



ORIGINAL RESEARCH PAPER

Hepatobiliary Surgery

IMPROVED ERGONOMICS WITH SECTORISATION OF PORTS IN LAPAROSCOPIC CHOLECYSTECTOMY

KEY WORDS:

Musculoskeletal Injury To Surgeons, Laparoscopic Cholecystectomy, Sectorisation Of Ports, Ergonomics.

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ABSTRACT

The physical strains and injuries occurring to Laparoscopic surgeons in this era of minimal invasive surgery are quite a significant amount and is often neglected. Ergonomical principles of Laparoscopy are over and again re-examined to benefit the surgeons at work. In this trial we have compared the physical injuries occurring to the laparoscopic surgeons operating for a Laparoscopic Cholecystectomy using the conventional triangulation of ports technique with sectorisation of ports. The outcome of the study shows low incidence of physical strain when using sectorisation of ports technique in Laparoscopic cholecystectomy and that it could be a safe, feasible and surgeon friendly alternative for the conventional triangulation of ports.

Introduction

Laparoscopic Cholecystectomy has become the gold standard treatment for all benign diseases of Gall bladder since its inception in 1985. More than 90% of cholecystectomies are done laparoscopically in the current era. It is currently the most commonly performed laparoscopic surgery worldwide. In the wake of all advances comes the drawback. Laparoscopy is no exception for it. Performance of high volume of Laparoscopic surgeries has stressed the surgeon unknowingly. Laparoscopic cholecystectomy is one such surgery performed in high volume, on day to day aspect, with possibility of causing all known types of surgical stress injury to the operating surgeon. Conventionally the triangulation of working ports has been used and almost standardised in the practice of Laparoscopic Cholecystectomy. Ergonomics for the conventional Laparoscopic cholecystectomy has been studied in detail and it has been pointed out that the triangulation of working ports with optical port in the center has caused various stresses to the operating surgeon such as Hyper abduction injury to the shoulder, Extension injury to the neck, Hand muscle injury, Tenosynovitis of hand muscles and Carpal tunnel syndrome.

As an alternate and complete replacement for the conventional triangulation of ports, Sectorisation of ports technique is being appraised. Sectorisation is not a new technique; rather it is a more familiar technique as it is routinely followed in the Laparoscopic Appendectomy. Sectorisation involves placement of optical trocar lateral to the working trocars, so that the manipulation angle does not interfere with the optical axis. This old concept of Sectorisation has also been applied in performing Laparoscopic Cholecystectomy and was called as the French technique, popularly. Reclaiming its validity and precedence in prevention of surgical stress during Laparoscopic Cholecystectomy has been studied and compared with conventional triangulation technique in this trial. At the same time effectiveness of Sectorisation of ports in dealing various Gall bladder pathologies and its ability to achieve the critical view of Strasberg have also been evaluated. Complications in the perioperative period and conversion rates to the conventional triangulation methods or even open cholecystectomy have also been documented.

AIM

The primary aim of the study was to study the incidence of physical injury to the operating surgeon in a Laparoscopic Cholecystectomy surgery by Sectorisation of Ports in parallel with the conventional Triangulation of Ports technique.

MATERIAL AND METHODS

The study was conducted as a clinical trial with approval from the Institutional Ethical Committee at the Department of Minimal Access Surgery, Madras Medical College, Chennai-03, during the period September 2016 to July 2018.

Sample selection

The patients diagnosed to have benign Gall bladder diseases (such as Symptomatic Cholelithiasis, Gall Bladder Polyps and Acute or Chronic inflammation of Gall bladder) and planned for elective Laparoscopic cholecystectomy were included in the study. Exclusions were those with untreated choledocholithiasis, previous upper abdominal surgeries, comorbidities like cirrhosis, ascites & coagulopathy and anaesthetic fitness with ASA grading of 3 and above.

Sample size for comparing 2 independent groups in this randomized controlled trial was derived based on previous studies as 44 per each group at power of 80%, significance of 0.05 and drop rate of 10%. [3,4]

METHODOLOGY

Random numbers were generated and used to allocate patients into two groups A & B. Group A patients were operated with conventional Triangulation port placement technique while the Group B patients were operated with sectorisation port placement technique during the laparoscopic cholecystectomy. Both groups were operated by a trained laparoscopic surgeon and the number of surgery was restricted to one per day.

The camera ports in both methods were kept at umbilicus, either supra or infra umbilically. In group A patients, the conventional triangulation technique included 4 ports with one camera port, one retraction port and two working ports. The two working ports included the right hand port at epigastrium at the level of liver edge, through the right of falciform ligament and the left hand port was approximately at the right midclavicular line below the right subcostal margin and to the left of the optical axis. The sectorisation technique also involved 4 ports with one camera port at umbilicus, standard retraction port at right anterior axillary line and the two working ports. Both the working ports were placed lateral to the Optical port, by definition.

The right hand port was kept at the same epigastrium but much high up (roughly 5 cm below the Xiphisternum) and at midline. The left hand port was kept at midway between the optical and the right hand port, and to the left of the midline. Standard Laparoscopic instruments, operating tables and energy devices (Monopolar and Bipolar) were followed in both groups.

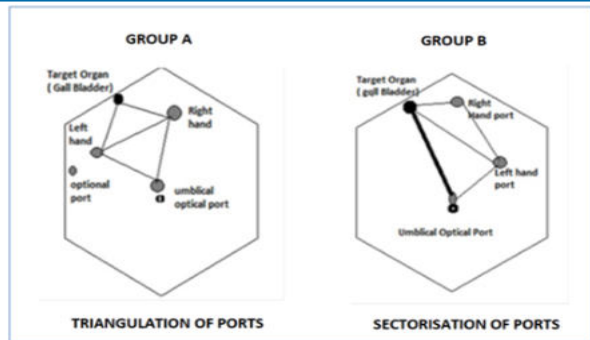


Figure 1. Port placements in Group A using triangulation and Group B using sectorisation techniques

A questionnaire was used to document the Injury to Surgeon immediately after each procedure. Scoring was also made based on the severity and number of the complications. A Score of 0 for nil injuries, score of 1 for mild & single injury lasting for few hours and score of 2 for multiple or severe injury lasting for more than a day, were given.

PARAMETERS	CONVENTIONAL LAP. CHOLECYSTECTOMY	SECTORISATION TECHNIQUE OF LAP. CHOLECYSTECTOMY
SHOULDER PAIN		
WRIST PAIN		
HAND MUSCLE INJURY		
EYE STRAIN		
NECK PAIN		
STRESS EXHAUSTION		

GRADE

0- NIL INJURIES

1- SINGLE AND MILD INJURY LASTING FOR FEW HOURS

2- MULTIPLE OR SEVERE INJURY LASTING MORE THAN A DAY

Figure 2. Questionnaire used for recording the injuries to the operating surgeon.

RESULTS

The age distribution in the study ranged from 12 years to 66 years with the (mean age 39 years) with 73 females and 15 males. The pathologies of the Gall bladder operated after histopathological examination included mainly symptomatic Cholelithiasis, followed by Chronic Calculous cholecystitis and Gall Bladder polyps. Physical injuries reported by the operated surgeons were more in Group A (21 out of 44). Stress exhaustion and hyper abduction shoulder injury was the common followed by the Hand muscle injury and wrist pain. Grade 2 injuries involving multiple or severe injury lasting for more than a day were documented in 6 cases. Injury to surgeon was more prevalent in obese individuals due to larger manipulation angles and poor leverage effects. Whereas in group B (sectorisation of ports), physical injury to the operated surgeon was reported in only 5 cases (11%). The documented injury type was hand muscle injury and wrist injury. There was no grade 2 type of injury reported in group B. But the surgeon had documented swording of instruments in about 7 cases. The average operating time and post-operative pain scores in patients of both groups were similar. The need of additional ports, inability to achieve critical view of Strasberg and conversion rates were little higher in the group B.

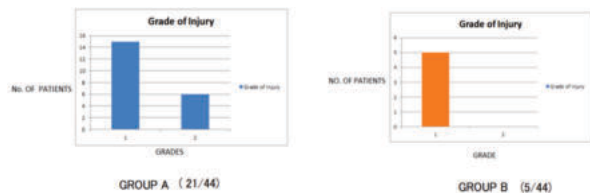


Figure 3. Incidence of Physical injuries to surgeon in both groups.

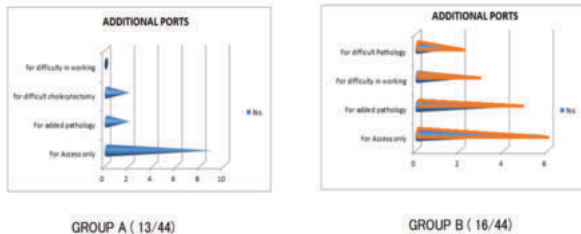


Figure 4. Need of additional ports to complete the surgery in both groups

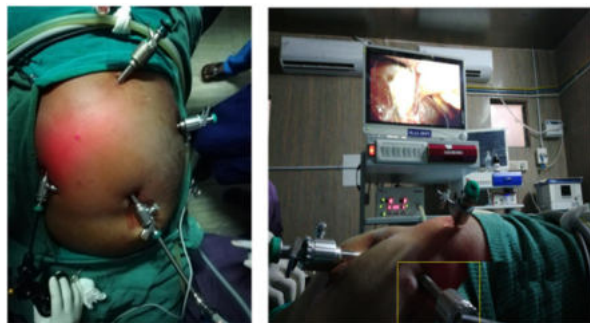


Figure 5. Intraoperative pictures of using sectorisation technique of ports in Laparoscopic cholecystectomy patient of Group B.

Table 1. Results of the study.

S.no.	Parameters	Group A (Conventional Triangulation of ports)	Group B (Sectorisation of ports)
1.	Number of participants	44	44
2.	Average operating time	52 minutes	57 minutes (25-150 min)
3.	Ability to achieve critical view of safety	42/44 2 cases converted to open surgery and completed.	38/44 5 converted to triangulation technique and completed 1 Case of pericholecystic abscess – only lap drainage done
4.	Additional ports requirement	13/44	16/44
5.	Conversions/ dropouts	2	6
6.	Average post-operative pain score in patients	4	4
7.	Physical injuries reported by operated surgeon	21/44 48%	5/44 11%

The chi-square statistic with Yates correction is 12.28. The p-value is .000457. Significant at p < .05.

DISCUSSION

Laparoscopic surgery provides patients with less painful surgery but is more demanding for the surgeon. There have been multiple reports of, thenar neuropathy, carpal tunnel syndrome, neck pain, eye strain, and cervical spondylosis among surgeons performing multiple laparoscopic procedures in high-volume centres [5,6,7]. In laparoscopic cholecystectomy, the optimal ergonomic orientation is provided when the surgeon stands behind the telescope but this frequently requires that a camera operator reach between the surgeon's hands to guide the telescope. So in American approach, in which the surgeon and camera operator stands on left side of patient side by side, the surgeon has to keep his left shoulder constantly abducted so that the camera assistant can manoeuvre the telescope under the abducted shoulder. There is also 10-20 degree flexion at the wrist joint of the surgeon's left-hand while grasping instruments with abducted arm which causes strains on the surgeon's wrist. In the French approach, the surgeon stands between the abducted legs of the patient and the camera assistant stands on the left side of patient. But still with this technique the camera assistant has to reach between the surgeon's hands to guide the telescope. It is really tire some for the surgeon to keep shoulder abducted and flexion at wrist in long and difficult surgeries. There have been frequent reports of shoulder pain due to abduction of shoulder (chicken wing scapula) during laparoscopy termed as 'laparoscopic shoulder', backache, hand finger joint pain, tenosynovitis, stress exhaustion, and hand muscle injury [8].

In order to overcome this problem, Sectorisation technique of ports placement was tried in which the second port was introduced on the left side of midline to retract the Hartmann's pouch of Gallbladder. With this approach surgeon can work with both elbows at the sides and the camera operator doesn't have to reach between the hands of the surgeon to guide the telescope. Both the wrists of surgeon remain in functional position of comfort during the procedure. In our study the percentage of Injuries was 11% in Group B compared to 48% in Group A and also the injuries reported in Group B was only Grade 1. Whereas the Group A surgeons suffered from more severe injuries of Grade 2 (13.6%). The type of reported injuries varied among the groups. Group A had all types of injury including Hyperabduction injury to shoulder, Stress exhaustion, Wrist injury, Hand muscle injury and Neck injury. But in the Group B only the Wrist injury and Hand muscle injury of Grade 1 type was reported. Muhammad Afzal Sindhu et al 2013 had reported with nil injuries in Sectorisation group. Overall the injuries to surgeon was significantly higher in Group A involving the conventional Triangulation of Ports in Laparoscopic Cholecystectomy and the factors augmenting the problem were High abdominal fat, Abdominal wall laxity including divarication of recti and the short & shout stature. The injuries reported in Group B was less significant and retrospective analysis of the cases shows that difficult pathology and anatomy may be a reason for the injuries caused and not the technique. The chronic calculous cholecystitis with fibrotic callot's triangle, fatty falciform ligament and overhanging left lobe of liver were the reasons claimed.

On the other hand there were instances of converting from sectorisation to conventional triangulation techniques in some difficult situations. Conversion is not a complication, not only in definition but also in Laparoscopy. The Conversion rates of Sectorisation method to Triangulation technique was around 11% (5 cases) to achieve the Strasberg's critical view of safety and the procedures were completed laparoscopically. The reasons found retrospectively was due to fatty falciform ligament and overhanging left lobe of liver obstructing the left hand working port in Sectorisation technique. The limitations of this study were that injuries reported were subjective to the surgeon, only experienced surgeons operated and average operating time was less than

an hour, which means the incidence recorded must be less than the actual in the reality with younger surgeons, use of biometric methods of recording the physical strains and longer operating times.

CONCLUSIONS

Sectorisation technique can be used as safe and effective alternative for the conventional Triangulation technique in Laparoscopic Cholecystectomy. Sectorisation technique can also be converted to Conventional Triangulation technique as and when indicated for ensuring safety and convenience of instrumentation. Sectorisation technique remarkably reduces injuries to the Operating Surgeon during the procedure of Laparoscopic Cholecystectomy such as laparoscopic shoulder, wrist joint strain, hand finger joint pain, stress exhaustion, and hand muscle injury.

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