ORIGINAL ARTICLE

Spinal versus general anesthesia for laparoscopic cholecystectomy: A comparative study of cost effectiveness and side effects

A. Turkstani, M.D.*, O. Ibraheim, M.D.*, G. Khairy, FRCS**, A. Alseif, FRCS***, N. Khalil, Arab Board Anesth ****

** Associate Professor, **** Anesthesiologist,*
Department of Anesthesia
*** Associate Professor, *** Assistant Professor*
Department of Surgery
College of Medicine, King Saud University, Riyadh (KSA)

Correspondence: *Dr. Ahmed Turkistani, Chairman Department of Anesthesia, College of Medicine, King Saud University, Riyadh (KSA)*

ABSTRACT

Objectives. Laparoscopic cholecystectomy (LC) has become a well developed surgical procedure. Currently LC is performed under general anaesthesia. As with any day case procedure, LC requires an anesthetic technique which provides rapid recovery and fewer side effects. Meanwhile beside patient's satisfaction, cost effectiveness is an important measure of quality of care. We designed a controlled, randomized trial in order to compare spinal anesthesia with general anesthesia for elective LC in reference to recovery times, hospital stay and costs of anesthesia at our setting.

Methodology. Fifty ASA I-II patients undergoing elective LC, were divided into two groups (25 patients each); spinal anesthesia group (SA) and general anesthesia group (GA). Standardized techniques of anesthesia were employed in both groups. VAS score was used for pain assessment postoperatively. The dose of analgesic required as well as the length of hospital stay was also recorded. The cost of each anesthetic technique was calculated. Statistical analysis was performed using SPSS version 13.

Results. VAS scores at admission to PACU were less with SA than with GA, and the need for analgesics for postoperative pain was also significantly less ($P<0.05$).

Patients in general anesthesia group showed a reduction in length of stay in PACU compared to spinal anesthesia group [29.4 ± 7.2 min versus 42.7 ± 4 min respectively ($P< 0.05$)]. No significant difference regarding hospital stay in both groups was noted; median hospital stay was 1 day (with a range of 1 to 3 days, and no patient required readmission for any reason. The total costs in SA group was significantly less than GA group; 14.54 ± 4.2 \$ versus 17.17 ± 3.2 \$ respectively ($P< 0.05$).

Conclusion. We conclude that SA is associated with less anesthetic cost compared to general anesthesia, lower postoperative pain and comparable hospital stay. Further studies are needed on the use of spinal anesthesia for high risk patients.

Key words: Laparoscopic cholecystectomy; Spinal anesthesia; General anesthesia; Cost.

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INTRODUCTION:

Currently laparoscopic surgery has been widely used for cholecystectomy. It is considered cost saving because it has been associated with decreased length of hospital stay compared to conventional surgery. Among the variables that might lead to an increase in cost in laparoscopic surgery are the anesthetic technique and drugs used. LC requires an anesthetic technique which provides for a rapid recovery and minimizes the incidence of side effects. On the other hand, the pressure for hospital resources has forced clinicians to develop specific pathways to accelerate recovery from anesthesia and hospital discharge[1,2]. In addition, particular consideration needs to be given to prevention and treatment of postoperative nausea and vomiting (PONV) and pain management. Many anesthetists advocate propofol based techniques, due to their beneficial reduction of PONV. Other investigators achieve satisfactory results with volatile anesthetics; however, regional anesthesia has not been used as the sole anesthetic procedure other than in the scenario of a patient at high risk[3]. We have shown in a feasibility study the ability to perform successfully and safely LC with low pressure nitrous oxide pneumoperitoneum under spinal anesthesia alone[4]. We have noticed that spinal anesthesia results in exceptionally minimal postoperative pain. The aim of the present study was to compare spinal anesthesia versus general anesthesia for elective LC in terms of recovery times, hospital stay, complications, and costs of anesthesia at our setting.

METHODOLOGY

After hospital approval and written informed consent, fifty patients of ASA I-II, who were to undergo LC, were enrolled for the study. Age ranged between 18-50 years. Patients were divided into two groups (25 patients each), spinal anesthesia group (SA) and general anesthesia group (GA). Inclusion criteria were, patients with BMI< 30 and a normal coagulation profile. Exclusion criteria were acute cholecystitis / cholangitis / pancreatitis, previous open surgery in the upper abdomen, any contraindication to spinal anesthesia (i.e. spinal deformity, mental disturbances). Data recorded from patients included, mean arterial pressure (MAP), heart rate (HR), tissue oxygen saturation (SpO_2), and $EtCO_2$. Postoperative pain was assessed using VAS at 2, 4, 8, 12, and 24 hours; total analgesic requirement, PONV and occurrence of shoulder pain were recorded. The following data were also recorded; duration of surgery (min), intraoperative fluid infusion (ml), conversion to open surgery, conversion to general anesthesia, discharge from the hospital, and cost evaluation.

Anesthetic techniques

GA group: Anesthesia was induced with inj. propofol 2 mg/kg and fentanyl 1 μg/kg IV. Tracheal intubation was facilitated with atracurium 0.6 mg/kg. Anesthesia was maintained with sevoflurane 1- 2% in combination with 50% O_2 in air. The lungs were ventilated mechanically to maintain $EtCO_2$ between 32 and 36 mm Hg. Sevoflurane 1MAC was maintained throughout the procedure. Supplemental doses of fentanyl and atracurium were used when required. Sevoflurane was discontinued at the time of the last surgical closing suture. Neostigmine and atropine were used in the usual doses to reverse atracurium at the end of surgery.

SA group: Spinal anesthesia was performed under complete aseptic precautions, at L2-3 interspaces with the patient in sitting position using a midline approach with a 25-gauge Whitacre unidirectional spinal needle. Free flow of CSF was verified before injection of the local anesthetic. Once flow of clear CSF confirmed, 2ml of inj. bupivacaine 0.5% (10 mg) ml mixed with 25 μg of inj. fentanyl were injected. Barbotage and aspiration was done once during injection. The patient was turned to supine position and nasal oxygen 4 liters/min was applied. Heart rate, BP, and SpO_2, respiratory rate and $EtCO_2$ were recorded every min for 15 min and every 5 min thereafter. Upper and lower levels of sensory (pinprick), and motor block (modified Bromage scale: 0 - able to lift extended legs; 1 - just able to flex knees, full ankle movement; 2 - no knee movement, some ankle movement; 3 - complete paralysis), were assessed and recorded every 5 min until the start of surgery, and every 15 min postoperatively. Once the block was considered adequate (minimum block T5T7 as assessed by pinprick), surgery commenced using CO2 insufflation with pressure <10 mm Hg. Anxiety was treated with midazolam 2 mg IV, shoulder pain with fentanyl 50 μg IV plus intraperitoneal instillation of 20 ml of 1% xylocaine. Hypotension was treated with inj. ephedrine 5 mg IV repeated as required. Drug consumption and fluid balance were recorded. During and after the procedure, the patients were encouraged to report any discomfort, abdominal or shoulder pain, nausea, vomiting, or pruritus. These symptoms were scored (0 - nil; 1 - mild; 2 - moderate; 3 - severe) every 5 min during surgery, and every 15 min postoperatively. Postoperative pain was assessed using VAS at 2, 4, 8, 12, and 24 hr. The patients were allowed to leave the hospital once they had passed urine and had been assessed by the surgeon as being free from any complication.

<u>Surgical techniques:</u> LC was performed by the same surgeon with the following modifications: intraabdominal pressure = 10 mmHg, all trocars were inserted at or below level of umbilicus and used nasogastric tube in order to decompress the stomach only when required.

<u>Cost evaluation:</u> The cost of anesthesia supplies, drugs, and gases used in each case were recorded during the entire procedure from the start of anesthesia to discharge from PACU. Supplies consisted of all used items, including IV cannulas, tubes, syringes, needles, spinal needles, fluids, and oxygen masks. Drugs consisted of all opened ampoules on condition that one needle and one syringe of the appropriate size were used for each drug and that broken but not completely used drugs were discarded. Gas consisted of the costs for sevoflurane which was calculated using the formula published by Enlund et al[5]. Cost of anesthesia was defined as total drug and supply costs (i.e., costs for anesthesia and recovery) per case excluding personnel costs. Furthermore, we calculated the fixed and variable costs [6]. Fixed costs were defined as costs that arise by induction of SA or GA (spinal needle, local anesthetic, ventilation tubes, bag, filter, tube etc…). Whereas variable costs were defined as costs that are associated with maintenance of anesthesia or continuous infusion therapy (consumed narcotics, gas, infusions, analgesics, etc...).

All patients were evaluated in the PACU by anesthetic staff without reference to the present study. Blinding as to patient group was not possible. During the study period, anesthetic, surgical, and nursing staffs was not changed. Discharge criteria and nursing standards also remained the same. Costs were calculated by an unblinded anesthesiologist who was not involved in the care of any study patient.

RESULTS

Of 25 patients in SA group, 22 were females with a mean age of 26.20 ± 4.25 yr (range 21 to 50 yr) and those in GA group 20 were females with a mean age of 28.62 ± 5.11 yr. Mean BMI values were 25.38 ± 5.2 in SA and 26.03 ± 2.22 GA groups respectively with no statistical difference (P>0.05).

All of the procedures were completed laparoscopically. Duration of surgery was 69.8 ± 8.5 min in SA group and 64.4 ± 12.5 min in GA groups respectively with no statistical significance (P>0.05). Conversion from spinal to general anesthesia was not required in any of the case and no major incident was recorded during the procedure. Shoulder tip pain or discomfort required fentanyl administration plus instillation of 20 ml xylocaine 1% on the surface of liver and right cupola of diaphragm in 12 (48%)

patients in SA group. In 8 patients in SA and 5 patients in GA groups, blood pressure was decreased by more than 20% of the pre-anesthetic value and was controlled by inj. ephedrine IV boluses. Two patients developed bradycardia in SA group requiring inj. atropine IV administration.

The induction time was shorter in the GA group as compared to SA group, this was offset by the increased "end of surgery to transfer time" in the GA group. Time for recovery and total time were similar in both groups (Table 1).

VAS scores at admission to PACU were less with SA than with GA groups (P<0.05). The need for analgesics for postoperative pain therapy in the PACU was significantly less in SA versus GA groups (P < 0.005). In our institution, it is standard that patients are not transferred to normal ward from PACU until they can move lower extremities. Patients in GA group showed a reduction in length of stay in PACU in comparison to SA group; 29.4 ± 7.2 min versus 42.7 ± 4 min respectively (P < 0.05).

Table 2. Side effects and cost of anesthesia

	Spinal	general	P Value
Additional opioids during surgery	3 (12%)	22 (88%)	< 0.001
Additional midazolam during surgery	8(32%)	0	< 0.001
Shoulder tip pain	12(48%)	0	< 0.001
Pain in PACU (VAS)	1.4 ± 0.80	4.7 ±1.40	< 0.001
Postoperative opioids, *n* (%)	3 (12%)	13 (52%)	< 0.008
PONV in PACU	4 (16%)	7 (28%)	< 0.001
PDPH	1 (4%)	-	NA
Epidural blood patch	1 (4%)	-	NA
Superior/Equal/Worse to expectation	15/8/2	19/4/1	<0.05
Same anesthesia next time (Yes/no)	18/7	22/4	<0.05
Cost in $ (per case)	14.54 ± 4.2	17.17 ±3.2	<0.05

All patients were mobilized on the same evening after surgery. PONV in PACU was recorded in 4 patients of SA and 7 patients of GA groups; which was controlled with inj. ondansetron. Two male patients in SA group experienced urinary retention requiring instant catheterization with no further consequences. One patient complained of post dural puncture headache (PDPH) necessitating epidural blood patch after failure of conservative management. There was no significant difference regarding hospital stay in both groups: median hospital stay was 1 day (with a range of 1 to 3 days), and no patient required readmission for any reason.

The total costs in SA was significantly less than GA groups; 14.54 ± 4.2 $ versus 17.17 ± 3.2 $ respectively (P<0.05) (Table 2).

Table 1. Demographic data of patients (mean ± SD)

	Spinal	general	P value
Age (yr)	26.20 ± 4.25	28.62 ± 5.11	NS
	25.38 ± 5.2	26.03 ± 2.22	NS
Anesthesia induction time (min)	12.4 ± 5.8	10.6 ± 4.9	0.01
End of surgery to transfer (min)	3.2 ± 0.21	9.2 ± 4.1	0.001
Total Duration Of Anesthesia and surgery (min)	69.8 ± 8.5	64.4 ± 12.5	NS
Time in PACU (min)	42.7 ± 4.5	29.4 ± 7.2	0.01
Hospital stay (days)	1.40 ± 1.00	2.00 ± 0.28	NS

DISCUSSION

In the present study we compared spinal versus general anesthesia for LC in terms of hospital stay, side effects and cost of the anesthetic technique used. In this selected patient population undergoing elective LC, intraoperative conditions were comparable in both groups. Recovery was faster in the SA group compared to GA group; but significant increased time to discharge from PACU in SA group compared to GA group was noted. Our results show the superiority of spinal analgesia in postoperative pain control compared with the general anesthesia. The total cost of anesthesia in SA group was significantly less than GA group.

Regional anesthesia has numerous advantages such as early recovery, reduced PONV, lower postoperative pain, and shorter hospital stay. However, it is necessary in laparoscopic surgery to use lower insufflation pressure and increase the degree of head-up tilt. Although laparoscopy in the awake patient appears to be tolerated well, shoulder tip pain may be a significant intraoperative problem6. We found that 48% of our patients experienced shoulder tip pain which was managed by intraabdominal instillation of lignocaine and IV fentanyl administration.

The use of low-pressure pneumoperitoneum in all patients did not jeopardize the adequacy of our procedure and the view, and virtually all of the procedures were completed without any technical difficulty. Intraoperative incidents recorded and related to either method of anesthesia or the creation of pneumoperitoneum was similar to those described in other studies[7]. Most patients who received spinal anesthesia experienced better postoperative analgesia compared to those who received general anesthesia during the same period, particularly during the first few hours after the procedure. It is presumably related to the avoidance of endotracheal intubation discomfort, and the presence of adequate level of analgesia for the first few hours after the completion of the surgical procedure[6,7].

We found that SA group was associated with significantly low perioperative use of drugs and supplies compared to GA group. Our finding that SA is more cost-effective than GA supports the findings of Lennox et al in outpatient gynecological laparoscopy and is in contrast to other studies that reported less or comparable cost for GA compared with SA for knee and laparoscopic surgery in outpatients[8-10]. The main difference was a longer time of stay in PACU in our study which did not affect total cost. Schuster et al underlined that cost comparisons of anesthesia techniques largely depend on the surgical duration of the cases studied. In a retrospective chart analysis in patients undergoing various surgical procedures and anesthetic drug regimens they found that SA offers a cost advantage over GA[11].

Although personnel costs are a major factor in health economic studies, we have knowingly neglected this important cost category for two reasons. First, our investigation could not detect any differences regarding total duration of anesthesia and surgery. Times for anesthesia, surgery, and recovery were comparable between both groups. The induction time was shorter in the GA group compared with the SA group; however, this advantage was offset by the faster 'end of surgery to transfer' times in the SA group. Second, staffing of our PACU is fixed and not dependent on the number of patients. In our study PACU times in SA group were longer compared to GA group. In other studies comparing SA and GA groups, PACU times varied considerably, depending upon the length of surgery and discharge criteria[12]. In our institution, it is a standard protocol that patients are not transferred from PACU to the ward until they can move their lower limbs. It is clear that a difference in transfer times between both groups was due to this very factor. In addition to the decreased costs in the SA group, VAS scores at admission to PACU were less with SA than with GA, and the need for analgesics for postoperative pain management in the PACU was also less, so the reduction of cost in SA group could be attributed to low cost of drugs, equipment and the disposables used.

CONCLUSION

We conclude that spinal anesthesia for LC is associated with less anesthetic cost compared to general anesthesia, lower postoperative pain and shorter hospital stay, but with higher incidence of shoulder tip pain or discomfort requiring intervention. Further studies are needed on the use of spinal anesthesia in high risk patients undergoing laparoscopic cholecystectomy.

REFERENCES

1. Calland JF, Tanaka K, Foley E, et al. Outpatient laparoscopic cholecystectomy: patient outcomes after implementation of a clinical pathway. Ann Surg 2001; 233: 704715.
2. Keulemans Y, Eshuis J, de Haes H, et al. Laparoscopic cholecystectomy: day-care versus clinical observation. Ann Surg 1998; 228: 734740.

3. van Zundert AAJ, Stultiens G, Jakimowicz JJ, et al. Segmental spinal anesthesia for cholecystectomy in a patient with severe lung disease. Brit J Anaesth 2006; 96: 4646.

4. Hamad MA, Ibrahim El-Khattary OA. Laparoscopic cholecystectomy under spinal anesthesia with nitrous oxide pneumoperitoneum: a feasibility study. Surg Endosc 2003; 17: 14268.

5. Enlund M, Lambert H, Wiklund L. The sevoflurane saving capacity of a new anaesthetic agent conserving device compared with a low flow circle system. Acta Anaesthesiol Scand 2002; 46:50611.

6. Tzovaras G, Fafoulakis F, Pratsas K, et al. Spinal vs. general anesthesia for laparoscopic cholecystectomy. Arch Surg 2008; 143:234-38.

7. Tzovaras G, Fafoulakis F, Pratsas K, et al. Laparoscopic cholecystectomy under spinal anesthesia. A pilot study. Surg Endosc 2006; 20: 58084.

8. Lennox PH, Chilvers C, Vaghadia H. Selective spinal anesthesia versus desflurane anesthesia in short duration outpatient gynecological laparoscopy: a pharmacoeconomic comparison. Anesth Analg 2002; 94:5658.

9. Martikainen M, Kangas-Saarela T, Lopponen A, et al. Two percent lidocaine spinal anaesthesia compared with sevoflurane anaesthesia in ambulatory knee surgery: cost-effectiveness, home readiness and recovery profiles. Ambulatory Surgery 2001; 9:7781.

10. Chilvers CR, Goodwin A, Vaghadia H, Mitchell GW. Selective spinal anesthesia for outpatient laparoscopy. V: pharmaco-economic comparison vs general anesthesia. Can J Anaesth 2001; 48:27983.

11. Schuster M, Gottschalk A, Berger J, Standl T. A retrospective comparison of costs for regional and general anesthesia techniques. Anesth Analg 2005; 100:78694.

12. Williams BA. For outpatients, does regional anesthesia truly shorten the hospital stay, and how should we define post-anesthesia care unit bypass eligibility? Anesthesiol 2004; 101: 36.

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