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Significant hemodynamic compromise or not: In laparoscopic cholecystectomy under spinal anaesthesia

Dr Ameena Azmin[1], Dr Abu Nadeem[2], Dr Jahan Ara[3], Dr Obaid Ahmed Siddiqui[4], Dr Wasif Mohammad Ali[5], Dr Rehman Hyder[*6]

1 Registrar, Critical Care-Meitra Hospital, Kozhikode, Kerala
2 Associate Professor, Department of Anaesthesiology and Critical Care at JN Medical College, AMU, Aligarh
3 Resident, Department of Anaesthesiology and Critical Care at JN Medical College, AMU, Aligarh
4 Associate Professor, Department of Anaesthesiology and Critical Care at JN Medical College, AMU, Aligarh
5 Associate Professor, Department of Surgery at JN Medical College, AMU, Aligarh
6 Assistant Professor, Department of Anaesthesiology and Critical Care at JN Medical College, AMU, Aligarh

Corresponding Author
Dr Rehman Hyder
Assistant Professor, Department of Anaesthesiology and Critical Care at JN Medical College, AMU, Aligarh
haider2k@gmail.com

Abstract
Background: The study aimed to investigate the effects of spinal anaesthesia on patients with hypotension and bradycardia. The procedure was uneventful, with no conversions from spinal to general anaesthesia. The study found significant variations in pulse rate after spinal and during GB handling in group S, which may be due to vagal stimulation or hemodynamic response to laryngoscopy and intubation. Bradycardia was an expected side effect due to rapid peritoneal stretch and vagal stimulation in laparoscopic cholecystectomy operations. The incidence of bradycardia was 11.43% and 2.86% in group S and group G, respectively. **Aim and objectives:** Hypotension and bradycardia were easily managed with inj. Mephentermine and inj. Atropine, respectively. Pre-anaesthetic hydration with 10ml/kg of ringer lactate prevented repeated hypotension occurrences. The decrease in pulse rate and BP in group S was due to the residual analgesic effect of local anaesthetic in subarachnoid space. **Methods:** Shore tip pain was a significant intraoperative problem caused by the irritation of the subdiaphragmatic area with CO_2. Previous studies have shown that maintaining intra-abdominal pressure below 10 mmHg reduces right shoulder pain and respiratory distress due to diaphragm irritation. However, the study's high intraabdominal pressure created during pneumoperitoneum affected hemodynamic values negatively and contributed to shoulder pain. **Results:** The surgical team was satisfied with sufficient abdominal relaxation during the operation in spinal anaesthesia. However, further studies with a larger sample size may be conducted to support observations. All patients in the spinal anaesthesia group remained

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 08, 2023

awake and oriented at the end of surgery, with a smooth transition of pain in the postoperative period. Avoidance of GA and opioids contributed to the lack of deterioration in cognitive function.

Introduction

It's a myth that laparoscopic cholecystectomy can only be done under general anaesthesia with endotracheal intubation. In order to prevent aspiration, abdominal discomfort and hypercarbia during carbon dioxide pneumoperitoneum endotracheal intubation was considered a necessity.[1] Surprisingly in the present era of minimally invasive medicine, regional anaesthesia has not gained much popularity and is not been routinely used as a sole method of anaesthesia in laparoscopic procedures.[2] Spinal anaesthesia is less invasive and has lower morbidity and mortality rates as compared to general anaesthesia. The limiting factor for use of spinal anaesthesia in laparoscopic cholecystectomy was the patient's discomfort associated with pneumoperitoneum and the shoulder tip pain.[3]

Neuraxial techniques as a mode of anaesthesia for a variety of surgical procedures resulted in decreased mortality, myocardial infarction, venous thromboembolism and several other complications.[4] Few problems that are related to the technique of general anaesthesia like sore throat, teeth and oral cavity damage during laryngoscopy and pain related to intubation and extubation are prevented by administering spinal anaesthesia to the patients undergoing laparoscopic interventions.[5] Both techniques have their advantages and disadvantages. General anaesthesia allows controlled ventilation and provides sufficient muscle relaxation, whereas regional anaesthesia is known to decrease postoperative morbidity and surgical stress. Also, the total cost of spinal anaesthesia during surgery and hospital stay, induction and recovery, and the need for postoperative analgesia and anti-emetics are much lower as compared to general anaesthesia. Recently reports have been published regarding the use of spinal anaesthesia for laparoscopic cholecystectomy in patients fit for general anaesthesia. Therefore combining a minimally invasive surgical procedure with a lesser invasive anaesthesia technique theoretically further enhances the advantages of laparoscopic cholecystectomy.

In this background, we designed a study to compare the intraoperative hemodynamic changes between spinal anaesthesia and general anaesthesia, the gold standard until now in laparoscopic cholecystectomy.

Materials and methods:

After registering the trial (CTRI/2021/04/032586) and getting approval from the institutional ethical committee, written informed consent was taken from all the patients after explaining the procedure. A study was carried out on 70 patients of either sex, who underwent elective laparoscopic cholecystectomy using spinal anaesthesia or general anaesthesia. All the patients were examined to assess their preoperative comorbidities and condition. Demographic data, vitals and routine investigations were recorded in brief. The patients were then divided into two groups of 35 each: group G receiving general anaesthesia and group S receiving spinal anaesthesia. After taking the patients into the operation theatre, an intravenous line was secured and an infusion of 500 ml of Ringer's Lactate solution was started. A blood pressure

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cuff, pulse oximeter and ECG electrode were applied. The initial pulse rate, blood pressure (BP), ECG and respiratory rate were recorded.

Patients randomized for spinal anaesthesia (GROUP S) were premedicated with inj. Ondansetron 0.08 mg/kg intravenously. The patient was made to sit. Appropriate space was palpated and 25-G Quincke spinal needle was introduced in subarachnoid space at L3–L4 interspace under all aseptic precautions. After confirming the free flow of cerebrospinal fluid, 0.4 mg/kg of hyperbaric Bupivacaine was injected intrathecally. Then the patient was made to lie in a supine position. The level of anaesthesia was checked before the start of surgery. A segmental sensory (pin-prick) block, extending between T4 and L5 dermatomes, without any respiratory distress was assessed. Any complaint of shoulder pain was treated with 0.5 mg/kg ketamine iv bolus. Patients randomised for General anaesthesia (GROUP G), were premedicated with inj Ondansetron 0.08 mg/kg, inj. Midazolam 0.03mg/ kg and inj. Fentanyl 2 mcg/kg . The patient was pre oxygenated for 3 min with 100% oxygen and then induced with inj. Propofol 2 mg/kg. The patient was relaxed with inj. Vecuronium 0.08 mg/kg. Orotracheal intubation was done with a cuffed endotracheal tube of appropriate size. The patient was maintained on oxygen, nitrous oxide, isoflurane and intermittent vecuronium 0.02 mg/kg and positive pressure ventilation. Laparoscopic cholecystectomy was performed using the same techniques in both the groups with standard 4 trocar insertion. After painting and draping, pneumoperitoneum was established by using the open (Hassen) technique with carbon dioxide at maximum intra-abdominal pressure of 14 mm Hg. All patients were monitored continuously both clinically and using non invasive hemodynamic monitors like ECG, pulse oximetry and blood pressure. Pulse rate (PR), systolic and diastolic blood pressure (SBP, DBP) were recorded as soon as the patient entered the operation theatre (Baseline), after spinal/ intubation, before insufflation, during maximum insufflation(14 mm Hg), after insufflation, during gall bladder(GB) handling, end of surgery (during the closure of ports with suture) and immediate post-op (before the patient was shifted outside the operation theatre).

The presentation of the Categorical variables was done in the form of numbers and percentages (%). On the other hand, the quantitative data were presented as the means ± SD and as median with 25th and 75th percentiles (interquartile range). The comparison of the variables which were quantitative in nature was analysed using the Independent t test. The comparison of the variables which were qualitative in nature was analysed using the Chi-Square test. If any cell had an expected value of less than 5 then Fisher’s exact test was used. The data entry was done in the Microsoft EXCEL spreadsheet and the final analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, ver 26.0. For statistical significance, a p value of less than 0.05 was considered statistically significant.

Result:
All the patients completed the study without any major complications or requiring a change of anaesthetic or surgical technique.

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 08, 2023

Table 1:-Comparison of demographic characteristics between group S and G.

Demographic characteristics	Group S(n=35)	Group G(n=35)	Total	P value
Gender				
Female	23 (65.71%)	26 (74.29%)	49 (70%)	0.434‡
Male	12 (34.29%)	9 (25.71%)	21 (30%)	
Age(years)				
Mean ± SD	38.83 ± 9.21	37.4 ± 7.95	38.11 ± 8.57	0.489*
Median(25th-75th percentile)	38(30.5-48)	38(30-44)	38(30-45.75)	
Range	18-50	25-50	18-50	

*** Independent t test, ‡ Chi square test**

Distribution of gender was comparable between group S and G. (Female:- 65.71% vs 74.29% respectively, Male:- 34.29% vs 25.71% respectively) (p value=0.434).

Mean ± SD of age(years) in group S was 38.83 ± 9.21 and group G was 37.4 ± 7.95 with no significant difference between them. (p value=0.489). It is shown in table 1.

Comparison of mean Pulse rate (per minute) between group S and group G

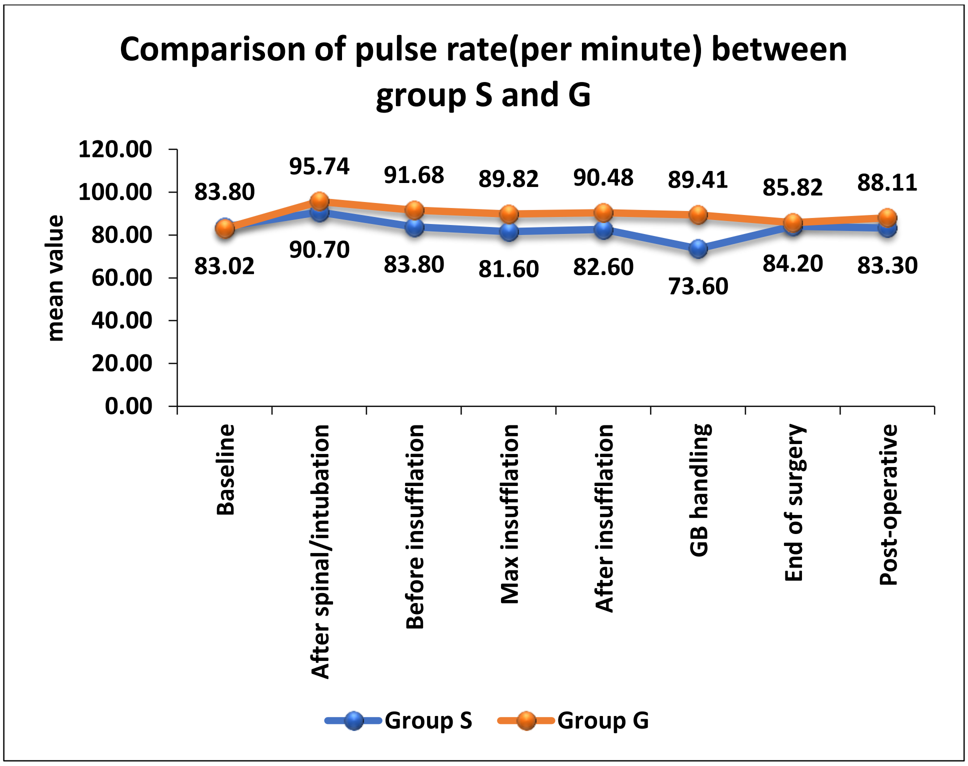

Figure 1:-Comparison of the trend of pulse rate (per minute) at different time intervals between group S and G.

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 08, 2023

In group S, variations in pulse rate (per minute) from the baseline (83.8 ± 9.71) were seen after giving spinal and during GB handling. The mean ± SD of pulse rate after spinal and GB handling was 90.7 ± 18.15 and 73.6 ± 16.28 respectively. Pulse rate before insufflation, max insufflation, after insufflation, end of surgery and immediate post op was 83.8 ± 20.09, 81.6 ± 20, 82.6 ± 20.43, 84.2 ± 12.16 and 83.3 ± 8.86 respectively and did not show much variation. In group G, an increase in pulse rate (per minute) from the baseline (83.02 ± 8.7) was seen after intubation (95.74 ± 10.72) and did not show much variation before insufflation (91.68 ± 10.25), max insufflation(89.82 ±11.17), after insufflation (90.48 ± 10.29), GB handling (89.41 ± 10.96), end of surgery (85.82 ± 6.51) and immediate post op (88.11 ± 6.31). It is shown in figure 1.

Comparison of mean systolic blood pressure (mm Hg) between group S and group G

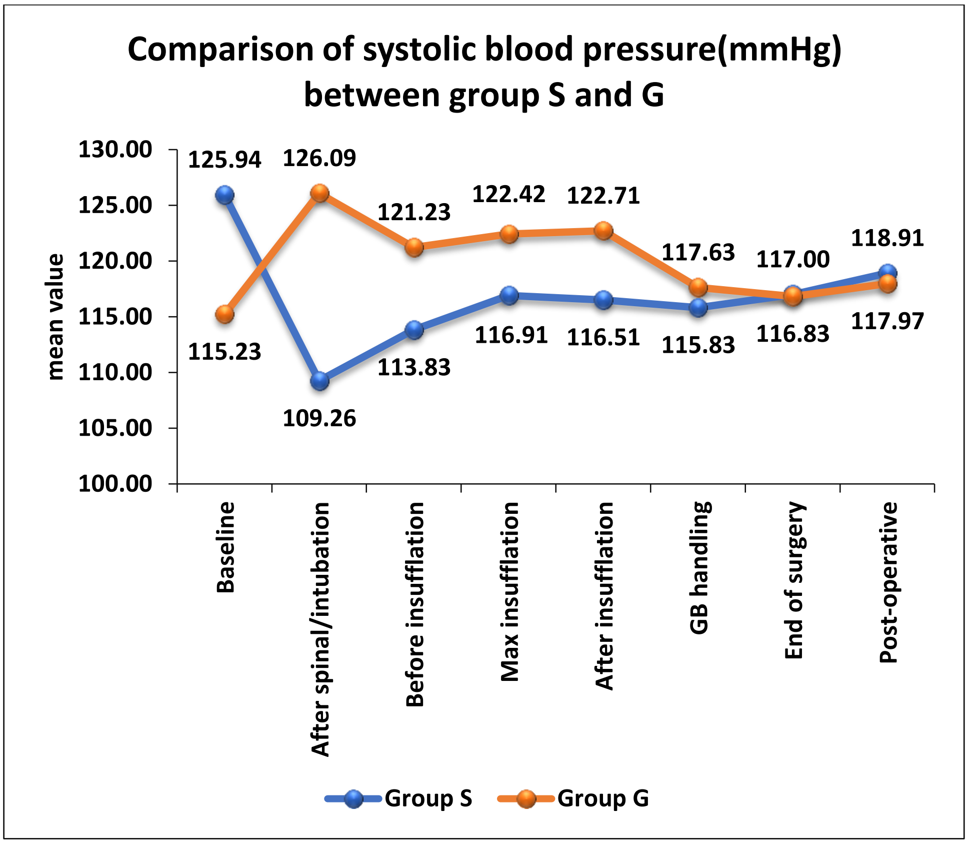

Figure 2:-Comparison of the trend of systolic blood pressure(mmHg) at different time intervals between group S and G.

In group S, a decrease in mean systolic blood pressure(mm Hg) from the baseline (125.94 ± 11.16) was seen after giving spinal (109.26 ±10.23). The values before insufflation (113.83 ± 14.13) ,max insufflation(116.91 ± 20.57), after insufflation (116.51 ± 13.24) , GB handling (115.83 ± 12.84) , end of surgery (117 ± 9.03) and immediate post op (118.91 ±

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 08, 2023

11.06) did not show much variation .In group G, an increase in mean systolic blood pressure(mm Hg) from the baseline (115.23 ± 9.04) was seen after intubation (126.09 ±9.84). The values before insufflation (121.23 ± 9.74) ,max insufflation (122.42 ± 11.65) , after insufflation (122.71 ± 7.86) , GB handling (117.63 ± 8.86) , end of surgery (116.83 ± 8.84) and immediate post op (117.97 ± 8.63) did not show much variation . It is shown in figure 2.

Comparison of mean diastolic blood pressure (mm Hg) between group S and group G

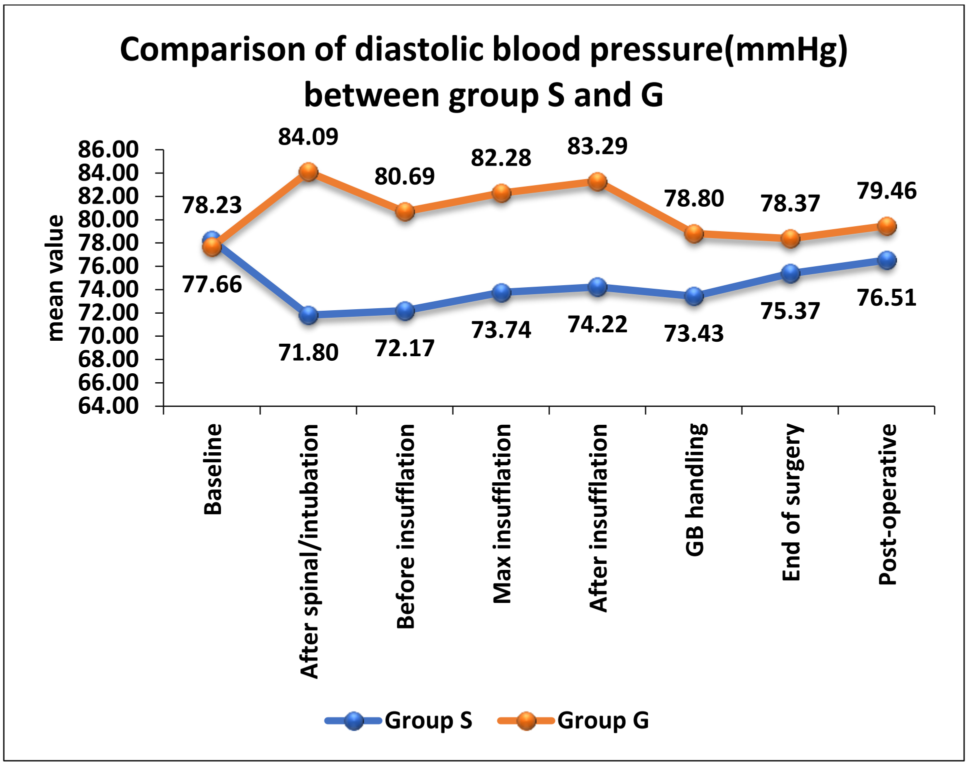

Figure 3:-Comparison of the trend of diastolic blood pressure(mmHg) at different time intervals between group S and G.

In group S, a decrease in mean diastolic blood pressure(mm Hg) from the baseline (78.23 ± 6.34) was seen after giving spinal (71.8 ± 8.81). The values before insufflation (72.17 ± 10.04) ,max insufflation(73.74 ± 10.89), after insufflation (74.22 ± 8.79) , GB handling (73.34 ± 8.04) , end of surgery (75.37 ±7.97) and immediate post op (76.51 ±6.51) did not show much variation .

In group G, an increase in mean diastolic blood pressure(mm Hg) from the baseline (77.66 ±6.15) was seen after intubation (84.09 ± 9.87). The values before insufflation (80.69 ± 9.62), max insufflation (82.28 ±10.32), after insufflation (83.29 ±8.44), GB handling (78.8 ±

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 08, 2023

7.57), end of surgery (78.37± 6.93) and immediate post op (79.46 ± 6.04) did not show much variation. It is shown in figure 3.

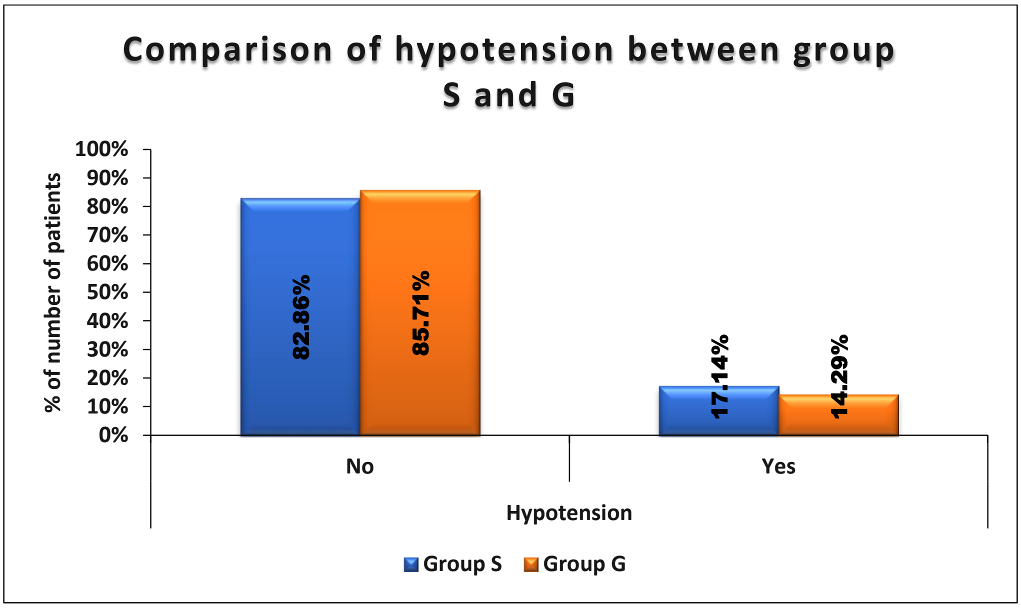

Figure 4:-Comparison of hypotension between group S and G.

Distribution of hypotension was comparable between group S and G. (17.14% vs 14.29% respectively) (p value=0.743). It is shown in figure 4

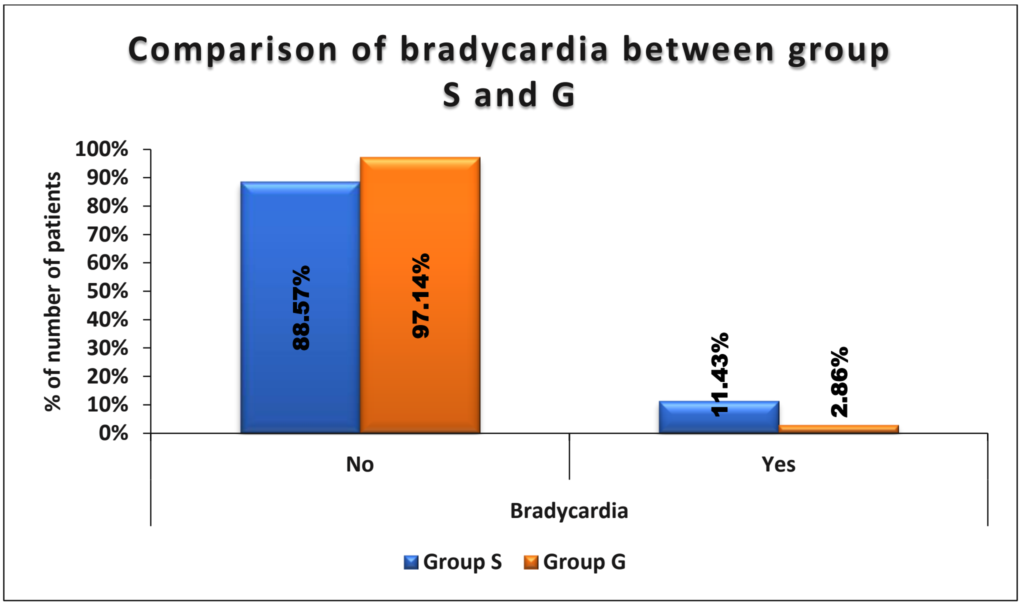

Figure 5:-Comparison of bradycardia between group S and G.

The distribution of bradycardia was comparable between group S and G. (11.43% vs 2.86% respectively) (p value=0.356).

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 08, 2023

It is shown in figure 5.

DISCUSSION

Intraoperative hemodynamic changes are common undesired consequences of spinal anaesthesia. In our study surgeries were uneventful, except for some cases which developed episodes of hypotension and bradycardia that were managed effectively. All the procedures were completed by the allocated method of anaesthesia and there were no conversions from spinal to general anaesthesia. Significant variation was seen in pulse rate(per minute) after giving spinal and during GB handling in group S. The increase in PR from the baseline can be explained as a reflex response to the fall in BP after giving spinal anaesthesia. During GB handling the decrease in PR that was observed may be due to vagal stimulation. In group G, the increase in PR after intubation is a result of hemodynamic response to laryngoscopy and intubation. Bradycardia is an expected side effect due to rapid peritoneal stretch and vagal stimulation in laparoscopic cholecystectomy operations.[6] Bradycardia is observed also in spinal anaesthesia in most cases due to the inhibition of T1-4 cardio accelerator fibres and decreased right atrial filling. However, studies have reported that this can be prevented by fluid replacement and vasopressor addition.[7] Turkstani et al. reported that 8% of the spinal anaesthesia group had bradycardia requiring atropine injection.[8] In our study the incidence of bradycardia (P=0.356) was 11.43% and 2.86% in group S and group G respectively. Mehta et al [9] and Gautam et al [10] did not find any incidence of bradycardia in any of their groups. In the study conducted by Swathi et al [11] out of the 30 patients in the spinal anaesthesia group, only 2 patients required treatment for bradycardia. A significant decrease in blood pressure after giving spinal anaesthesia in group S is due to the sympathetic blockade followed by a decrease in systemic vascular resistance and cardiac output. In our study, we had hypotension in 6 cases of spinal anaesthesia (17.14%) and 5 cases of general anaesthesia (14.29%). Several authors have reported this known complication in the spinal anaesthesia group due to sympathetic blockade and mechanical effect of pneumoperitoneum leading to reduced venous return ,peripheral vasodilation [12] increased intra abdominal pressure and reversed Trendelenburg position.[13] Sinha et al [14] noted an incidence of hypotension requiring support as 20.05% in their series. In the study by Mehta et al ;[9] hypotension was noted in 9 (30%) cases of spinal anaesthesia, out of which mephentermine 6 mg was given in only 2 cases and the rest were managed with iv fluids, while in the general

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anaesthesia group, hypotension was noted in 3 (10%) cases and all of them were managed with iv fluids. Tzovaras et al; [2] found that intraoperative hypotension is a well known adverse effect of spinal anaesthesia which was easily managed and did not affect the planned procedure. General anaesthesia is also commonly associated with hypotension caused by the vasodilatory and negative inotropic effects of many anaesthetic agents. In both cases, hypotension can be effectively managed with the judicious use of fluids and vasopressors.[15]Hypotension and bradycardia in our patients were easily treated with Inj. Mephentermine and inj. Atropine respectively. In our study, we noticed that pre anaesthetic hydration of patients with 10ml/kg of ringer lactate prevents the repeated occurrence of hypotension as compared to previous studies. The reason for hypotension in our study may be related to higher doses of the drug. However, various studies show that it can be easily prevented by preloading the patient, reducing the head tilt, reducing the intra-abdominal pressure and the use of vasopressors.[16] The decrease in pulse rate and BP in group S as compared to group G can be explained as a decrease in pain caused by the residual analgesic effect of local anaesthetic in subarachnoid space. Although recent studies have shown that laparoscopy in patients with regional anaesthesia may be tolerated well, shoulder tip pain can be a significant intraoperative problem which is caused by the irritation of the subdiaphragmatic area with CO_2 and is reported to be seen in 25% of laparoscopic cases performed under spinal anaesthesia.[17] This area is innervated by phrenic nerve originating from the 3rd to 5th cervical nerve roots. Normally this level is not blocked, and the pain cannot be prevented in conventional spinal anaesthesia .In our study, only 4 patients developed shoulder pain that was treated with inj. ketamine 0.5 mg/kg iv. However, the pain was mild and disappeared in a short time, and conversion to general anaesthesia due to shoulder pain was not required in any patient. Previous studies [18] have shown that maintaining intra-abdominal pressure below 10 mmHg reduces right shoulder pain and respiratory distress due to diaphragm irritation. Yuksek et al,[19] reported incidence of intraoperative right-shoulder pain in 50%; it was severe enough to necessitate anaesthetic conversion in three patients (10.3%) and in five patients (17.2%), additional spraying of the diaphragm with 2% lidocaine solution was required for control of the pain. One of the limitations of our study is the high intraabdominal pressure created during pneumoperitoneum. This affected hemodynamic values negatively and contributed to the occurrence of shoulder pain. Imbelloni et al. worked under pressure of 8 mm Hg and applied intraperitoneal local anaesthetic when patients felt pain. In this way, they reduced the rate of

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shoulder pain by 47% to 20%.[20] However, it should be kept in mind that low pneumoperitoneum pressure may lead to limited surgical vision. In our case, the surgical team was satisfied with sufficient abdominal relaxation during the operation in spinal anaesthesia. However, further studies with a larger sample size may be conducted to support observations. All of our patients in the spinal anaesthesia group remained awake and oriented at the end of surgery. A smooth transition of pain in the postoperative period was found in spinal anaesthesia which is an added advantage. Avoidance of GA and opioids must have contributed to the lack of deterioration in cognitive function. There was no aspiration or neurological complaint intraoperatively. In our study, all of the patients were discharged on the 1st day postoperatively. In fact, the patients with spinal anaesthesia were allowed to be discharged earlier but they were kept in the hospital for 24 hours for surgical considerations.

BIBLIOGRAPHY

1. Tiwari S, Chauhan A, Chaterjee P, Alam MT. Laparoscopic cholecystectomy under spinal anaesthesia: A prospective, randomised study. J Minim Access Surg. 2013 Apr;9(2):65-71.
2. Tzovaras G, Fafoulakis F, Pratsas K, Georgopoulou S, Stamatiou G, Hatzitheofilou C. Spinal vs general anesthesia for laparoscopic cholecystectomy: interim analysis of a controlled randomized trial. Archives of Surgery. 2008 May 1;143(5):497-501.
3. Berberoglu M, Dilek ON, Ercan F, Kati I, Ozmen M. The effect of CO2 insufflation rate on the post laparoscopic shoulder pain. J Laparoendosc Adv Surg Tech A 1998;8:273-7.
4. Yu G, Wen Q, Qiu L, Bo L, Yu J. Laparoscopic cholecystectomy under spinal anaesthesia vs. general anaesthesia: a meta-analysis of randomized controlled trials. BMC anesthesiology. 2015 Dec;15(1):1-9.
5. Bayrak M, Altıntas Y. Comparing laparoscopic cholecystectomy in patients with chronic obstructive pulmonary disease under spinal anesthesia and general anesthesia. BMC surgery. 2018 Dec;18(1):1-6.
6. Myles PS. Bradyarrhythmias and laparoscopy: a prospective study of heart rate changes with laparoscopy. Australian and New Zealand journal of obstetrics and gynaecology. 1991 May;31(2):171-3.
7. Longo MA, Cavalheiro BT, de Oliveira Filho GR. Laparoscopic cholecystectomy under neuraxial anesthesia compared with general anesthesia: Systematic review and meta-analyses. Journal of Clinical Anesthesia. 2017 Sep 1;41:48-54.
8. Turkstani A, Ibraheim O, Khairy G, Alseif A, Khalil N. Spinal versus general anesthesia for laparoscopic cholecystectomy: A comparative study of cost effectiveness and side effects. Anaesthesia, Pain & Intensive Care. 2019 Feb 8:9-14.
9. Mehta PJ, Chavda HR, Wadhwana AP, Porecha MM. Comparative analysis of spinal versus general anesthesia for laparoscopic cholecystectomy: A controlled, prospective, randomized trial. Anesthesia, essays and researches. 2010 Jul;4(2):91.

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 08, 2023

10. Gautam B. Spinal anaesthesia for laparoscopic cholecystectomy: A feasibility and safety study. Kathmandu University Medical Journal. 2009;7(4):360-8.
11. Swathi S, Nagaraj A.V, Nataraj MS. Spinal anaesthesia for laparoscopic cholecystectomy: A comparison with general anaesthesia regarding haemodynamic and respiratory stability. Indian Journal of Clinical Anaesthesia, April-June, 2019;6(2):254-257
12. Liu X, Wei C, Wang Z, Wang H. RETRACTED ARTICLE: Different anesthesia methods for laparoscopic cholecystectomy.Der Anaesthesist. 2011 Aug;60(8):723-8.
13. Hirvonen EA, Poikolainen EO, Pääkkönen ME, Nuutinen LS. The adverse hemodynamic effects of anesthesia, head-up tilt, and carbon dioxide pneumoperitoneum during laparoscopic cholecystectomy. Surgical endoscopy. 2000 Mar;14(3):272-7.
14. Sinha R, Gurwara AK, Gupta SC. Laparoscopic cholecystectomy under spinal anesthesia: a study of 3492 patients. Journal of Laparoendoscopic & Advanced Surgical Techniques. 2009 Jun 1;19(3):323-7.
15. W.Rattenberry, A Hertling and R. Erskine .spinal anaesthesia for ambulatory surgery. BJA Education, 2019(10): 321-328
16. Hartmann B, Junger A, Klasen J, Benson M, Jost A, Banzhaf A, Hempelmann G. The incidence and risk factors for hypotension after spinal anesthesia induction: an analysis with automated data collection. Anesthesia & Analgesia. 2002 Jun 1;94(6):1521-9.
17. Sarli L, Costi R, Sansebastiano G, Trivelli M, Roncoroni L. Prospective randomized trial of low-pressure pneumoperitoneum for reduction of shoulder-tip pain following laparoscopy. Journal of British Surgery. 2000 Sep;87(9):1161-5.
18. Gurusamy KS, Vaughan J, Davidson BR. Low pressure versus standard pressure pneumoperitoneum in laparoscopic cholecystectomy. Cochrane Database of Systematic Reviews. 2014(3)
19. Yuksek YN, Akat AZ, Gozalan U, Daglar G, Pala Y, Canturk M, Tutuncu T, Kama NA. Laparoscopic cholecystectomy under spinal anesthesia. The American journal of surgery. 2008 Apr 1;195(4):533-6.
20. Imbelloni LE, Fornasari M, Fialho JC ,Sant'Anna R, Cordeiro JA.General anesthesia versus spinal anesthesia for laparoscopic cholecystectomy. Revista brasileira de anestesiologia. 2010;60(3); 217-27