How to Cite:
Aggarwal, L. K., Goyal, G., & Tomar, N. S. (2022). Comparing cholecystectomy in patients with chronic obstructive pulmonary disease under spinal anaesthesia and general anaesthesia. *International Journal of Health Sciences*, *6*(S3), 7055–7062. https://doi.org/10.53730/ijhs.v6nS3.7640

Comparing cholecystectomy in patients with chronic obstructive pulmonary disease under spinal anaesthesia and general anaesthesia

Lokesh Kumar Aggarwal
Senior Consultant, Laparoscopic, General and Uro Surgery, Raman Hospital, Dholpur, Rajasthan, India

Govind Goyal
Assistant Professor, Department of Anaesthesiology, Dholpur Medical College, Dholpur, Rajasthan, India

Narendra Singh Tomar
Junior Specialist, Department of Anaesthesiology, Dholpur Medical College, Dholpur, Rajasthan, India
*Corresponding author email: dr.narendrasinghtomar@gmail.com

***Abstract*---**Introduction: The prevalence of Chronic obstructive lung disease has been increased globally. We compared the effectiveness of SA versus GA for open cholecystectomy with regards to post operative pain reduction, analgesia requirement, respiratory complications and length of hospital stay in chronic obstructive lung disease patients. Materials and Methodology: Group 1 (the GA group) received 0.6 mg/kg rocuronium bromide, 2 mg/kg propofol, and 2 µg/kg fentanyl. After 90-120 seconds 100% oxygenation, these patients underwent endotracheal intubation. Maintenance of anaesthesia was performed using 1 – 2% sevoflurane in 50% nitrous oxide/50% oxygen. Group 2 (the SA group) received their anaesthesia while sitting. Patients underwent lumbar puncture using a 25 - gauge needle in the L3-L4 intervertebral space and were given an intrathecal injection of 25 mg fentanyl and 3ml hyperbaric bupivacaine (0.5%), following which they were told to lay supine for 5 minutes. Results: There was no significant difference between the GA and SA groups, postoperative pulmonary functions were impaired more frequently in the GA group, and 4 GA patients required mechanical ventilation. There was no significant difference in operation duration between the SA and GA groups. Conclusion: Cholecystectomy could be performed safely under GA and SA in patients with COPD. Therefore, it is recommended that SA should be used in COPD patients, as it alleviated the risk of extubation, bronchoconstriction and respiratory depression and

Manuscript submitted: 27 March 2022, Manuscript revised: 9 April 2022, Accepted for publication: 17 May 2022

decreases the requirement of post-operative mechanical ventilation which could actually leads to a faster postoperative recovery.

***Keywords*---**COPD, cholecystectomy, spinal anaesthesia.

Introduction

There are patients reported with chronic obstructive pulmonary disease (COPD) are mostly associated with an increased risk of mortality and morbidity and have continuous limitations in airflow. And these limitations are usually diagnosed by considering the ratio of forced expiratory volume in 1 sec (FEV1) to forced vital capacity (FVC). The severity of limitations in airflow is evaluated only by a patient's FEV1 which has been given to predetermine the mortality in COPD patients.[1] The severity of COPD patients should be evaluated with the help of a pre-operative exam which include a comprehensive medical history, spirometry and arterial blood gas (ABG) measurement. It is well documented that advanced COPD patients have more undesirable outcomes when given GA with tracheal intubation and intermittent positive pressure ventilation (IPPV). These patients might have a higher rate of pulmonary complications following the surgery and are more susceptible to hypoxemia, laryngospasm, barotrauma, bronchospasm and cardiovascular instability. Hence, many researchers thought that SA is a better choice than GA for these patients. Moreover, it should be observed that spinal and epidural anaesthesia (when given at the lumbar level) do not affect respiratory function indirectly.[2-4]

Jonnesco[5]elaborated the use of general spinal anaesthesia for surgeries in the skull, head, neck and the thorax. The punctures were conducted between the 1st and the 2nd thoracic vertebrae and therefore resulted in good analgesia for the head, neck and upper limbs. He intrigued puncture between the 12th thoracic vertebra and the 1st lumbar vertebra and this inferred in anaesthesia for the lower half of the body. Frumin et al[6] postulated that the use of segmental spinal block using low thoracic puncture. van Zundert[7]studied segmental spinal block for cholecystectomy in patient reported with severe obstructive lung disease using a low thoracic puncture (T10) for combined spinal–epidural block.

Spinal anaesthesia (SA) is considered as an alternate to GA and was first used by Hamad MA et al[8] for cholecystectomy. Since all the procedures involving cholecystectomy are merely a change in access and still require the same amount of anaesthesia; therefore, the difference from conventional surgery is reported to be small. It is to be expected that SA can be as effective in open cholecystectomy as in laparoscopic approach. In fact, SA with lesser effect on respiratory functions, better post operative pain control, reduced surgical stress response and lower incidence of deep venous thrombosis,[9] can be considered as a better choice than GA. Sinha R conducted a study in India elaborated the safety profile of SA for laparoscopic cholecystectomy in 3492 patients during 12 years. However, the safety and efficacy of SA has not yet been studied for upper abdominal surgeries like open cholecystectomy. So, in this present study, we compared the effectiveness of SA for open cholecystectomy versus GA with regards to post operative pain reduction, analgesia requirement, respiratory

complications and length of hospital stay in chronic obstructive lung disease patients.

Materials and Methodology

Patients observed with COPD who were admitted for cholecystectomy were given the choice of spinal anaesthesia instead of general anaesthesia. The choice of different anaesthesia was the part of our routine care. Spinal anaesthesia is a commonly used method in both cholecystectomy and other upper abdominal operations in our hospital. All volunteers were provided with proper informed consent before the study procedure. 40 COPD patients had cholecystectomy under GA (Group 1) and another 40 COPD patients had cholecystectomy under SA (Group 2). The age, gender, ASA scores, pre-operative spirometer findings (FEV_1, FEV_1/FVC), concomitant systemic diseases (hypertension, diabetes mellitus, coronary artery disease) were assessed. Exclusion criteria for spinal anaesthesia were in those patients' upper abdominal surgery and body mass index (BMI) over 55. The spirometry test records from every patient were used to assess the COPD staging[10] and ASA scores (American Society of Anaesthesiology) Group 1 (the GA group) received 0.6 mg/kg rocuronium bromide, 2 mg/kg propofol, and 2 µg/kg fentanyl. After 90-120seconds 100% oxygenation, these patients underwent endotracheal intubation. Maintenance of anaesthesia was performed using 1 – 2% sevoflurane in 50% nitrous oxide/50% oxygen.

Group 2 (the SA group) received their anaesthesia while sitting. Patients underwent lumbar puncture using a 25 - gauge needle in the L_3-L_4 intervertebral space. Followed this, they were given an intrathecal injection of 25 mg fentanyl and 3ml hyperbaric bupivacaine (0.5%), following which they were told to lay supine for 5 minutes. Cholecystectomy was conducted when the patient achieved a sensory level of T_4 dermatome. The SPSS 17.0 packet program was used to predict the data obtained. Categorical measurements were summarized as numbers and percentages and continuous measurements were listed as means and standard deviations (or as medians and minimums-maximums when applicable). Categorical variables were then compared with the Chi square test or Fisher test. Student's t test was employed to compare continuous measurements between the groups. The values of $p < 0.05$ were considered significant.

Table 1
Distribution of demographic variables

Parameters	General		Spinal		P - value
	N	%	N	%	
Gender					
M	30	75	31	77.5	0.781
F	10	25	9	22.5	
BMI	40	34.92 ± 5.53	40	33.57 ± 6.12	0.373
ASA score					
2	11	27.5	10	25	0.842
3	22	55	23	57.5	
4	7	17.5	7	17.5	
COPD stage					

1 2 3	16 18 6	40 45 15	18 18 4	45 45 10	0.974

Table 2
Postoperative analgesia

Parameters	General		Spinal		P - value
	N	%	N	%	
Post-op analgesia requirement (first 2h) Yes No	40 0	100 0	0 40	0 100	0.0001
Post-op analgesia requirement (2 – 8h) Yes No	33 7	82.5 17.5	35 5	87.5 12.5	0.0001

Table 3
Postoperative morbidity

Parameters	General		Spinal		P - value
	N	%	N	%	
Post-op mechanical ventilation Yes No	4 36	10 90	0 40	0 100	0.129
Post-op shoulder pain Yes No	8 32	20 80	5 35	12.5 87.5	0.493
Post-op respiratory problem Yes No	6 34	15 85	2 38	5 95	0.116
Post-op urine retention Yes No	0 40	0 100	4 36	10 90	0.484
Post-op headache Yes No	0 40	0 100	2 38	5 95	1.004

Table 4
Comparison of groups related to operation duration and length of hospitalization

Parameters	General Anaesthesia	Spinal Anaesthesia	P - value
Operation duration (mins)	31.9 ± 5.4	30.8 ± 5.4	0.322
Length of hospital stay (days)	3.4 ± 1.9	1.7 ± 0.6	0.0001

Results

Demographic characteristics of the patients are given in tables 1 and 2. Open cholecystectomy was conducted under spinal anaesthesia (40 patients) or general anaesthesia (40 patients). All of the cholecystectomy patients well-tolerated the spinal anaesthesia and only 5 (12.5%) experienced postoperative shoulder pain. This pain was usually relieved by a routine shoulder massage in 3 patients (7.5%). The other 2 patients (5%) required analgesia with 25-50 mcg fentanyl. Intra-operative hypotension was observed in 3 patients (6.7%) and they returned to normal with ephedrine 5 mg. Bradycardia occurred in 1 patient (3.3%) and normocardia was inferred with 0.25 mg atropine. Urinary retention occurred in 4 patients (10%) in the post-operative periodand hence urinary catheter was inserted at this glance. 2 patients (5%) experienced postoperative headache and none of the patients needed endotracheal intubation during the procedure. Of the patients who underwent general anaesthesia (GA), 1 experienced postoperative hypotension (3.3%) who recovered by 5 mg ephedrine. Tachycardia occurred in 2 patients which was recovered by increasing the respiration rate in the anaesthesia device.

Four patients (10%) required postoperative mechanic ventilation due to hypercarbia and acidosis. Non-invasive continuous positive airway pressure (CPAP) was administered to 2 patients for 2 hours. Two patients with Stage 3 COPD required prolonged intubation; one of these patients was weaned after 8 hours, and the other after 12 hours. The postoperative analgesia requirement is displayed in table 2. The postoperative analgesia requirement was significantly higher in the spinal anaesthesia group. Postoperative morbidity is shown in Table 3. Although there was no significant difference between the GA and SA groups, postoperative pulmonary functions were impaired more frequently in the GA group, and 4 GA patients required mechanical ventilation. There was no significant difference in operation duration between the SA and GA groups. However, the length of hospitalization was significantly lower in the SA group (Table 4).

Discussion

Earlier studies have reported that after the abdominal surgery, COPD patients have a significant risk of developing pulmonary complications.[10-12]The respiratory system is known to be affected by group of opiate drugs, general anaesthetic agents, mechanical ventilation and muscle relaxants.[13] Anaesthetics are well known to produce changes in muco-ciliary transport; therefore, it is also known that abdominal surgery (in particular, upper abdominal surgery) can have undesirable negative effects on the respiratory system which include closing volume, vital capacity (VC), functional residual capacity (FRC) and tidal volume (TV).[14,15] Patients diagnosed with COPD who are receiving anaesthesia through inhalation or intravenously might have respiratory problems due to impaired muco-ciliary clearance. Moreover, COPD patients might have respiratory problems due to CO_2 pneumo-peritoneumwhich could result in diaphragm splinting causing systemic CO_2 absorption. Hence, the use of cholecystectomy with newer anaesthetic techniques (e.g., spinal, epidural blockage) might consider as a safer

choice for COPD patients.[16]In this study, we report that the use of general and spinal anaesthesia for COPD patients undergoing open cholecystectomy.

Various reports have revealed that patients undergoing laparoscopy experience changes in their CO_2 parameters. In a study which include40 patients who had undergonecholecystectomy under GA, *Ozyuvacı* E et al observed that these patients had a significantly increased post-operative $PaCO_2$ when compared to preoperative levels.[19]Yet another study observed the similar results.[20]Similarly, in this current study, the postoperative $PaCO_2$ levels of the GA group were significantly higher than those included in the SA group. Also in this current study, 4 patients in the GA group required mechanical ventilation because of postoperative hypercarbia and acidosis. Whereas on the other hand, patients in the SA group well-tolerated the procedureand had no observed impairment in respiratory functions. The study conducted by *Gramatica* et al further sustains the use of regional anaesthesia (RA) for cholecystectomy in advanced COPD cases, as they reported that all of the patients were stable throughout the surgical procedure. Also, in 1998, *Pursnani*et al observed that cholecystectomy with regional anaesthesia could be considered safe in patients reported with severe COPD.[16]

A unique predictor of post-operative pulmonary function is the effective analgesia after the surgery. Though opioids can be reported with excessive sedation, spinal analgesia is considered as a better choice, as it does not have this side effect and therefore lowers the risk of respiratory failure. Various other studies have revealed that regional anaesthesia can be useful for reducing the postoperative pain in COPD patients.[16,17,19,20] In this current study, some results indicate that patients who underwent cholecystectomy with SA had significantly lesser early analgesic requirement and postoperative pain when compared with patients who underwent cholecystectomy with GA; the SA patients had a reduction in pulmonary complications. Earlier studies have given that the incidence of intra-operative right shoulder pain (requiring iv fentanyl) was between10 and 55.2%.[21,22] In this current study, 5 (12.5%) SA patients observed with shoulder pain; 3 (7.5%) of patients required fentanyl, while 2(5%) were satisfied with shoulder massage. The results observed in our current study shown that no significant difference in the average operating time between the GA and SA groups. This is most likely because we applied an experienced surgical team who kept the operative times relatively very short. Various other studies had observed that mean operation duration times as 47.4 min (*Kalaivani* Vet al) and as 40 min (*Pursnani* et al).[16,23] In our current study, 4 patients (10%) in the SA group suffered from urinary retention; therefore, this complication did not increase their hospitalization times. The mean length of the hospitalization was 1.7 ± 0.6 days in the SA group, which was significantly lower than that of the GA group (3.2 ± 1.7 days). It was assessed that the SA patients had a rapid recovery. A previous study by *Chi Hsun Hsieh* et al reported that the mean length of the hospitalization to be 3.3 ± 1.6 in 20 patients with COPD who underwent cholecystectomy with GA.[19]

Conclusion

We conclude that cholecystectomy could be performed safely under GA and SA in patients with COPD. Therefore, it is recommended that SA should be used in

COPD patients, as it alleviated the risk of extubation, bronchoconstriction and respiratory depressionand decreases the requirement of post-operative mechanical ventilation which could actually leads to a faster postoperative recovery.

References

1. Kim TH, Lee JS, Lee SW, Oh YM. Pulmonary complications after abdominal surgery in patients with mild-to-moderate chronic obstructive pulmonary disease. Int J Chron Obstruct Pulmon Dis. 2016;11:2785–96.
2. Sinha R, Gurwara AK, Gupta SC. Laparoscopic cholecystectomy under spinal anaesthesia: a study of 3492 patients. J Laparoendosc Adv Surg Tech A. 2009; 19(3):323–7.
3. Celli BR, MacNee W, Force AET. Standards for the diagnosis and treatment of patients with COPD: a summary of the ATS/ERS position paper. Eur Respir J. 2004;23(6):932–46.
4. Gramatica L Jr, Brasesco OE, Mercado Luna A, Martinessi V, Panebianco G, Labaque F, et al. Laparoscopic cholecystectomy performed under regional anaesthesia in patients with chronic obstructive pulmonary disease. SurgEndosc. 2002;16(3):472–5.
5. Jonnesco T. Remarks on general spinal anaesthesia. Br Med J 1909;2:1935.
6. Frumin MJ, Schwartz H, Burns J, et al. Dorsal root ganglion blockade during threshold segmental spinal anaesthesia in man. J Pharm Exp Ther1954;112:387–92.
7. van Zundert AA, Stultiens G, Jakimowicz JJ, et al. Segmental spinal anaesthesia for cholecystectomy in a patient with severe lung disease. Br J Anaesth2006;96:464–6.
8. Hamad MA, El-Khattary OA. Laparoscopic cholecystectomy under spinal anaesthesia with nitrous oxide pneumoperitoneum: a feasibility study. SurgEndosc. 2003;17:1426–1428.
9. Tzovaras G, Fafoulakis F, Pratsas K, Georgopoulou S, Stamatiou G, Hatzitheofilou C. Laparoscopic cholecystectomy under spinal anaesthesia: a pilot study. SurgEndosc. 2006 ;20:580–582.
10. Gupta H, Ramanan B, Gupta PK, Fang X, Polich A, Modrykamien A, et al. Impact of COPD on postoperative outcomes: results from a national database. Chest. 2013;143(6):1599–606.
11. Sakai RL, Abrao GM, Ayres JF, Vianna PT, Carvalho LR, Castiglia YM. Prognostic factors for perioperative pulmonary events among patients undergoing upper abdominal surgery. Sao Paulo Med J. 2007;125(6):315–21.
12. Yang CK, Teng A, Lee DY, Rose K. Pulmonary complications after major abdominal surgery: National Surgical Quality Improvement Program analysis. J Surg Res. 2015;198(2):441–9.
13. Licker M, Schweizer A, Ellenberger C, Tschopp JM, Diaper J, Clergue F. Perioperative medical management of patients with COPD. Int J Chron Obstruct Pulmon Dis. 2007;2(4):493–515.
14. Hansen G, Drablos PA, Steinert R. Pulmonary complications, ventilation and blood gases after upper abdominal surgery. Acta Anaesthesiol Scand. 1977; 21(3):211–5.
15. Meyers JR, Lembeck L, O'Kane H, Baue AE. Changes in functional residual capacity of the lung after operation. Arch Surg. 1975;110(5):576–83.

16. Pursnani KG, Bazza Y, Calleja M, Mughal MM. Laparoscopic cholecystectomy under epidural anaesthesia in patients with chronic respiratory disease. SurgEndosc. 1998;12(8):1082–4.
17. Ozyuvaci E, Demircioglu O, Toprak N, Topacoglu H, Sitilci T, Akyol O. Comparison of transcutaneous, arterial and end-tidal measurements of carbon dioxide during laparoscopic cholecystectomy in patients with chronic obstructive pulmonary disease. J Int Med Res. 2012;40(5):1982–7.
18. Iwasaka H, Miyakawa H, Yamamoto H, Kitano T, Taniguchi K, Honda N. Respiratory mechanics and arterial blood gases during and after laparoscopic cholecystectomy. Can J Anaesth. 1996;43(2):129–33.
19. Hsieh CH. Laparoscopic cholecystectomy for patients with chronic obstructive pulmonary disease. J Laparoendosc Adv Surg Tech A. 2003;13(1):5–9.
20. Imbelloni LE, Sant'anna R, Fornasari M, Fialho JC. Laparoscopic cholecystectomy under spinal anaesthesia: comparative study between conventional- dose and low-dose hyperbaric bupivacaine. Local Reg Anesth. 2011;4:41–6.
21. Mehta PJ, Chavda HR, Wadhwana AP, Porecha MM. Comparative analysis of spinal versus general anaesthesia for laparoscopic cholecystectomy: a controlled, prospective, randomized trial. Anesth Essays Res. 2010;4(2):91–5.
22. Yuksek YN, Akat AZ, Gozalan U, Daglar G, Pala Y, Canturk M, et al. Laparoscopic cholecystectomy under spinal anaesthesia. Am J Surg. 2008; 195(4):533–6.
23. Pujari VS, SM R, Hiremath BV, Bevinaguddaiah Y. Laparoscopic Cholecystectomy Under Spinal Anaesthesia vs. General Anaesthesia: a prospective randomised study. J Clin Diagn Res. 2014;8(8):NC01–4.
24. Fischli, A. E., Godfraind, T., & Purchase, I. F. H. (1998). Conclusions and Recommendations. Pure and Applied Chemistry, 70(9), 1863-1865. https://doi.org/10.1351/pac199870091863