IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 15, Issue 6 Ver. X (June 2016), PP 07-12
www.iosrjournals.org

Regional Anaesthesia for Diagnostic Laparoscopic Gynaecological Procedures – Feasibility and Success

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Abstract
Background: *General anaesthesia has been the gold standard for laparoscopy , but trend is changing towards regional anaesthesia to provide fast track anaesthesia. This study was conducted to evaluate adequacy, safety and feasibility of subarachnoid block for diagnostic gynaecological laparoscopies with respect to maximum level of sensory and motor blockade, hemodynamic and respiratory monitoring, shoulder tip pain , recovery profile, rescue analgesia, surgeon's and patient's satisfaction.*
Methodology: *100 female patients scheduled for laparoscopy were given Subarachnoid block with 3ml of 0.5% hyperbaric Bupivacaine + Fentanyl. All patients received intravenous sedation Midazolam + Fentanyl . After creation of pneumoperitoneum, 20 ml of 0.25 % Bupivacaine was instilled intraperitoneally . Head low tilt of 15degree, IAP 10- 12 mmHg were maintained with low CO_2 gas flow.*
Results: *Results were analyzed with repeated measures ANOVA test. Hemodynamic parameters were stable . During pneumoperitoneum $ETCO^2$ showed increasing trend 35.222 +/- 1.922 to 39.778 +/- 2.728 (P<0.001) also accompanied by increase in respiration rate. Only 15% patients complained of shoulder pain , out of that 10% responded to intraperitoneal instillation of LA and 5% required additional supplementation of Fentanyl. Recovery profile was attained within 8 hrs. Patient & surgeon satisfaction was excellent in 85% cases.*
Conclusion: *Regional anaesthesia is better alternative for diagnostic gynaecological laparoscopy using low intraabdominal pressure, high sensory block , experienced surgeon and cooperative patient.*
Key words- spinal anaesthesia, Intraperitoneal instillation, laparoscopy

I. Introduction

Laparoscopy has reached to all fields of surgery because of minimum invasiveness, rapid recovery and better cosmetic results. It is the most common surgical procedure performed nowadays. Gynaecologic surgeries are its first applications. Anesthesia for laparoscopy, is complicated by pathophysiologic changes developed because of pneumoperitoneum and required positioning of the patient.[1] Offering anesthesia for these day care laparoscopies are challenging.

Initially general anaesthesia was gold standard for laparoscopy. But postop nausea vomiting, dizziness, postoperative pain remains major causes of delaying discharge of patients.[2] So to provide fast track anaesthesia , trend is changing towards regional anaesthesia. Subarachnoid block is advantageous because of awake patient, minimum drug cost and avoiding polypharmacy and airway intervention.

Shoulder tip pain yet remains the limiting factor for laparoscopy done under regional anesthesia. Intraperitoneal instillation of local anesthetic in right subdiaphragmatic region is one of the method described in literature to manage shoulder pain.[3] This method has been used in many studies for patients under general anaesthesia. We explored the efficacy of this technique under regional anaesthesia.

The aims of this prospective interventional study were to evaluate adequacy, safety and feasibility of subarachnoid block for laparoscopic diagnostic gynecological procedures. We assessed onset and duration of sensory and motor block, cardiorespiratory parameters, Ramsay sedation score, shoulder tip pain, recovery profile, any complications, surgeon's and patient's comfort and cost effectiveness.

II. Methodology

After institutional ethics committee approval, 100female patients were randomly selected of (ASA I & II), 18-65 years of age, undergoing elective diagnostic laparoscopic procedures. Patients having coagulopathy, infection , allergic to local anesthetic, refusal to give consent were excluded.

After written informed consent patients were wheeled inside operating room. Noninvasive monitors such as ECG, pulseoximeter, NIBP, end tidal CO_2 using nasal prongs in spontaneously breathing patients were attached. Patients were preloaded with lactateted Ringer's solution 10-15 ml/kg. For premedication Inj. Ondensetron was given. Sedation was achieved using Midazolam 0.03 mg /kg and Fentanyl 2mcg/Kg intravenously.

Under all aseptic precautions, Subarachnoid block was given with patient in lateral position by 23G Quincke spinal needle at L3- L4 space in midline. 3ml of 0.5% hyperbaric Bupivacaine + 25 mcg Fentanyl was injected intrathecally. After procedure, patient was turned supine. O_2 was supplemented with Hudson mask .Hemodyanamic parameters, sensory level and motor blockade were monitored every 5 minutes for first 30 minutes and every 10 minutes till the complete recovery of the motor blockade. Sensory block was assessed by pin prick & motor block by Modified Bromage scale.

Lithotomy position was given after achieving T6 sensory level. After intraabdominal placement of trocar & cannula, approx. 15 degree head low tilt was given. Pneumoperitoneum was created with low flow CO_2 1 lit/min. Through side port of cannula, 20 ml of 0.25 % Bupivacaine was instilled intraperitoneally in Right subdiaphragmatic region. Intraabdominal pressure was kept constant between 10-12 mmHg by maintaining low flow of CO_2 1-3 lit /min .

During intraoperative period, vital parameters were monitored such as- HR , BP, ECG,RR, SPO2, $ETCO_2$. Shoulder tip pain was assessed by VAS scores post pneumoperitoneum every 15 min till the end of surgery . Sedation was monitored using Ramsay sedation score every 15 min till patient recovers fully. Perioperative complications like hypotension, hypertension, bradycardia, nausea, vomiting , pruritus were noted .

Recovery profile was monitored with respect to -Time duration for 2 segment regression, Time to ambulation, Time to void urine. Patient and surgeon satisfaction was also documented at the end of surgery. Postoperatively pain was assessed at 0, 2, 4, 8, 12 hrs**.** For Rescue analgesia ,Diclofenac (1mg /kg IV) was given when VAS was more than 3 and time was noted.

Statistical analysis – Results were expressed as mean+/- SD. The recorded parameters were analyzed by GraphPad Instat DTCG statistical software using repeated measures (ANOVA) test , comparing within subject effect and confidence interval adjustment using Tukey-Kramer Multiple Comparisons Test. Statistical significance was considered at the level of $p< 0.05$.

III. Observation and results

Out of 100 patients, 84 were of ASA I and 16 of ASA II. The demographic data is given in table 1.

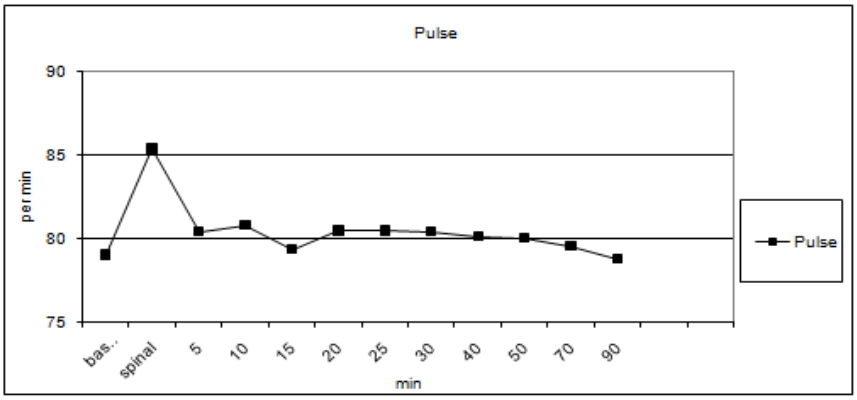
Table 1. Demographic data

Age	28.87 yrs +/- 5.839
Height	165.64 cm +/- 5.528
Weight	56.23 kg +/- 10.804

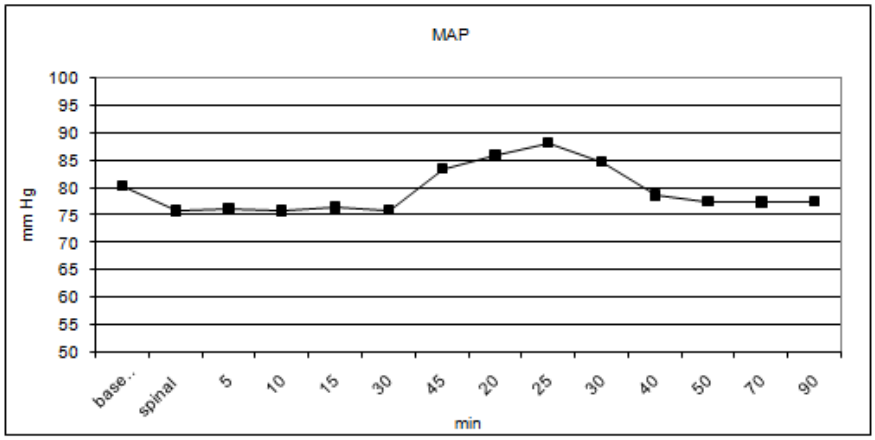
In this study, 87 patients, sensory block uptoT6 was recorded within 8+/- 1.080 min. Maximum sensory level upto T4 was recorded in 13 patients within 8.45+/- 1.010 min. Maximum modified Bromage scale (III) was achieved within 10.04+/-0.910 min in all patients.

Hemodynamic parameters like Heart rate and mean arterial blood pressure were maintained within +/- 20% of the preoperative value in 94% patients. 6 patients developed hypotension (> 20% decrease in BP from Baseline), but 4 patients responded to IV fluids and 2 patients required Inj. Ephedrine 6 mg.

Graph I: Hemodynamic parameter – pulse



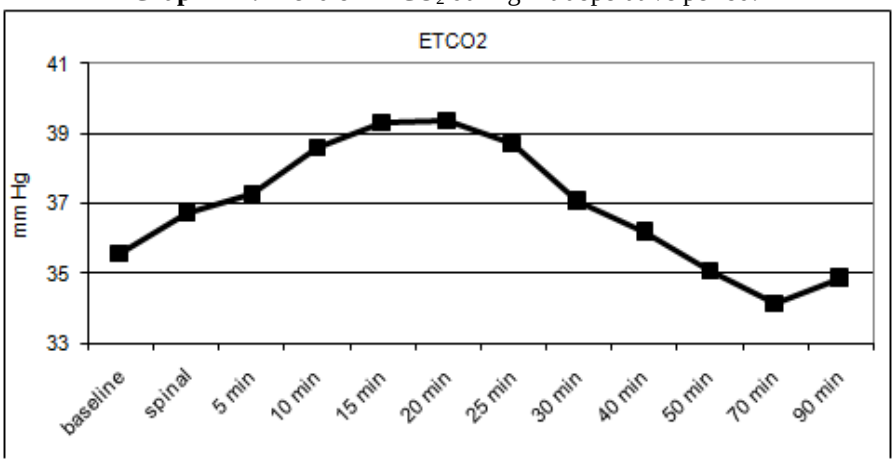
Graph II: Hemodynamic parameter MAP (mean arterial pressure)



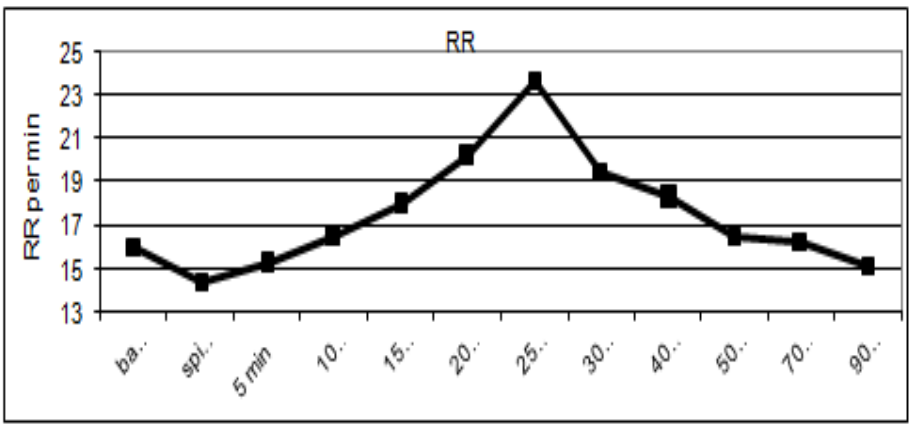
Oxygen saturation was maintained in all cases. Patients were comfortable and Ramsay sedation score was maintained 2-3 in periop period.

In $ETCO_2$ trend it was observed that , after CO_2 insufflation , there was significant increase in $ETCO_2$ from mean value of 35.222 +/- 1.922 to 39.778 +/- 2.728 (P<0.001). It was accompanied by increase in respiration rate from mean value of 16.0 +/-2.062 to 22.66+/-3.162 (P<0.001). It led to gradual decline of CO_2level . After desufflation the $ETCO_2$ and respiratory rate came down to baseline RR 16.333 +/- 2.739 (P>0.05) and $ETCO_2$ 35.667 +/- 2.121 (P>0.05) respectively. All the observed changes were well within physiological limits.

Graph III: Trend of $ETCO_2$ during Intraoperative period.



Graph IV: Trend of respiratory rate during Intraoperative period



During pneumoperitoneum, only 15% patients had shoulder pain. Out of that, 10 % patients complained of mild shoulder pain (VAS 1-3) and responded to intraperitoneal instillation of Bupivacaine within

10.45+/- 1.493 min. 5 % patients with moderate pain (VAS 4-7) required repeat Fentanyl dose 1 mcg/kg . Duration of pneumoperitoneum was 40.53 min +/- 14.151 and duration of surgery was 67.98 min+/- 13.782.
Incidence of complications was low, hypotension in 6 % ,mild pruritus in 4 % , nausea , vomiting in 6 % patients. All were treated accordingly.
Only 12 patients required rescue analgesia mainly after 8 hrs and supplemented with Diclofenac IV. 88% patients didn't require rescue analgesia in 24 hours. Operative data and recovery profile are shown in Table 3.

Table : Recovery profile of patients

Duration of pneumoperitoneum (min)	40.53 +/- 14.151
Duration of surgery (min)	67.98 +/- 13.782
Time for Two segment regression T6- T8 (min)	105.37 +/- 21.405
Time to void urine (hrs)	7.5473 +/- 0.62701
Time to ambulate (hrs)	7.8431 +/- 0.60329

Patient's recovery was achieved mostly within 8 hours .

Table 4 is showing patient's and surgeon's satisfaction about anaesthesia

	Excellent	Good	Average	Bad
Surgeon satisfaction	85%	11%	2%	2%
Patient satisfaction	88%	5%	5%	2%

IV. Discussion

The several advantages of laparoscopy over open abdominal surgery like reduced surgical trauma, less pain, fewer post-operative pulmonary complications, reduced postop morbidity , shorter recovery time and hospital stay has made laparoscopy, the procedure of choice. It has moved many surgeries into the outpatient arena and reduced overall costs. Amongst them diagnostic laparoscopic procedures are commonly performed.
In planning the mode of anesthesia, the pathophysiology of laparoscopic surgery and its possible effects on the patient, play major role. Therefore it is important to choose anesthetic agents which provide stable cardiorespiratory parameters , better postop pain control , early recovery and a low incidence of nausea and vomiting. These all criteria are fulfilled by regional anaesthesia.

But for laparoscopy, under regional anaesthesia, awake patient may feel discomfort due to pneumoperitoneum. It increases intraabdominal pressure and pushes diaphragm upward. Also blood, peritoneal fluid with dissolved CO_2 irritates diaphragm in trendelenberg position. So physical stretch and chemical irritation are main causes of shoulder pain during procedure. To deal with such problems in awake patient ,anaesthesia and surgical technique have to be optimised.

Intravenous sedation makes patients more cooperative and allay their anxiety. Yasser Ali et al also used a sedative combination of Ketamine and Propofol in addition to spinal anesthesia for sick patients for laparoscopy and found to be safe and efficient. [4] But we preferred Midazolam and Fentanyl because Ketamine has side effects such as increased secretions, hallucination.

High sensory block upto T6 abolishes the discomfort of surgical handelling of the gastrointestinal structures and provides good muscle relaxation which allows to create pneumoperitoneum with low IAP.
Lal et al recommended a sensory block upto T6 level or higher for the success of the laparoscopic inguinal hernia repair under epidural anesthesia.[5]In our study, IAP was maintained upto 12mmHg by keeping low CO2 insufflation rate. As IAP less than 15 mmHg , causes squeezing of venous bed and increases venous return. It maintains hemodynamic and respiratory parameters. The diaphragmatic and peritoneal stretch is also less, significantly reduces the shoulder pain and discomfort. Joshipura Vismit, Pradyumna M S et al, found under general anesthesia low pressure pneumoperitoneum significantly advantageous in terms of postoperative pain, use of analgesics, preservation of pulmonary function, and hospital stay during laparoscopic cholecystectomy.[6]
In our study, Head low tilt was restricted upto 15 degrees and was given after T6 level was achieved. This avoids sudden hemodynamic and respiratory changes and make awake patient more comfortable. A. A. J. van Zundert et al reported that avoidance of extreme degrees of head down tilt reduces shoulder tip pain because blood and other irritant fluids did not run onto the diaphragm. [7]

In our study, heart rate and mean arterial blood pressure were maintained within +/- 20 % of baseline values in 94% patients . This is probably because of adequate preloading and slow CO_2 insufflation, keeping low IAP. Hemodynamic effects of pneumoperitoneum such as hypertension, tachycardia were counterbalanced by sympathetic blockade due to subarachnoid block.

In other study conducted by Raju pusapati et al also found stable hemodynamics. It was attributed to the lithotomy and trendelenberg position, in maintaining the venous return and the attending cardiac output. [8]
In contrast to our findings, Yasser et al found a significant decrease in both heart rate and the mean arterial blood pressure under spinal anesthesia. Those changes were attributed to the sympathetic block and decreased after load.[4]

Critchley et al has presented the more alterations in hemodynamic parameters during pneumoperitoneum under general anesthesia with insufflation pressure of 15 mmHg. [9] It shows that as compared to GA , spinal anaesthesia maintains stable hemodynamics.

During intraperitoneal CO_2 insufflation, the increase in $ETCO_2$ was accompanied by significant increase in the respiratory rate to stabilize at a higher level but within physiological limits. After desufflation , $ETCO_2$ values came down to near the pre-operative value. This suggests that the ventilatory response to hypercapnia & inspiratory activity of the diaphragm are preserved under spinal anesthesia even in the settings of increased intra-abdominal pressure. Ciofolo et al and Chiu et al also reported increase in respiratory rate and minute ventilation to maintain arterial CO2 level during epidural anesthesia. [10, 11]

But in contrast to our study Raju pusapathi et al did not find any change in the respiratory rate with increasing P_ECO2 from 31.68+/- 4.13 to 37.62+/-4.21. They also showed no significant changes in ABG findings. [8] Shoulder pain is also one of the deterrent for laparoscopy under regional anaesthesia. In our study, 15% patients complained of shoulder discomfort and responded to intraperitoneal instillation of local anesthetic. The other contributory factors for such low incidence were high sensory block T6, adjuvants with local anesthetic (opiate) in spinal drug, adequate sedation, low intra-abdominal pressure, less head low tilt position and careful emptying of carbon dioxide pneumoperitoneum. Ghodki et al recommended subarachnoid block with intrathecal low dose Clonidine 30mcg to abolish shoulder pain.[12] Pursnani et al managed it with reassurance or simple analgesics like intravenous Tramadol and Diclofenac.[13]Hamad and El-Khattary found only1patient out of 10 for laparoscopic cholecystectomy under spinal anesthesia had to be converted to general anesthesia due to intolerable shoulder pain. [14]In contrast to our study, Hirschber et al stated that most of the patients in their study experienced severe agitation and chest pain due to the lack of efficient sedation or a low level of the block.[15]Tzovaras et al experienced some degree of shoulder pain in 43% patients, but only half of those patients required treatment. [16]

Intraperitoneal instillation of local anesthetics such as Bupivacaine is one of the proven methods for shoulder pain relief. There are many studies stating its usefulness for post-operative shoulder pain relief under general anesthesia. This is the first study to use this method under subarachnoid block in awake patient to see its efficacy. It has onset in 10-12min and provides intraoperative pain relief for shoulder pain.

N Malhotra et al also reported intraperitoneal Bupivacaine as a good option to relieve immediate postoperative pain, reducing analgesic doses in women after laparoscopic surgery.[17]

Patients were awake and oriented throughout the procedure with no postoperative pain, absence of nausea , vomiting. They were able to ambulate and void urine within 8 hrs. Thus subarachnoid block provides fast track anesthesia.

G. Tzovaras also found spinal anaesthesia for laparoscopic cholecystectomy , very advantageous for the patients, mainly better postoperative pain control and good recovery. [16]In 87% patients had good experience. Only 2% patients were uncomfortable because of long duration of procedure. In 90% cases surgeon were comfortable. Subarachnoid block provides good muscle relaxation which reduces the intra-abdominal pressure required for pneumoperitoneum & provides adequate working room in abdominal cavity.

Similar results were seen in study conducted by Lee et al.[18]The surgeon found no difficulty related to the technique, and relaxation was enough to perform the Laparoscopic cholecystectomy under epidural anaesthesia. Postoperative nausea and vomiting, which are common after general anesthesia, were also not seen in our patients. Other studies also reported a very low incidence of complication under spinal anaesthesia.[14,16]Spinal anesthesia has lower postoperative mortality and fewer complications than general anesthesia, so spinal anesthesia seems more suitable for the minimally invasive laparoscopic surgery.[18]

The incidence of postoperative pain was very low in our patients. In post-operative period only 12% patients required rescue analgesia after 8 hrs. These results are in-agreement with Tzovaras G who found that there was minimal post-operative pain in patients undergoing laparoscopic cholecystectomy under spinal anesthesia when low flow and low insufflation pressure technique are used. [16]

Subarachnoid block is cost effective anesthesia because polypharmacy (Propofol, muscle relaxant , inhalational agents) was avoided compared to general anesthesia. Also due to low flow CO_2 insufflation only 5 CO_2 cylinders were used during study period as compared to 12 in previous year when cases were done under general anaesthesia. Patient could be discharged within 8-10 hrs of surgery.[19]

Lennox confirms our study by concluding that in ambulatory gynecologic laparoscopy small-dose spinal anesthesia is an effective alternative to a Desflurane general anesthetic in terms of cost and recovery profiles.[20]Future implications- With the advent of gasless laparoscopy and micro-laparoscopy, the role of spinal anesthesia will probably increase in the future. It will be advantageous in sicker patients with comorbid conditions where general anaesthesia outweighs risk in terms of patient outcome.[18]

Limitations of the study- We have not included patients with comorbid diseases who may have benefitted more from the regional technique. We have not compared general anesthesia with subarachnoid block

in laparoscopic surgeries. We have not monitored arterial blood gas investigation as it is invasive and not very sensitive.

V. Conclusion

Regional anesthesia is feasible and efficient for short duration laparoscopic procedures with cardiovascular stability , good postop pain relief, early recovery and minimal complications.

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