

Medial Arcus Costae Eight (MACE) Incision Approach as an Alternative Cholecystectomy in Pandemic COVID 19

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Abstract

Background

Laparoscopic Cholecystectomy which requires expensive equipment, large-scale surgeon training, and generate aerosol has put most developing countries in inconvenience especially in COVID-19 Pandemic. Mini-laparotomy cholecystectomy has started replacing the prior method. This method is reported to give more advantage as morbidity and postoperative pain observed are lower than the prior method. Furthermore, transverse incision compared to oblique incision may result in better outcome due to the landmark MACE (Medial Arcus Costae Eight) salvaging more rectus abdominis muscle and lateral cutaneous nerve. This study observed postoperative pain, duration of surgery, length of hospital stay, and postoperative functional status between two groups.

Methods

This study was a cross-sectional study conducted in Saiful Anwar Hospital Malang's Surgery Clinic for 7 months. Originally, there were 64 subjects participated but 4 subjects dropped out due to organ adhesion. Each group had 30 subjects agreed to undergo mini-laparotomy cholecystectomy. Patients underwent surgery, were given ketorolac injection, wound care, and standard observation in the hospital. The data were analyzed using independent T test, Mann-Whitney test, and Chi-square test.

Results

There was a significant difference between the mean value of Visual Analogue Scale (VAS) 6 hour, 12 hour, and 24 hour after surgery between transverse incision mini-laparotomy group (4.0 ± 0.00 ; 2 ± 0.00 ; 2 ± 0.00) and oblique incision mini-laparotomy group (4.47 ± 0.86 ; 2.87 ± 1.63 ; 2.4 ± 0.81) ($p=0.005$; 0.005 ; 0.010).

Conclusion

Mini-laparotomy cholecystectomy with transverse incision produces lower pain level than oblique incision in 6-hour, 12-hour, and 24-hour post-surgery. No significant differences were found between two groups in terms of length of hospital stay, duration of surgery, and post-surgery functional status. In the future, more subjects and post discharge follow up are advised. This will allow to discover complication that may develop later regarding the surgery.

Keywords: Cholelithiasis, MACE, Mini-Laparotomy Cholecystectomy, Oblique Incision Pain, Transverse Incision

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I. Introduction

Laparoscopic Cholecystectomy which require expensive equipment and large-scale surgeon training has put most developing countries in inconvenience.¹ Since March 2020, due to COVID-19 Pandemic, the use of laparoscopy which generate aerosol has become a problem in Indonesia. The Aerosol may affect all operating team while releasing laparoscopic trocar, non-airtight gas exchange on instrument, gas leak on incision site, also during intubation and extubation using endotracheal tube.²

Mini-laparotomy cholecystectomy has been known since 1990's replacing the conventional subcostal incision. This finding is supported by 3 out of 4 randomized controlled trial. The modifications conducted by Dubois and Bethelot and Dan et al shown that this procedure is feasible and save (lower morbidity and postoperative pain).^{1,3} Also, no difference in operating time, difficulties, and complication was reported by Assalia et al.⁵

There are several approaches in mini-laparotomy cholecystectomy which includes oblique and transverse incision. The incision is 3-5 cm long parallel to costal arch for both methods. Less complication (0.2%) and patient readmitted after surgery (0.3%) were reported by Seale and Ledet with 1207 patients using 4-7 cm transverse incision and maximum rectus abdominis muscle conservation.⁴ Thomas et al reported 73.35% patients discharge on the day of surgery although complication and readmission also happened.⁵ Some of the research published used 5 cm long incision, also in this research the landmark called Medial Arcus Costae Eight

(MACE) is used. MACE is the technique in which transverse incision is made 2 cm medially from the 8th costae then widened 3 cm to the medial. This technique was reported to generate less pain than the other incision method. To add on, mini-laparotomy seems to be more advantageous attributable to lower cost, minimally invasive, availability in Indonesia, and no aerosol generated reasonably because of the use of spinal anesthesia. Therefore, mini-laparotomy cholecystectomy may become the alternative to the gold standard laparoscopy.²

Researchers have been comparing conventional cholecystectomy with laparoscopic cholecystectomy, but no detailed incision technique has been discussed. In response to this, writer decides to compare oblique and transverse incision prospectively in terms of postoperative pain, length of hospital stay, duration of surgery, and postoperative function status in cholelithiasis patients. Different incision approach produces distinct postoperative acute pain level in accordance to the structure affected. The pain mentioned are nociceptive pain caused by mechanical trauma, heat caused by the surgery cutting rectus abdominis muscle and branch of intercostal nerve which responsible in transmitting nociceptive pain impulse.

Abdominal wall is a complex anatomical structure consist of muscles, nerves, and vascular supplies. One of the structures is rectus abdominis muscle that is orientated longitudinally and wrapped in an aponeurosis then merges in the midline (linea alba). The vasculature of anterior part of the abdominal wall originates from superior and inferior epigastric artery. The innervation for the muscles originate from anterior division of T6-T12 spinal nerve. The skin above the structure are innervated by afferent branch of T4 through L1 and T10 nerve root⁶ Many organs are located in the abdominal wall one of which is gall bladder. It is a pear-shaped pouch about 7-10 cm long and 30-50 ml capacity, located in the inferior fossa of the liver.⁷

Incision and the methods used in abdominal surgery is very important. Hematoma, scars, incisional hernia, and disruption of wound edges may develop due to improper incision site, suturing methods, and suture material. Accessibility, Extensibility, and Security should be considered in determining incision site. Kocher subcostal incision is the appropriate incision site for open cholecystectomy. This technique provides optimal surgical field showing gall bladder and biliary duct.⁸

Mini-laparotomy cholecystectomy is a modified version of open cholecystectomy. The lengthwise incision (oblique incision) starts 4 cm laterally from the midline, 2 finger below the last costae on the right. The exposure of gall bladder and hepatoduodenal ligament is important to ensure the safety of the surgery. Calot's triangle and Common Bile Duct (CBD) is identified using index finger. Cystic duct is identified to avoid CBD injury, then cystic duct and cystic artery is separated before ligation. Ligation is done near the branch towards CBD. This technique may reduce the disadvantageous gained from wide incision in open cholecystectomy.⁹



Figure 1. Transverse Incision Mini-laparotomy (MACE) Procedure

As shown in Figure 1, these are the steps of transverse incision mini-laparotomy surgery. 1) after drapping, incision design is made by identifying the 8th costae and costal arch 2) incision is made 2 cm from the 8th costae then transversely 3 cm to the medial 3) deepen the incision sharply, until rectus abdominis muscle or tendinous inscription of the muscle is identified. Widen the field of view using langenbuch's retractor 4) cut the peritoneum transversely by scissor after retracted using 2 koecher 5) insert 1 clamp gauge to expose Calot's triangle then engage the structure using 2 smallest size Deaver's retractor 6) reach the gallbladder fundus using sponge holding forceps or kelly clamps 7) decompress the gallbladder by aspirating the content inside using syringe 8) dissection begins retrogradely by separating the gallbladder and liver bed until cystic duct is exposed. Cut the cystic duct distally from the ligated part 9) control the bleeding and close the incision layer by layer followed by applying antiseptic 10) suture the subcutaneous tissue.

Postoperative pain dominantly caused by inflammation in the incision site and tissue injury. Ischemia caused by tissue retraction due to vascular supply disruption may contribute to pain. This is shown by high level of lactate and high acidity level (pH) in incision site. Several risk factors for chronic postsurgical pain are classified by preoperative, intraoperative, and postoperative factors. Preoperative factors are moderate to severe pain lasting more than a month, repeat surgical procedure, psychological vulnerability, preoperative anxiety, female gender, younger age, genetic predisposition, and inefficient diffuse noxious inhibitory control. Intraoperative factor is surgical procedure with nerve damage risk. Postoperative factors are acute moderate to severe pain, radiation therapy, neurotoxic chemotherapy, depression, and psychological vulnerability.¹⁰ Degree of pain assessment is important, some criteria are used to acquire a more objective assessment. Wong-Baker Faces Pain Rating Scale, Verbal Rating Scale, Numeric Rating Scale, and Visual Analogue Scale are some of the methods of assessing pain intensity. The method chosen is based on patient's physical, emotional, and cognitive condition. Pain intensity is assessed regularly as it provides information of the effect of surgery and determines the use of analgetic.^{11,12}

Postoperative functional status is assessed using Barthel Index. Barthel index consist of 10 area of daily activities, with score ranging from 0-100. The detailed interpretation are 0-20 total dependency, 21-60 severe dependency, 61-90 moderate dependency, 91-99 slight dependency, 100 independent.¹³

II. Material And Methods

The design of this study was a cross-sectional clinical study comparing effects of transverse and oblique incision in mini-laparotomy cholecystectomy in cholelithiasis patients. This research has been ethically approved by the ethic committee of Faculty of Medicine Universitas Brawijaya Malang. The subjects are patients diagnosed with cholelithiasis who agreed on joining this research. Subjects are selected by using block randomization method with minimal 30 subject of each incision technique (transverse incision and oblique incision). The inclusion criteria are patients ranging from 40-60 years old, patients diagnosed with cholelithiasis based on physical examination, laboratory, and abdominal USG, patients who agreed to undergo cholecystectomy, and will received spinal anesthesia. The exclusion criteria are patients with complication such as acute cholecystitis and gall bladder tumor, patients with metabolic disease, history of elevated bilirubin, history of gall bladder surgery, and obesity. Drop out criteria is patients with complication (including organ adhesion) during surgery that needs widening of incision and other procedures than cholecystectomy.

Patients were evaluated in the Saiful Anwar Hospital Malang's Surgery Clinic and were planned to undergo the mini-laparotomy cholecystectomy. Patients were examined thoroughly regarding their symptoms, duration, diseases, history of surgery, complete physical examination, laboratory, echocardiography, thorax x-ray, and abdominal ultrasonography. Patients were given prophylactic antibiotic (cefazoline) 2 hours prior to the surgery. After surgery, patients were given injection of ketorolac (3x30 mg), wound care, and will be discharged if they had no complain with moderate dependency. The variable observed are degree of postoperative pain (assessed using Visual Analogue Scale 6,12,24,48 hours after surgery), length of hospital stay (less than until 2 days and more than 2 days), duration of surgery (less than until 1 hour and more than 1 hour), and postoperative functional status (Barthel index).

The data obtained then presented descriptively as shown in table 1. The variables were analyzed statistically using chi-square test, Independent T test if normally distributed else using Mann-Whitney test.

III. Results

This research was conducted for 7 months until July 2020 in Saiful Anwar Hospital Malang. There were 30 subject for each intervention group excluding 4 dropout subjects due to adhesion of gallbladder, omentum, and surrounding organs in the abdomen. No significant differences were found in gender and age between two groups hence confounding factors were able to be controlled. All subjects were hospitalized for two days, oral intake was given after surgery and no additional analgesics other than the protocol were given.

The mean age of subjects in the transverse incision group and oblique incision group was 45.5 ± 9.8 years old and 46.3 ± 10.5 years old respectively. There were 11 male and 19 female in transverse incision group while in oblique incision group there were 13 male and 17 female. Average bleeding volume for transverse incision and oblique incision group was 50 ± 0 and 52.0 ± 6.1 respectively (Table 1).

There was a significant difference between the mean value of Visual Analogue Scale (VAS) 6 hour, 12 hour, and 24 hour after surgery between transverse incision mini-laparotomy group (4.0 ± 0.00 ; 2 ± 0.00 ; 2 ± 0.00) and oblique incision mini-laparotomy group (4.47 ± 0.86 ; 2.87 ± 1.63 ; 2.4 ± 0.81) ($p=0.005$; 0.005 ; 0.010) (Table 2).

Table 1 Respondent’s characteristic for both intervention groups

Variable	Transverse incision mini-laparotomy		Oblique incision mini-laparotomy	
	n(%)	Mean \pm SD	n(%)	Mean \pm SD
Age (years)		45.5 ± 9.8		46.3 ± 10.5
Gender				
Male	11(36.7)		13(43.33)	
Female	19(63.33)		17(56.67)	
Bleeding Volume (cc)		50 ± 0		52.0 ± 6.1

Total subjects for each group are 30 patients

Table 2 Variables observed between two intervention groups

Variable	Transverse incision mini-laparotomy	Oblique incision mini-laparotomy	p value	r
	n(%)	Mean \pm SD		
VAS 6-hr after surgery		4.0 ± 0.00	4.47 ± 0.86	0.005^*
VAS 12-hr after surgery		2 ± 0.00	2.87 ± 1.63	0.005^*
VAS 24-hr after surgery		2 ± 0.00	2.4 ± 0.81	0.010^*
VAS 48-hr after surgery		0.0 ± 0.0	0.2 ± 0.61	0.078^*
Length of hospital stay				
≤ 1 day	30(50)		27(45)	0.076^\dagger
>1 day	0(0)		3(5)	0.224
Duration of surgery				
≤ 1 hour	30(50)		27(45)	0.076^\dagger
>1 hour	0(0)		3(5)	0.224
Postoperative functional status		95.0 ± 0.0	92.5 ± 7.63	0.078^*

VAS = Visual Analogue Scale

*mann-whitney test

\dagger chi-square test

IV. Discussion

Significant differences were found in 6-hour, 12-hour, and 24-hour post-operative pain between two groups. The pain observed were thought to be local pain from surgical wound. Lower pain levels were found in transverse incision group in accordance to the advantage gained from the incision landmark (Medial Arcus Costae Eight/MACE). Incision done on this landmark was parallel to lateral cutaneous nerve responsible in conducting pain while in oblique incision, 2-3 nerves may be cut. Transverse incision was done on tendinous inscription lateral of 8th costae which has less vasculature and innervation. The procedure produces less bleeding and rectus abdominis injury thus less pain associated with cauter occurred. Other advantage gained from transverse incision was better visualization of gallbladder hence the surgery went well with average surgery time of 30 minutes and no complication.

No significant differences were found in length of hospital stay, duration of surgery, functional status after surgery between two groups. Mini-laparotomy is a minimally invasive procedure hence duration of wound closure will approximately be the same between two group. This procedure also produced no acute complication thus, length of hospital stay and functional status in both groups appear to be the same.

Limitations of this study are limited subjects observed, limited post-surgery observation time due to limited time and resource. Further observations are needed in order to obtain more data regarding complications that may develop later in the future.

V. Conclusion

Mini-laparotomy cholecystectomy with transverse incision produces lower pain level than oblique incision in 6-hour, 12-hour, and 24-hour post-surgery. No significant differences were found between two groups in terms of length of hospital stay, duration of surgery, and post-surgery functional status. In the future,

more subjects and post discharge follow up are advised. This will allow to discover complication that may develop later regarding the surgery.

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