]. The patients' satisfaction with this anaesthetic technique is demonstrated by the fact that all of those (98 patients) who needed to undergo the same procedure in the other leg asked us to have the same anaesthesia again.

This study could be criticized because it is retrospective and because we did not include a control group but the major scope of this trial was to describe the safety and reliability of the anaesthesia technique we used in a huge number of patients. Another important limitation regards the time to discharge. Usually in our centre, patients are sent home when the surgeon, after ending the daily session, visits and checks them. The patients who are operated on early in the morning stay in hospital for a longer time than the patients who are operated on later. Unfortunately, we missed to record when the patients were "ready to discharge". Nevertheless the median duration of the postoperative period before discharging was 195 min (Table 1). Probably many patients operated early in the morning would have been discharged sooner.

In conclusion, we can affirm that light general anesthesia with propofol-alfentanil coupled with local anaesthetic infiltration is a simple and reliable technique for greater saphenous vein stripping procedure for outpatients.

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Optimising operating list scheduling in the day surgery department: can statistical modelling help?

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Abstract

Introduction: Optimal theatre usage involves maximal utilisation of scheduled theatre sessions without incurring overruns. The aim of this study was to explore the use of statistical techniques that might facilitate efficient operating list scheduling.

Methods: Historical theatre data relating to individual general surgery teams' day surgery sessions carried out over a seven year period at a London teaching hospital were acquired and subjected to linear statistical analyses.

Results: The relationship between the time spent operating on a list correlated strongly with the time taken to complete the list (r=0.617,P<001). The size of lists also correlated strongly with list duration (r=0.601,P<0.001). The strength of these relationships varied greatly for differing surgeons' sessions. A multi-level model was constructed for the prediction of list duration (the dependent variable) according to the size of operating lists (the explanatory variable) where operations and surgeons were designated first order and second order hierarchical ranks respectively. The model demonstrated large differences between the operative workloads that are appropriate for individual surgeons' 4-hour sessions. Two thirds of the model variance was attributable to the unpredictability associated with operations and one third to the surgeons.

Discussion: The correlation between list size, the time spent operating on individual surgeons' lists and list duration may have applications as robust markers of inefficient theatre time usage. Statistical modelling permits improved understanding of surgical service delivery in the ambulatory setting and could facilitate managerial decision making regarding appropriate surgeon specific list scheduling.

Keywords: workload, theatre utilization, multilevel modelling.

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Introduction

Operating theatres are resourced with nursing and anaesthetic personnel only during designated scheduled sessions. Efficient theatre usage relies upon optimal utilization of scheduled theatre time. As such the avoidance of under-utilized theatre time is essential. Conversely, operating lists that over-run the scheduled finish time often incur additional hospital and patient costs due to staff overtime payments and case cancellations respectively. In consequence, lists that finish either excessively early or late are to be avoided if efficient theatre usage is prioritised.

In the NHS long waiting lists for surgery exist within most Trusts [1,2]. The current government has attempted to expand day surgery services [3] as a means of enhancing elective operative capacity within the health service. To this end emphasis has been placed upon improving theatre efficiency within theatre units [4]. Ideally, all theatre sessions would be utilized to maximal capacity without ever over-running. In reality however, the operative workload achieved on differing surgeons' sessions, as well as their tendency to 'under-run' or 'over-run' the scheduled session time, varies significantly [5]. Although the workload achieved per session does, in part, reflect the operative speed of surgical teams it is also dependent upon other session factors many of which are beyond the direct control of the surgeon. Specifically, late starting sessions, early finishes and large time gaps between patients all serve to limit optimal session output. In contrast, list over-runs tend to enhance list output albeit at the expense of incurring additional costs.

Extreme caution should be taken regarding the unquestioned desirability of 'efficient' service performance in the absence of measures of clinical outcome. Certainly, effective service providers are not necessarily associated with good clinical outcomes. As such dangers potentially exist if managerial efforts focus on accelerating clinical service provision without the measurement of adverse clinical consequences. Under these circumstances it is perhaps more appropriate that managerial efforts focus on optimisation, rather than maximization, of session performance according to the differing abilities of individual surgical teams to manage operative workload.

Study Aim

This study specifically sought to investigate potential methods that might facilitate operating list scheduling on general surgical lists at an NHS day surgery centre. The ability of surgeon specific markers such as the size of an operating list and the historical workload achieved on surgeons' day surgery sessions were evaluated as potential predictors of list duration. The potential use of multilevel statistical modelling to enable surgeon-specific tailoring of list size to suit session duration was investigated.

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. General surgeons that had conducted >100 database operations were entered into the database on an individual basis.

Definitions

List length was defined as the time consumed from the start of the scheduled session to the removal of the surgical drapes of the last patient on the operating list. For example, the list length of a session scheduled to start at 2PM where the last case finishes at 5:30PM, is 3 hours and thirty minutes (i.e. 210 minutes). The start of the session was defined as the scheduled start time.

The *procedure time* of an individual case was measured as the time spent carrying out the operation i.e. from the start of anaesthesia until the removal of drapes at the end of the procedure.

The *cumulative list procedure time* was defined as the sum of the 'procedure times' of the constituent list procedures i.e. the time on the operating list actually spent performing anaesthesia or operating.

A scoring system for operating list size

A scoring system – *the Operative Score of Complexity Index (OSCI)* – was developed from all database procedures to quantify the size of general surgery operating lists.

Case scores (OSCI 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 OSCI 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. Average historical surgeon specific operating list size was described as the mean list size (+/- standard error) in OSCI units per 4-hour day surgery session.

Statistical Analysis

Correlation statistics: Pearson correlation analyses were used to evaluate the relationship between the cumulative procedure time for all cases on an operating list and session duration, as well as operating list size (measured in OSCI units) and session duration. For all tests of significance, $P<0.05$ was considered statistically significant.

Hierarchical theatre output models: multilevel regression analysis was used to develop surgeon specific regression curves that predicted for list duration as a function of operating list volume. The model was fitted with a Maximum Likelihood (ML) method known as IGLS (iterative generalised least squares) technique. All multilevel modelling was carried out using MlwiN software. The model construction, including definition of the model levels and predictors included, is described below in detail. The relative influence of predictor categories on utilization within models was investigated by changes in the –2 Log likelihood (IGLS deviance) statistic. 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.

Model construction: the regression equation employed considered list length as the dependent (y) variable with list volume as the predictor variable (x). A second-order hierarchical model structure was used with the 2nd level pertaining to individual surgeons and the 1st level to individual operations. The model was constructed according to the following equation definition:

$$List\ length_{ij} = \beta 0_{ij}\ constant + \beta 1_{j}\ list\ size_{ij}$$

Where: i=individual operations
j= individual surgeons sessions
List length = represents the time from the scheduled start of the session to the end of the last case (measured in minutes).
List-score = represents the size of the operating list (measured in OSCI units)

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 sessions scheduled to last 4 hours. 14 surgeons performed more than 100 database procedures (Table 1). 61.1% (n=5,083) of all operations were performed on afternoon operating lists. The median late start for operating lists was 32 minutes (interquartile range 17-48minutes, n=2,087). The median list over-run was 50 minutes (interquartile range 24 – 84 minutes, n=627).

The relationship between cumulative list procedure time and operating session duration

When all surgeons' operating sessions were considered collectively the cumulative duration of all of the procedures on the list (i.e. cumulative procedure time) demonstrated a clear relationship with the session duration (Pearson correlation $r=0.617$, $p<0.001$). Individually, all surgeons demonstrated a significant relationship between cumulative list procedure time and list duration but the strength of this relationship varied greatly (Table 2).

The relationship between list size and operating session duration

The size of operating lists correlated significantly with the duration of the session (Pearson correlation $r=0.601$, $p<0.001$). Once again all surgeons' lists demonstrated a clear relationship between list size and duration ($p<0.001$) but differed in the magnitude of this relationship (Table 2).

Optimisation of list volume to session duration – development of a multilevel statistical approach

Figures 1 and 2 demonstrate a scatter plot with regression line of list volume against operating list duration for all consultant surgeons' day surgery operating lists (n=2,092) that took place between the study dates. As one would anticipate a clear linear relationship between list volume (i.e. list-score) and list length was observed. The regression curve (illustrated in grey in Figure 2) represents a simple linear curve (i.e. non-hierarchical) for all general surgery consultant surgeons operating in the day surgery department at the study centre.

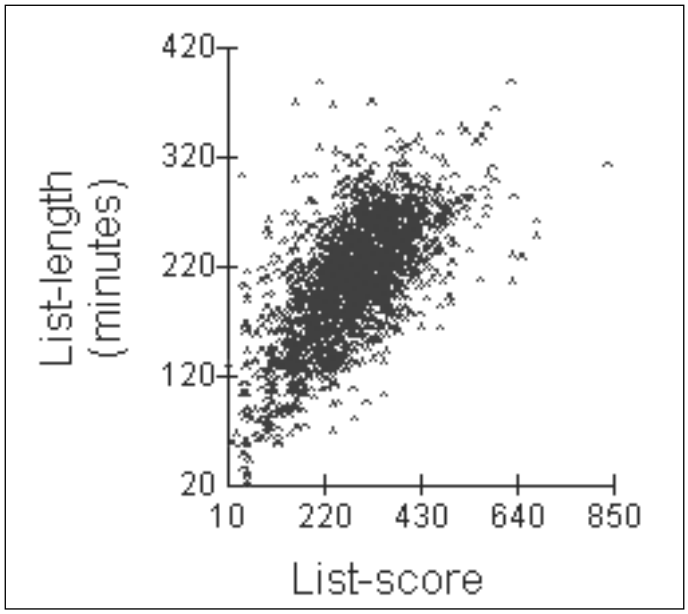
Use of the simple regression curve above permits that a crude estimate of achievable 'optimal' operating list volume can be derived when a hypothetical list length is set. For this model a target list duration of 4 hours was used. The latter session length was selected as 99.2% of all day surgery lists were of 4 hours duration. As such it represents a 4-hour session that starts on time and is performed by general surgeons at the study institution. Under these circumstances, the optimal list volume that predicts a 4 hour finish is 353 units (Figure 3). This 'volume' represents a crude estimate of the operative load that could be scheduled on a routine day surgery operating list and could be expected to finish at the end of a 4 hour operating

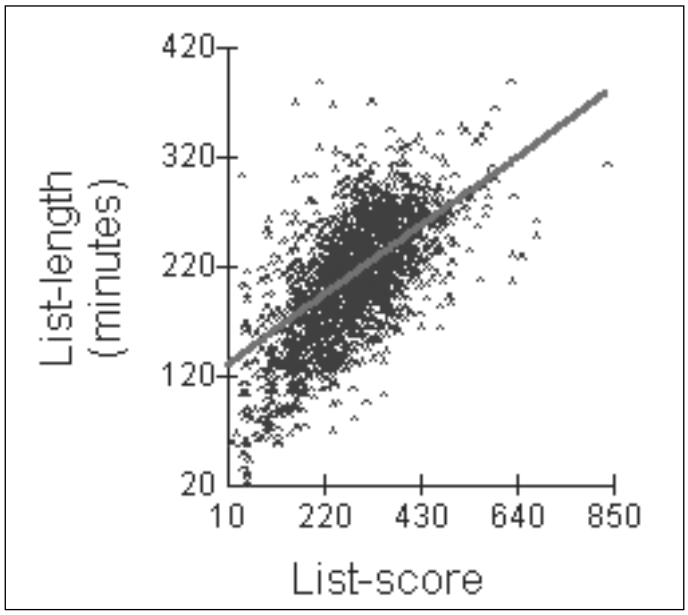
Table 1. The predicted list volume ranges for surgeons finishing their 4 hour operating lists within 20 minutes of the scheduled session finish time and their historical mean list scores per 4 hour session in the day surgery department.

Surgeon	No of cases	Predicted list-score (OSCI units) for: Surgeon No of cases 220 mins	260 mins	Mean list-score in OSCI units/ session (standard error)	% cases on overrunning lists
Surgeon 1	612	228	357	340.2(4.2)	59.9%(367/612)
Surgeon 2	146	285	486	343.8(7.3)	42.2%(62/146)
Surgeon 3	1269	270	418	317.1(2.6)	43.3%(551/1268)
Surgeon 4	384	362	463	325.1(5.4)	27.0%(104/384)
Surgeon 5	185	354	434	284.4(6.6)	9.1%(17/185)
Surgeon 6	249	254	334	253.3(4.5)	34.1%(85/249)
Surgeon 7	1106	365	578	379.4(3.2)	34.2%(378/1104)
Surgeon 8	158	340	445	272.5(7.7)	13.9%(22/158)
Surgeon 9	1332	309	455	321.5(2.6)	35.6%(475/1332)
Surgeon 10	679	262	370	256.4(4.2)	39.9%(271/678)
Surgeon 11	576	344	495	317(3.8)	29.0%(167/575)
Surgeon 12	118	235	336	246.6(6.4)	44.0%(52/118)
Surgeon 13	556	327	498	307.7(4.4)	31.8%(177/556)
Surgeon 14	288	281	410	274.0(4.1)	37.8%(109/288)

Table 2. The correlation between cumulative list procedure time (in minutes) and list length and list size (in OSCI units) and list length on individual surgeons' operating lists.

Session	Cumulative list procedure time and list length (r)	p-value	Operating list size and list length (r)	p-value
Surgeon 1	0.585	<0.001	0.622	<0.001
Surgeon 2	0.338	<0.001	0.377	<0.001
Surgeon 3	0.642	<0.001	0.618	<0.001
Surgeon 4	0.733	<0.001	0.737	<0.001
Surgeon 5	0.816	<0.001	0.873	<0.001
Surgeon 6	0.717	<0.001	0.673	<0.001
Surgeon 7	0.599	<0.001	0.569	<0.001
Surgeon 8	0.825	<0.001	0.799	<0.001
Surgeon 9	0.472	<0.001	0.591	<0.001
Surgeon 10	0.697	<0.001	0.715	<0.001
Surgeon 11	0.661	<0.001	0.585	<0.001
Surgeon 12	0.747	<0.001	0.692	<0.001
Surgeon 13	0.543	<0.001	0.545	<0.001
Surgeon 14	0.640	<0.001	0.554	<0.001





Figures 1(top) & 2 (bottom) Scatter-plot (Figure 1) with regression line (Figure 2) of list length against list volume in the day surgery department.

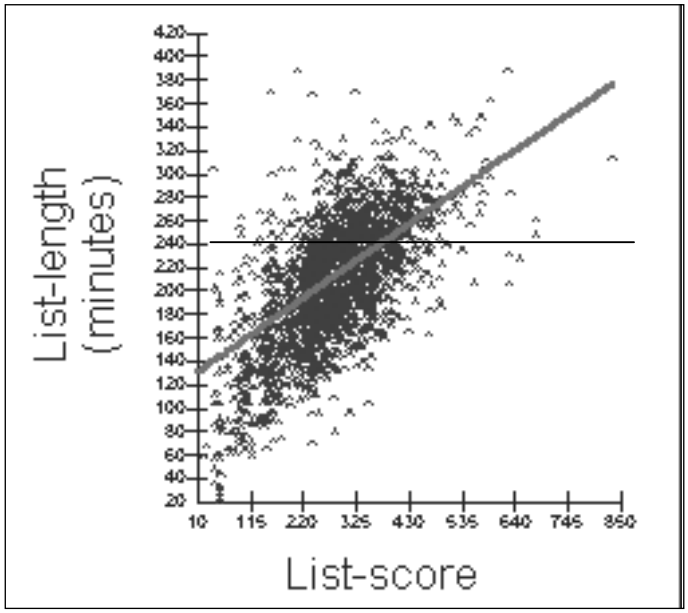


Figure 3 The optimal list volume for a 4 hour (240 minutes) session in the day surgery department.

session. Importantly, the above simple regression curve is non-specific regarding the individual surgeon's operating list. As such it represents only changes in list length (y) as a function of operative volume (x) for all general surgeons at the Trust. Adoption of the multi-level model structure below was consequently performed to incorporate the specific influence of differing surgeons' sessions in determining list duration.

Model equation*:

$\text{List length}_{ij} = \beta 0_{ij}\ \text{constant} + \beta 1_j \text{list size}_{ij}$

$\beta 0_{ij} = 118.9(7.64)$

$\beta 1_j = 0.335(0.025)$

Variance between surgeons of the constant $U_{0j} = 823.2(319.0)$

Variance between surgeons of the slope $U_{1j} = 0.009(0.003)$

Variance between operations $e_{0j} = 1412.9(21.9)$

* **Additional Notes** Figures in brackets correspond to the standard error. The regression equation permits a prediction of the list length (in minutes) through addition of the coefficient of the constant (i.e. 118.9) to the size of the operating list (i.e. the list-score in OSCI units) multiplied by the list size coefficient (i.e. 0.335).

Figure 4. illustrates the individual regression lines for all consultant surgeons operating in the day surgery department throughout the study period. From this multilevel approach it can be seen that surgeons differ in their operative output at 4 hours (i.e. 240 minutes on y-axis) as well as their abilities to handle increasing volume (i.e. the slope of their respective curves).

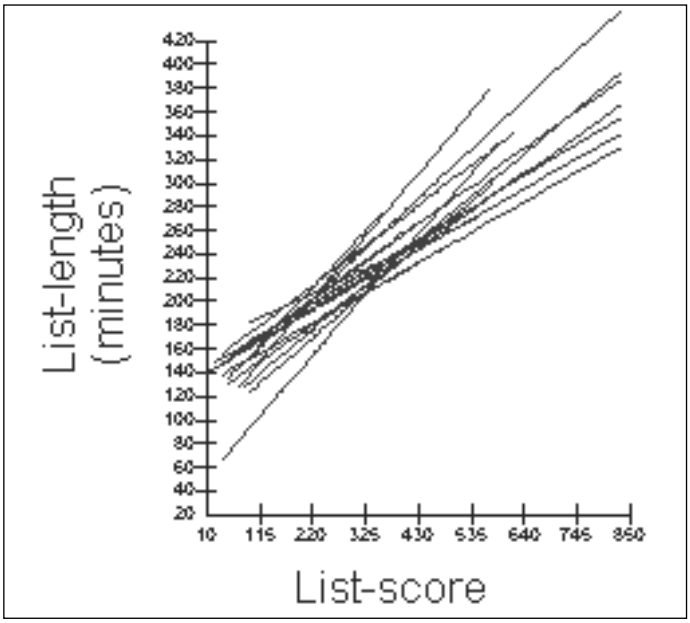


Figure 4 Individual consultant surgeons' regression curves for list duration according to list volume.

Multi-level modelling was used to theoretically investigate whether 'optimal' operating list volume could be estimated. To this end, practical parameters of the desired time zone within which to finish an operating list were chosen. In this instance 20 minutes either side of the 4-hour session duration was used as the upper and lower predictors of session volume. Figure 5 illustrates the predicted range of list score for a specific surgeon (Surgeon 5 - regression line in grey) at 220 and 260 minutes respectively. Table 1 demonstrates the predicted 'appropriate list volume' ranges for all consultant surgeons' sessions in the day surgery department – assuming that they are operating in 4 hour sessions and the session duration parameters remain at 20 minutes either side of the finish time. In addition,

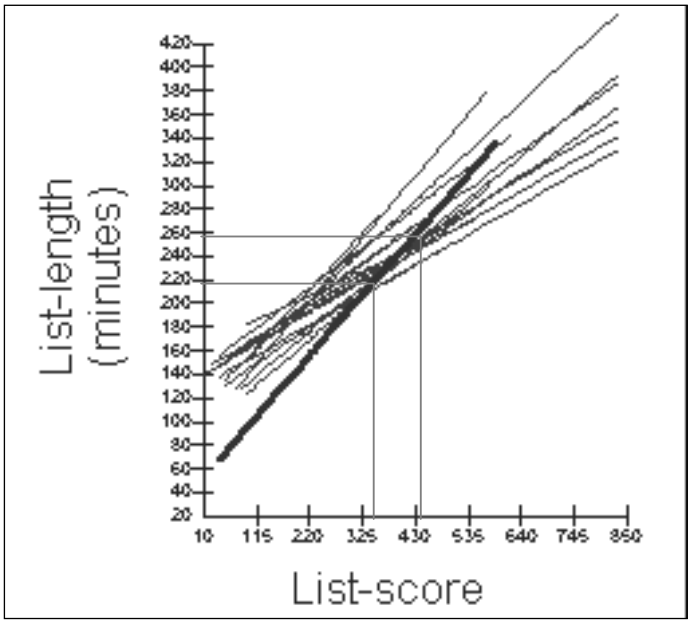


Figure 5 The predicted list volume range for Surgeon 5 (in bold) to finish a 4 hour operating list within 20 minutes of the scheduled session finish time.

the historical mean list scores for surgeons operating on 4 hour day surgery sessions is tabulated. Figure 6 represents examples of operating lists that are appropriate to the differing predicted 4 hour list capacities of surgeon 7 and surgeon 12 according to the multi-level model.

Discussion

Due to the financial costs associated with staffing a theatre complex theatre usage is expensive [6]. Attempts are consequently made to limit the time that theatres are under-utilized as this represents a missed opportunity to perform operations. In addition, significant staffing costs are associated with theatres that overrun [2]. Obviously, the prevention of overruns for the purpose of efficient theatre usage requires balancing against other managerial goals such as the need to achieve waiting list targets. The specific costs associated with chronic overruns are difficult to generalise as they differ amongst hospitals. Direct costs relate to staff overtime payments and will depend on local staff contracts. Indirect costs arise from staff absenteeism, recruitment difficulties and agency costs.

Overall, an optimal theatre list workload represents the operative volume that will fully utilize the list yet finish precisely at the end of its scheduled duration. Unfortunately, the variation associated with operative procedures renders complete accuracy of list duration impossible to predict [7]. Some investigators have found that reasonable prediction of the time taken for a specific surgeon to complete a series of operations is possible when historical data is available [8-13] although it is questionable whether this predictive ability is of sufficient strength to be of practical value [14]. In our own study a strong relationship was identified between the cumulative list procedure time and list duration. Although a clear relationship is identifiable it does not necessarily follow that this method permits a sufficiently reasonable prediction of optimal list volume for all surgical teams in order to be of managerial value. Specifically, the degree that procedure time correlated with list length varied broadly between different surgeons' lists ($r = 0.338$ for surgeon 2 versus 0.825 for surgeon 8). As such, although prediction of an optimal list schedule on the basis of historical procedure times might suffice for surgeon 8 it is too inaccurate to be of value for surgeon 2's list. Despite this apparent weakness even the identification of a poor relationship, such as the one that exists for surgeon 2, might alert operational decision makers to question why this has arisen. In consequence, remediable list events such as inconsistent late starts or erratic time gaps between patients might be identified as the basis to this poor relationship and, once highlighted, corrected. Interestingly, the strength of the relationship (i.e. the value of the coefficient) between cumulative list procedure time and list length is similar to that observed between list-score (i.e. size of the operating list) and list length even when individual surgeons' operating lists were considered. Although, on one level this might seem unsurprising as list score, like cumulative list procedure time, is a based upon historical procedure times it is essential to note that these two variables do fundamentally differ. Specifically, an OSCI score is a score assigned to a specific procedure based upon the historical time that it historically took all database surgical teams to perform that operation whereas procedure time is the amount of time to carry out an operation by a given surgical team. The fact that cumulative list procedure time and list score demonstrated such similar strength relationships with list length when individual surgeons' lists were analysed (i.e. broadly similar r values) probably denotes the uniform complexity of the operative work in the day surgery department. More precisely, the strength of their respective relationships with list length was mostly defined by the inconsistencies of the time spent 'not operating' on a list rather than inconsistencies of time spent 'operating'.

Accurate prediction of an appropriate workload to optimally consume scheduled operating time would undoubtedly facilitate planning of service delivery. In this study a technique is demonstrated that uses hierarchical statistical modelling to this end. Importantly, however, the variance in the multi-level model that arose from the operations (i.e. the level 1 variance), as opposed to the surgeons (the level 2 variance), suggests that total reliance on this method might be

Operating list 1 – suited to surgeon 12	**Operating list 2 – suited to surgeon 7**
Right Inguinal Hernia Repair (106 units)	Haemorrhoidectomy (70 units)
Left Inguinal Hernia Repair (106 units)	Right Inguinal Hernia Repair (106 units)
Haemorrhoidectomy (70 units)	Right Inguinal Hernia Repair (106 units)
	Examination Under Anaesthesia (48 units)
	Examination Under Anaesthesia (48 units)
	Examination Under Anaesthesia (48 units)
	Exc. Sebaceous cyst (42 units)
List-score = 278 units	**List-score = 468 units**

Figure 6 An example of the differing 4 hour operating list capacity for Surgeon 7 and Surgeon 12.

unrealistic for scheduling future surgeon specific list volumes. Whilst it might offer accurate prediction for certain surgeons' lists it may be too inaccurate for others. Despite this the modelling approach does give an important overview as to how individual surgeons working within a similar field deliver their ambulatory operative service (Figure 6).

In contrast to complex statistical modelling use of mean historical session productivity rates (i.e. the workload, measured in OSCI units, achieved by individual surgical teams on historical operating lists) potentially represents a far easier tool to construct. It is of less practical value than the hierarchical approach for two reasons. Firstly, mean historical session productivity rates do not give decision-makers an insight into how differing surgical teams within the same field handle increasing operative volume (i.e. the slope of the regression curve in the multi-level model). This could be important for tactical decision making such as for choosing which surgical team to incentivise with additional theatre time in order to meet operational targets. Mean historical productivity rates includes the historical tendency for surgical teams to over-run or under-run their lists. Certainly the surgical teams with the highest overrun rates demonstrated mean productivity rates (OSCI scores per session) that were higher than those that would have been expected according to the multi-level model (i.e. well above the mid-point of the 220 –260 minute range). For this reason, efficient resource usage involves optimisation of scheduling to reduce the list size for teams that tend to 'over-run' their lists and enhance the list size for teams that tend to under use the potential of their lists.

In order to answer the question posed in the title of this thesis a pragmatic approach to operating list planning is required in ambulatory centres. Certainly, direct extrapolation of the specific study findings from our institution to other NHS centres cannot be reliably made. It is possible to incorporate the study findings into a loosely applicable algorithm that might facilitate managerial decision making regarding operating list scheduling.

In the first instance attention must focus on the generation of reliable operating list volumes. This entails ensuring that patients that are listed for surgery attend for their operations and are not cancelled on the day of their expected operations. Obviously, efforts aimed at scheduling an optimal operating list volume specifically tailored to each surgical team's service performance record is futile if the desired cases fail to attend or are then cancelled. To this end the Modernisation Agency have published a toolkit that offers practical solutions to these specific problems [15]. Following this, attention should focus on poorly performing sessions. Firstly, poor operating list service performance needs to be diagnosed. In our opinion, the use of measures of historical workload or utilization of session performance should be avoided as these markers only give an idea of what has been carried out on the list and make no allowance for the differing speeds of surgical teams and whether surgical teams achieve their workload by consistently over-running the intended session duration. Furthermore, the apparent poor performers highlighted by this system could represent those surgical teams that compromise the speed of service delivery but have the best clinical outcomes and dedicate their list to the teaching of junior personnel. As such, it is our opinion that these methods should be avoided. We propose that the correlation between cumulative list procedure time and list length could represent a better marker of how well surgical teams use their theatre time. Similarly, the relationship between list workload (as measured by either the OSCI method or another equivalent case-mix adjusted measure of operative workload) and list duration could also be used. An investigation into the practical value of these qualitative markers, or 'coefficients' of list performance, and their comparison to theatre utilization, is currently underway. Once sessions where a loose relationship between time spent operating and list duration have been identified factors preventing efficient theatre time utilization can be tackled. Involvement of surgical teams themselves at this stage could facilitate this process. By improving the relationship between cumulative procedure time and list length better prediction of how list volume will translate into session length is afforded. It will enhance the predictability associated with the 'non-operative' time on the list i.e. the time intervals at the start of the list and the gaps between operations. It will not alter the unpredictability associated with operations' durations themselves. Once the former unpredictability that can be controlled has been controlled another method is required to determine how much to schedule on individual surgeons' lists. Although, in this study a complex statistical model was constructed for this purpose it is recognized by the authors that this is beyond the need or scope of what is required at a managerial level in most departments. In reality, a 'trial and error' approach to optimising volume on individual surgeons lists is likely to be equally effective once the handling of operative volume on poorly performing lists has been improved.

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