Laparoscopic cholecystectomy: the anaesthetist's point of view

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Although the surgical advantages of laparoscopic cholecystectomy (LC) have been reported, the anaesthetic problems associated with this new technique have not been well described. For the first 101 patients undergoing laparoscopic cholecystectomy at our institution, we prospectively documented intraoperative critical observations and adverse outcomes in the PACU (Post-Anaesthetic Care Unit). In order to put the magnitude of these problems into perspective, we compared, in an identical manner, the anaesthetic management and outcomes of two more familiar surgical groups, cholecystectomy by laparotomy (C), and laparoscopy for gynaecological examination (LG). For this new procedure LC, intraoperative hypotension (12.9%), and PACU hypothermia (31.4%), nausea and vomiting (12.9%) and desaturation (10.9%) were common but excessive pain (4.0%) was rare. Patients undergoing C, who were older and less healthy, tended to have fewer incidents of OR hypotension (3.4%) but in the PACU experienced more desaturation (25.9%) and excessive pain (12.9%) ($P \leq 0.05$). The younger and healthier LG group had fewer problems, less OR hypotension (0.4%), and less PACU nausea and vomiting (5.7%) and desaturation (1.3%) ($P \leq 0.05$). However, the LG group had a similar incidence of excessive pain (4.4%). We have documented considerable postoperative anaesthetic benefits for patients undergoing laparoscopic cholecystectomy compared with conventional cholecystectomy. However, there is still considerable perioperative morbidity compared with gynaecological laparoscopies. Now that specific problems have been identified, they may be amenable to specific anaesthetic interventions.

Les avantages chirurgicaux de la cholécystectomie laparoscopique (CL) ont déjà fait l'objet de plusieurs observations mais ce n'est pas les cas des difficultés d'ordre anesthésique associées à la méthode. Dans notre institution, pour les 101 premiers patients subissant cette intervention, nous avons mené une étude prospective peropératoire portant sur la gravité de certains événements et les incidents défavorables survenus en la salle de réveil. Dans le but d'analyser l'importance de ces problèmes, nous avons comparé sous des approches identiques la condiute anesthésique et les résultats de deux catégories d'interventions mieux connues, la cholécystectomie par laparatomie (C) et la laparascopie gynécologique (LG). Pour la nouvelle intervention CL, l'hypotension peropératoire (12,9%) et l'hypothermie en salle de réveil (31,4%) les nausées et vomissements (12,9%) et les épisodes désaturation (10,9%) ont été fréquents mais la douleur intolérable (4,0%) a été un phénomène rare. Quant aux patients qui ont subi C, en général plus âgés et en moins bonne condition, ils ont éprouvé moins d'épisodes hypotensifs en salle d'opération (3,4%) mais, en salle de réveil, plus d'épisodes de désaturation (25,9%) et de douleurs intolérables (12,9%) ($P \leq 0,05$). Le groupe plus jeune et en meilleure santé LG a connu moins de problèmes, moins d'hypotension peropératoire (0,04%) et moins de nausées, vomissements (5,7%) et d'épisodes de désaturation (1,3%) ($P \leq 0,05$) en salle de réveil. Cependant le groupe LG a connu une incidence égale de douleurs intolérables. Nous avons documenté des bénéfices post-opératoires considérables anesthésiques pour les patients subissant la cholécystectomie laparoscopique lorsque nous les avons comparés à la cholécys-tectomie conventionnelle. Cependant, la morbidité périopératoir demeure élevée lorsqu'on fait la comparaison avec la lapara-scopie gynécologique. Maintenant que des problèmes spécifiques sont identifiés, on peut entrevoir des solutions anesthésiques spécifiques.

Key words
COMPLICATIONS: morbidity, anaesthetic;
SURGERY: laparoscopy.

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Recent surgical reports have shown that cholecystectomy by laparoscopy (LC) is associated with a shorter hospital stay and improved patient satisfaction.[1-4] However, no studies of patients undergoing LC have examined anaesthesia-related critical observations in the operating room (OR) or postoperative adverse events in the post-anaesthetic Care Unit (PACU).

In this study, we document the range of adverse anaesthetic outcomes associated with LC at our hospital and make clinical management recommendations based on these observations. Since there has been little experience with this new procedure, the scope and extent of post-anaesthesia adverse events associated with LC is largely unknown. To put the rate of complications during and following LC into perspective, we compared perioperative characteristics, intraoperative management and critical observations in the OR and complications in the PACU for patients who underwent LC with patients who had conventional cholecystectomies (C) and gynaecological laparoscopies (LG) over a one-year period (Jan 1/91 to Dec. 31/91).

Methods

Following approval of the Human Ethics Committee, information was obtained prospectively from anaesthetic (OR) and PACU records as part of an anaesthesia follow-up programme.

Patient population

For one year information was collected on all consecutive patients undergoing laparoscopic cholecystectomy, conventional cholecystectomy, and gynaecological laparoscopy. Excluded from the analysis were patients who underwent an additional surgical procedure during the same surgical time. To keep the LG group as uniform as possible, gynaecological patients who had a tubal ligation, a dilatation and curettage during laparoscopy, or a laparoscopy prior to a laparotomy for definitive surgical procedures were eliminated. As well, patients who had laparoscopic cholecystectomies which were converted to open laparotomy or patients who had a conventional cholecystectomy with a common bile duct exploration were not included in the comparative analysis. Patients who required an unanticipated laparotomy for post-operative complications (at St. Michael's Hospital only) following LC, C or LG were also identified.

Intraoperative and PACU management

No attempt was made to standardize the anaesthetic management by multiple anaesthetists during these three procedures. All patients were monitored continuously with an ECG, BP cuff (automatic when available), pulse oximetry and sampling of end-tidal CO_2. Temperature monitoring and use of HME (heat and moisture exchanger) were at the discretion of each anaesthetist. The tracheas of all patients were intubated while asleep and their lungs ventilated during the procedure.

Surgical technique during LC was standardized and included continuous flow of carbon dioxide into the abdomen to maintain a pneumoperitoneum at constant pressure. The head up position was used to drop the bowel contents away from the liver bed. Laser coagulation was not available for any cases. Saline lavage (less than 500 ml) instilled at the completion of the procedure was aspirated.

Routine PACU management included recording of vital signs and admission and discharge scores,[5] and medications (antiemetics and narcotics) as required. Oxygen (40% FIO_2) was administered on admission and discontinued half an hour prior to discharge, while saturation monitoring was continuous during the entire PACU stay. Skin temperature was obtained for patients in whom the procedure had lasted more than two hours. If oxygen saturation in the PACU decreased below 90% at any time, interventions included airway manipulation, increased oxygen concentration, or continued oxygen therapy after discharge from PACU.

Data collection

New OR and PACU records with carbonless copies had previously been developed and piloted to document objectively case mix (sex, age, weight, etc.), preoperative medical illnesses, ASA status, and intraoperative and postoperative management (drugs, techniques, monitors, etc.). As well, each record contained a list of over 40 critical observations in the OR and adverse events in the PACU (occurrences which were less than ideal) along with a concise definition printed directly on the record.[6] Definitions of the main critical observations and adverse events of interest are given in the Figure.

Anaesthetists completed the preoperative assessment and documentation of intraoperative management on the OR record and noted intraoperative critical observations. The PACU nurses recorded assessment scores on arrival and discharge, drugs given, physiological variables, discharge location from the PACU and adverse events. Both groups, anaesthetists and PACU nurses, were instructed on standardized definitions and recording of variables before the start of this study. Charting for all patients attended by an anaesthetist in our OR, for all procedures (n = 13,678/year), were completed and reviewed systematically the day following the surgery by a research nurse and a clinical anaesthetist. Queries concerning specific omissions were made by these reviewers and records completed as required.

Critical observations in OR	
Hypotension:	BP < 80 mmHg for more than 5 min, and/or active treatment by a vasopressor
Tachycardia:	Sinus rhythm > 120 beats per minute for 10 minutes
Hypercarbia:	End tidal CO_2 > 55 mmHg for 5 min or $PaCO_2$ > 50 mmHg
Dysrhythmia:	New atrial fibrillation, supra ventricular tachycardia, heart block *or* > 5 premature ventricular contractions per minute for 5 minutes
Desaturation:	SaO_2 < 90% for 1 min *or* PaO_2 < 60 mmHg at any time
Hypothermia:	< 34° C skin or < 35° C nasal/oral
Adverse events in PACU	
Hypovolaemia:	Requiring any fluid bolus (including blood products) in the PACU
Hypotension:	< 20% pre-op systolic > 15 min *or* < 50% pre-op systolic on one reading
Nausea and vomiting:	Volunteered complaints of nausea or observed active retching, requiring antiemetics or n/g tube insertion
Excessive pain:	Moaning or writhing in pain at any time in the PACU or initial care dominated by pain control
Desaturation:	SaO_2 < 90% at any time and/or cyanosis and/or PaO_2 < 60 mmHg
Hypothermia:	Skin temperature < 35° C

FIGURE Definitions of outcomes.

Database

All data from the carbonless copies on preoperative conditions, anaesthetic management and PACU stay, as well as critical observations and adverse events listed by both OR and PACU personnel were entered into a computerized database, using dBase IV software.[7] Surgical procedures were coded by the ICD.9.CM system. New ICD.9.CM codes specific for laparoscopic cholecystectomy and laparotomy for cholecystectomy following failed laparoscopy were included, as well as the existing codes for cholecystectomy (ICD.9.CM, 51.22) and laparoscopy for gynaecological examination (ICD.9.CM, 54.21). In order to determine in-hospital mortality and length of stay, files from the hospital medical records department were merged with our database files.

Data analysis

The distribution of preoperative factors, intraoperative anaesthetic management, postoperative discharge location, and frequency of critical observations in the operating rooms and adverse events in the PACU were determined for each of the LC, C, LG surgical groups. Mean OR duration (measured from the time the anaesthetist attended the patient until the patient arrived in the PACU) and the hospital mean and median length of stay (determined from the day of surgery), were calculated. Comparisons between the three groups were done using the chi square statistic or unpaired t test with statistical significance being accepted at the $P \leq 0.05$ level.

Results

During the one-year period, there were 101 patients undergoing LC, 88 C and 454 GL. In addition, there were six patients in whom laparoscopic cholecystectomy was converted to open laparotomy, three for anatomical reasons, one for severe inflammation and two for dense adhesions (5.4% conversion rate).

Preoperative characteristics

The case mix for the three procedure groups revealed differences in proportions of patients by sex, age, ASA status, weight, history of previous health problems and current medication prior to surgery (Table I). The C group was older, had more patients with ASA scores of 3 and 4, and had more preoperative illnesses (hypertension, diabetes and smoking history). On the other hand, the LG group (all women by definition) were younger, lighter, healthier and fewer took preoperative medications. Oxygen saturation measured in the OR breathing room air prior to induction of anaesthesia was also different. In the LC group, there were no patients with acute cholecystitis or pancreatitis and no emergency procedures. All LC and C were inpatients, whereas 419 (92.3%) of the LG were outpatients.

Intraoperative management

Patients in the LC and C groups were treated in a similar

TABLE I Preoperative characteristics of the three groups: laparoscopy cholecystectomy (LC), cholecystectomy (C) and laparoscopy for gynaecological examination (LG).

Characteristic	*LC n = 101*	*C n = 88*	*LG n = 454*
% Women	78.8	68.2	100.‡
% Age >60 yr	22.8	40.9†	0.‡
% ASA III or IV	7.2	24.1†	0.2‡
% Overweight:			
– men > 100 kg	17.8	24.7	6.7‡
– women > 80 kg			
% History of any illness	46.3	67.1†	32.8*
% Hypertensive	13.7	22.0*	1.7‡
% Diabetic	3.2	12.2*	0.5*
% Current smokers	21.1	35.4*	20.5
% Taking any meds pre-op	43.2	51.6	15.9‡
O_2 saturation on room air (mean and SD)	97.2 ± 1.9	96.4 ± 1.8*	98.1 ± 1.3‡
% Emergency surgery	0	13.6	3.1

Patients in C and LG groups are compared to those in the LC group. *$P \leq 0.05$, †$P \leq 0.01$, ‡$P \leq 0.001$.

TABLE II Intraoperative management for LC, C, and LG

Management	*LC n = 101*	*C n = 88*	*LG n = 454*
% Narcotic pre-med	39.6	30.7	1.8‡
% Antiemetic pre-med	40.6	30.7	1.5‡
% With automatic blood pressure	69.3	58.0	69.0
% Having temperature monitoring	80.2	77.3	37.2‡
% With nasogastric tube	5.0	10.2	0.2
% With HME exchanger	46.5	38.6	9.7‡
% Propofol use	5.9	1.1	19.4‡
% Antiemetic *iv* in OR	58.4	55.7	77.5‡
OR fentanyl – mean dose ($\mu g \cdot kg^{-1} \cdot hr^{-1} \pm SD$)	1.09 ± 0.82	1.19 ± 0.63	1.71 ± 0.95‡
OR duration (hrs. ± SD)	2.24 ± 0.6	1.94 ± 0.58‡	0.76 ± 0.23‡

Patients in LG and C groups are compared to LC.
‡$P < 0.001$.

TABLE III Intraoperative critical observations

	LC n = 101	*C n = 88*	*LG n = 454*
% OR any event	19.8	14.8	3.7‡
% Hypothermia if temperature measured	6.2	2.9	0
% OR hypotension	12.9	3.4	0.4‡

Patients in LG and C groups are compared to LC.
‡$P < 0.001$.

manner (Table II). However, fewer pre-medications and less frequent use of temperature and HME were recorded for the LG patients. Drugs for anaesthetic induction and maintenance were similar in the LC and C groups (proportion receiving enflurane and *iv* anti-emetics, dimenhydrinate and droperidol). Urinary catheters were used infrequently in all groups. The use of fentanyl (99% of patients in both groups) and the mean dose of fentanyl used during the surgical procedure (expressed as $\mu g \cdot kg^{-1} \cdot hr^{-1}$) were similar in the LC and C patients. However, during LG, there was an increased use of propofol for induction (19.4% of patients), more frequent use of intraoperative antiemetics (dimenhydrinate and droperidol) and a higher mean dose of fentanyl (used in 98% of patients). The OR duration was shorter for both the C and LG groups compared to the LC procedure ($P < 0.001$). The minimum and maximum times for LC surgery were 1.1 and 4.2 hr.

PACU management

All but three patients (all in the C group, who were transferred directly to the Intensive Care Unit for monitoring and ventilation), were observed in the PACU following surgery. For cases with anaesthetic times greater than two hours, temperature was recorded in the PACU (87% of LC patients, $n = 54$ and 77% of C patients, $n = 22$). No cases of LG were longer than two hours. In 92%, 78% and 98% of LC, C and LG patients leaving PACU on oxygen saturation while breathing room air was available prior to discharge. In the PACU arrival and discharge scores were similar following the three procedures. Postoperative narcotics in PACU (intravenous morphine or meperidine) were used for 67.3% of the LC patients, but more frequently in the C group (94.1%) and less commonly in the LG group (20.7%) ($P < 0.001$). When these narcotics were used in the PACU, the mean doses used for each patient ($mg \cdot kg^{-1}$) were similar. Antiemetics in PACU (dimenhydrinate), given for complaints of nausea or active vomiting or retching, were used at similar frequencies (19.8% and 28.2% respectively) for the LC and C groups but less frequently following LG (6.8%) ($P < 0.001$).

Intraoperative critical observations

Critical observations in the OR relevant to the anaesthetist are noted in Table III. The rate of any critical observation occurring in the OR was higher in patients undergoing LC and C (19.2% and 14.8% respectively) than LG (3.7%) ($P < 0.001$). The incidence of hypotension in the OR (BP < 80 for more than five minutes and/or vasopressor therapy) was also more common during LC (12.8) than LG (0.4%) ($P < 0.001$). Although not statistically significant, the trend suggested that the incidence of hypotension in the OR during C was also less (3.4%) than LC. Hypothermia when temperature was recorded intraoperatively was uncommon (6.2% for LC, 2.9% for C and 0% for LG). During LC only one case of elevated airway pressure was described, and there were no cases of dysrhythmia, hypercarbia, or excessive bleeding.

PACU outcome

In the PACU, all events (any type) were common, but less frequent during LG (52.5% LC, 58.8% C, 20.0% LG, $P < 0.001$) (Table IV). In the LC patients, common events included hypothermia (31.4% of 54 cases longer than two hours in whom temperature was measured), nausea and vomiting (12.9%) desaturation (10.9%) and use of narcotics in the PACU (67.3%). Following C, desaturation (25.9%), excessive pain (12.9%), and requirements for postoperative narcotics (94.1%) were more frequent ($P < 0.05$). During oxygen therapy this desaturation occurred with similar frequency in all three groups (3.0%, 8.2% and 1.1% following LC, C and LG respectively), but differences in the incidence of desaturation on room air were noted when oxygen was removed prior to PACU discharge (10.7%, 27.3%,0.2% for LC, C and LG respectively, $P < 0.05$). The mean value of the lowest saturation while breathing room air measured in PACU prior to discharge

TABLE IV PACU adverse events for LC, C, and LG patients

	LC *n = 101*	*C* *n = 85*	*LG* *n = 454*
% Patients with any event	52.5	58.8	20.0‡
% Hypothermia§	31.4	11.8	
% Nausea/vomiting	12.9	16.4	5.7†
% Desaturation at any time	10.9	25.9†	1.3‡
% Excessive pain	4.0	12.9*	4.4
% Requiring narcotics	67.3	94.1†	20.7†

Patients in LG and C groups are compared to LC.
§Only in patients whose anaesthetic time was greater than two hours and temperature was recorded.
*$P < 0.5$, †$P < 0.01$, ‡$P < 0.001$.

was different among groups (94.5 ± 2.7% for LC, lower for C 92.6 ± 3.5%, and higher for LG 97.2 ± 2.2%, $P < 0.001$). For patients in the LG group, nausea and vomiting and desaturation at any time period were less frequent than for LC patients ($P < 0.05$). Excessive pain was noted at frequencies similar in both the LC (4.0%) and LG (4.4%) groups. However, LG patients required narcotics less frequently. Hypotension, hypovolaemia and shivering in the PACU were uncommon in all three groups.

Hospital outcomes

Following LC, two patients were returned to the operating room at three and five days respectively for repair of bile leak. No subsequent surgical procedures relating to the initial procedures were necessary at our hospital for patients who had C or LG.

Length of hospital stay (calculated from the day of surgery) was longer for patients in the C group but similar for inpatients in the LG group compared with those in the LC group (Table V). The median length of stay was different for each group, two days for LC, five days for C, and one day for inpatient LG. There was no in-hospital mortality in any of the groups. Seven patients from the C group were transferred to the intensive care unit postoperatively (three for pulmonary ventilation and monitoring and four for monitoring alone). One patient from the LC group required tracheal reintubation in the OR for bronchospasm and desaturation. A postoperative chest *x*-ray in the PACU revealed a left lower lobe infiltrate secondary to aspiration. She was transferred to the intensive care unit and made an uneventful recovery after 24 hr of postoperative ventilation.

TABLE V Hospital outcomes for the three groups (LC, C and LG)

Variable	*LC*	*C*	*LG*
Proportion of cases who were inpatients (%)	100	100	13.4‡
Mean length of hospital stay (days ± sd) (inpatients only)	2.50 ± 5.20	6.60 ± 5.09‡	1.60 ± 1.23
Median post-op stay (days)	2	5	1
Transfer to intensive care unit (number of patients)	1	7	0

(‡$P < 0.001$)

Discussion

Similar to other studies, our data have shown a decrease in hospital stay for LC compared with conventional C as well as similar rates of conversion to open laparotomy and re-operation for bile leaks.[8,9] In our centre, patients admitted for LC were healthier and younger than those undergoing C, possibly a result of case selection during the learning period for this new technique by five surgeons. Surgical experience before the onset of this study was limited to supervised cases (15) performed by one surgeon in another hospital and experience with animal models. The senior surgical resident who assisted with the majority of our cases had completed 150 cases at another institution. The LG group was used in this study as a comparison group of relatively healthy patients to show that differences in the rate of adverse events found between LC and C cannot be ascribed only to patient selection. In the PACU, LC patients were less prone to excessive pain, required narcotics less frequently and had a lower incidence of hypoxia when compared to patients in the C group. Despite these advantages, there was clinically important intraoperative and postoperative morbidity associated with this new procedure. Hypotension was a common problem in the OR during LC procedures. In the PACU, many LC patients were hypothermic and nausea and vomiting were frequently reported.

The anaesthetic literature on LC is limited to successful case reports[10,11] and incidental reports of complications. Case reports have described problems such as post-operative bleeding,[12] air embolism from a Nd:Yag laser,[13] and nausea and vomiting.[14] Published series have reported the beneficial respiratory effects of LC compared with conventional cholecystectomy by laparotomy (C).[15,16] However, our study is one of the first to describe the incidence of anaesthetic complications in a large consecutive group of patients. Some of these may be preventable with anaesthetic interventions.

Hypotension may be related to a decrease in cardiac output secondary to decreased venous return from caval compression[17,18] or the head-up position which improves surgical exposure of the gall bladder during LC. The LC group had little cardiovascular disease compared with the C group and, therefore, this relative hypovolaemia may be

an important factor. Patients undergoing C, despite more cardiorespiratory disease (smoking, diabetes and pre-op hypertension), were rarely hypotensive during the OR and only three required vasoactive drugs. All patients were fasted for at least six hours preoperatively and the fluid losses during all procedures were minimal. Body position, duration and magnitude of the pneumoperitoneum are different for the LC than for the LG group. Preoperative volume loading and avoidance of the extreme head-up position may be useful interventions to avoid this hypotension.

Previous studies have shown postoperative pulmonary dysfunction following upper abdominal surgery.[19-22] Patients undergoing LC have also been shown to have a decrease in postoperative pulmonary function tests for up to 24 hr following surgery.[23,24] Our study, which used the lowest oxygen saturation while breathing room air before PACU discharge as a marker of respiratory problems demonstrated an advantage of laparoscopy over laparotomy for cholecystectomy. The cause of this respiratory dysfunction following laparotomy may be related to diaphragmatic dysfunction which occurs during surgery or inability to take deep breaths secondary to incisional pain. Again, our study shows that excessive pain is a much less frequent problem following LC than C. Another explanation may be the case selection of the C group patients. They were older, there were more smokers and they had a lower mean oxygen saturation breathing room air prior to induction.

The high incidence of PACU hypothermia in LC may be related to the long duration of this new surgical procedure, fluid therapy at room temperature, dry cold anaesthetic gases, or the irrigating solutions used at the end of the operation. During LC a heat and moisture exchanger was used in the anaesthetic circuit in only 46.5% of cases. Similar use of heat and humidity exchangers in C (38.6%) and a shorter operative duration was not associated with PACU hypothermia in the C group. In future, we suggest temperature monitoring for all LC patients in the OR and PACU. Heat and humidity exchangers should be included in the anaesthetic circuit and if patients require substantial volume replacement, a fluid warmer should be considered.

Nausea and vomiting following laparoscopy and upper abdominal surgery is not surprising and the incidence has been reported to be as high as 42% following LC and 28% following LG.[14,25] The 24 hr incidence of postoperative nausea and vomiting in our patients may be higher than our reported incidence because we only examined this frequency in the PACU. The interference with gastric emptying and bowel manipulation may be more profound with LC and C which would explain the lower incidence found in LG patients. Although intraoperative antiemetic therapy was used in similar proportions during LC and C (<60% of patients) more frequent use might reduce this incidence. Other methods to reduce this annoying side effect include substitution of regional anaesthesia or nonsteroidal anti-inflammatory drugs for narcotics, increased use of propofol and routine use of nasogastric tubes. As well, a nasogastric tube may improve surgical exposure and decrease the risk of visceral laceration from the trochar.

Limitations of this study include the lack of a standardized protocol for anaesthetic drugs and a variable case mix selection for each of the three groups. Although anaesthetic techniques were similar for the three groups, it is impossible to control all variables during outcome studies in clinical practices. The long surgical duration during LC may account for some of the complications. This cannot be avoided with new and difficult surgical techniques and these related complications will be relevant in all centres who initiate this procedure.

The purpose of this study was to document the range of anaesthetic adverse events which are associated with LC and make clinical management recommendations where possible. We have shown that despite the many surgical and social advantages to the patient, there is considerable perioperative morbidity associated with the procedure. Our case series thus far has shown that younger, healthier patients have been selected as candidates for LC. As the popularity of LC increases and the selection of patients widens to older sicker people, this morbidity we have seen with younger healthier patients should serve as a cautionary note for increased vigilance of patients undergoing this new procedure.

Conclusion

Major surgical and anaesthetic advantages have been described for patients following this new surgical technique, laparoscopy for cholecystectomy, but it is not without anaesthetic-related morbidity. There remains a high incidence of annoying anaesthetic morbidity, intraoperative hypotension, and postoperative nausea, vomiting and hypothermia. Now that these problems have been identified, specific anaesthetic interventions (increased preoperative and perioperative fluid administration, active intraoperative warming and more frequent use of antiemetics) should be instituted to improve further patient outcome.

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