Bupivacaine intermittent wound irrigation is an effective and cost-reducing modality for postoperative analgesia after open cholecystectomy

Ahmed Zeidan,[a] *MD;* ***Hussein G El-Gohary,***[a] *MD;*
Ashraf M Abd elkader,[a] *MD;* ***Mohamed Fouad,***[b] *MD*

a) Department of General Surgery, Benha University, Benha, Egypt.
b) Department of Anesthesia, Benha University, Benha, Egypt.

Abstract

Objectives: To evaluate postoperative outcome of open cholecystectomy in patients receiving local anesthetic (LA) wound irrigation (WI) for postoperative (PO) analgesia.

Patients & methods: The study included 40 female patients with mean age of 34.1±3.4 years. All surgeries were performed through Kocher's subcostal incision, during muscle cutting, the neurovascular bundle was identified and after peritoneal drainage and closure, an 8F neonatal feeding catheter with fashioned multiple pores was inserted partly between anterior abdominal wall muscles and partly under subcutaneous tissue directly on the neurovascular bundle. Patients were divided into: Control group (Group C) who received WI using 0.9% saline and study group (Group S) who received 8-hourly WI using 20 ml of bupivacaine 0.25% for 48 hours. Wound pain was assessed using 10-mm visual analogue scale (VAS). Duration of PO analgesia and frequency of requests and total dose of intravenous mepridine, time for first ambulation and oral intake were recorded. All patients were discharged after irrigation catheter removal on the morning of the 3rd PO day.

Results: All surgeries were completed uneventfully without complications within a mean operative time of 46.5±5.3 minutes. Patients who received LA irrigation showed significantly longer duration of analgesia with significantly lower frequency of requests and total dose of mepridine and lower cumulative VAS pain score compared to control group. Mean time till 1st ambulation and oral intake was significantly shorter in Group S compared to group C. Seven patients had postoperative nausea and/or vomiting (PONV), 4 in control and 3 in study group and only one patient in control group required stoppage of oral intake, but all patients responded well to antiemetic therapy.

Conclusion: Wound irrigation with bupivacaine significantly improved outcome of open cholecystectomy and could be advocated for various open surgical procedures. The applied modality was safe, effective and cost reducing with significant opioid sparing effect.

Key words: Wound irrigation, bupivacaine, laparotomy.

Introduction:

Despite the widespread use of laparoscopy, open surgery still constitutes one of the most frequent approaches for surgical management of various pathologies. The control of pain following these operations represents a major challenge as highly complex nociceptive pathways are involved especially if surgery required extensive dissections, or bowel resection and anastomosis.[1-3]

Moreover, postoperative period is accompanied with neuroendocrine, metabolic and immune alteration which is caused by tissue damage, anesthesia, postoperative pain and psychological stress. Postoperative pain contributes to dysfunction of immune response as a result of interaction between central nervous and immune system. The

postoperatively activated hypotalamo-pituitary-adrenocortical axis, sympathic and parasympathic nerve systems are important modulators of immune response. According to bidirectional communication of immune and nervous system, appropriate postoperative pain management could affect immune response in postoperative period and helps to ameliorate the postoperative catabolic state.[4,5]

However, post-laparotomy pain may not be amenable to pharmacological monotherapy, and systemic application of opiates for pain relief after open abdominal operations was found to be insufficient and intensive pain was noted in 58% of patients, while they are moving, and in 26%--in a rest state.[5]

Modern analgesic strategies involve the combination of many agents including parenteral opiates, non-steroidal anti-inflammatory drugs, paracetamol and epidural infusion techniques. Unfortunately, there is no ideal analgesic regimen and all current techniques have disadvantages in the form of important side-effects, cost, patient compliance, procedural complications and delays in discharge.[6,7]

For patients who had laparotomy, it is mandatory to provide the optimal pain control using drugs free of side effects related to gastrointestinal motility or inducing respiratory complications, because this will hinder return of gastrointestinal motility thus delaying return to oral intake and subsequently elongates the duration of hospital stay.[8-10] Wound perfusion with local anesthetic is a promising modality for postoperative analgesia especially in cases requiring potent analgesics for a duration longer than the immediate postoperative period.[11,12] Thus, the present prospective placebo-controlled study aimed to evaluate the postoperative outcome of open cholecystectomy in patients receiving local anesthetic wound irrigation for postoperative analgesia.

Patients and methods:

The present study was conducted at Departments of General Surgery and Anesthesia, Benha University Hospital since Dec 2010 till May 2012. After approval of the study protocol by the Local Ethical Committee and obtaining fully informed written patients' consent; 40 female patients assigned for open cholecystectomy were enrolled in the study.

Exclusion criteria included morbid obesity with body mass index >35 kg/m^2, chronic pain, liver disease, psychological disorders and lactation. Also, patients with history of allergic disorders or development of adverse reactions to local anesthetics were excluded.

Enrolled patients underwent full history taking, complete physical examination and radiological assessment. All surgeries were conducted under general anesthesia using cuffed endotracheal tube and were premedicated with midazolam (2.5 mg) and atropine (0.5 mg). Also, ondansetrone 40 mg and dexamethasone 8 mg were given to prevent postoperative nausea and vomiting (PONV) and combat laryngeal edema. Anesthesia was induced using propofol 2.5 mg/kg, cisatracurium 0.15 mg/kg and fentanyl 1μg/kg. After tracheal intubation, mechanical ventilation with 1:1 O_2:air was initiated and adjusted to keep the end-tidal CO_2 tension in range of 30-35 mmHg. Anesthesia was maintained using sevoflurane 1-1.5% and fentanyl 1-2 μg/kg/hr. At the end of procedure, neuromuscular block reversal was given and patients were maintained on 100% O_2 at rate of 8 liters/min.

All surgeries were performed through Kocher's subcostal incision, after skin incision was commenced, **Figure(1)** and during muscle cutting meticulous dissection was conducted for identification of the neurovascular bundle, **Figure(2)** which was marked using a stitch loop outside the surgical field to be protected against injury. Then, cholecystectomy was conducted and after peritoneal drainage and closure, an 8F neonatal feeding catheter with fashioned multiple pores was inserted between internal oblique muscle and transversus abdominus as a catheter bed and external oblique was closed over the catheter so as to maintain some pores underneath of its sheath and others were out to irrigate the subcutaneous tissue, **Figure(3)**. The catheter was tested for patency using 20 cc of saline injected through it. Then subcutaneous tissue and skin were closed. Each of drainage and irrigation catheters was extracted through watertight separate stab

for each away from the main wound line, **Figure(4)**. Irrigation catheter was fixed to abdominal wall allowing free end for application of irrigation syringe.

Patients were randomly, using sealed envelops, divided into two groups according to irrigation fluid: Control group (Group C) received wound irrigation using 0.9% saline and study group (Group S) received intermittent wound irrigation every 8 hours for 48 hours using 20 ml of bupivacaine 0.25%. Once patients were completely recovered, wound was irrigated for the first time with assigned solution. Wound pain was assessed hourly using 10-mm visual analogue scale (VAS) starting after patients transfer to post-anesthetic care unit for four hours and then four-hourly till 48 hours and cumulative VAS pain score was calculated. Duration of analgesia was defined as the time lapse since first wound irrigation till request of rescue analgesia. Rescue analgesia for both groups was provided as intravenous mepridine 50 mg on request or at VAS ≥4. The frequency of PONV, side effects or complications occurring with the first 48 postoperative hours was reported. Time for first ambulation and oral intake was also recorded. All patients were discharged after irrigation catheter removal on the morning of the 3rd postoperative day.

Figure (1): Skin incision and dissection of subcutaneous tissue.

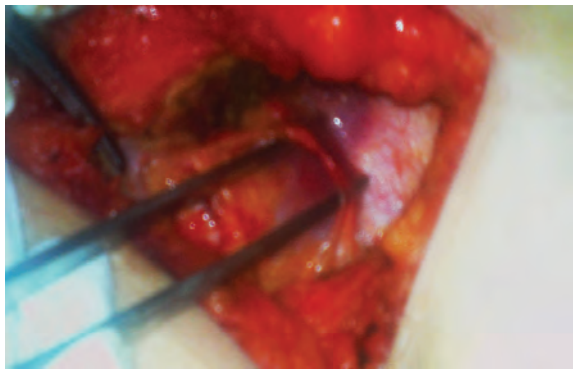

Figure (2): Dissection and identification of the neurovascular bundle as shown elevated by the forceps.

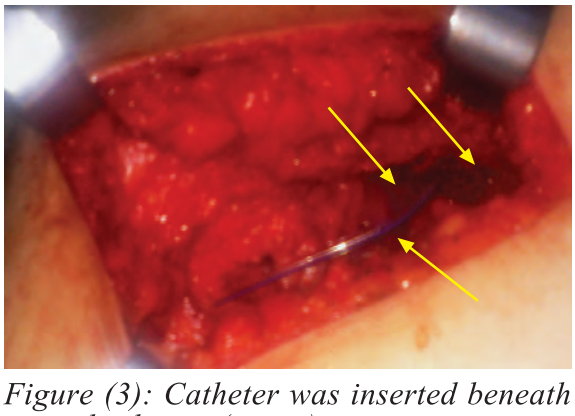

Figure (3): Catheter was inserted beneath muscular layers (arrow).

Figure (4): Catheter was extracted out of the wound through a separate stab away from that used for the bed drainage.

Statistical analysis:

Obtained data were presented as mean±SD, ranges, numbers and ratios. Results were analyzed using Wilcoxon's ranked test for unrelated data (Z-test) and Chi-square test (X^2 test) for numerical data. Statistical analysis was conducted using the SPSS (Version 15, 2006) for Windows statistical package. P value <0.05 was considered statistically significant.

Results:

The study included 40 female patients with mean age of 34.1±3.4; range: 26-43 years. Thirty-one patients (77.5%) were ASA grade I and 9 patients (22.5%) were ASA grade II. All surgeries were completed uneventfully without intraoperative complications within a mean operative time of 46.5±5.3; range: 35.8-55 minutes. Patients' details and operative

times were shown in **Table(1)**. There was a non-significant (p>0.05) difference between studied patients as regards the age, weight, height, body mass index (BMI), ASA grade and duration of surgery. Baseline measures of SAP, HR, RR and SpO_2 showed non-significant (p>0.05) difference between both groups with non-significant change recorded at end of PO 24-hrs compared to baseline measures and between both groups, **Table(2)**.

Patients who received local anesthetic irrigation showed significantly longer, (Z=3.926, p<0.001) duration of PO analgesia compared to those who received placebo, **Figure(5)**. Throughout 48-hr PO, 12 patients (60%) in group S requested rescue analgesia once, 7 patients (35%) requested it twice and only one patient (5%) requested it thrice. While in group C, 12 patients (60%) requested rescue analgesia twice and 8 patients (40%) requested it thrice with significantly (X^2=7.807, p<0.01) lower frequency of number of requests of rescue analgesia in study group compared to control group. Mean cumulative VAS pain score, recorded throughout 48 hours after surgery, was significantly lower in group S compared to group C, (Z=3.735, p<0.001). Moreover, total dose of mepridine consumed throughout 48 hours was significantly lower, (Z=4.359, p<0.001) in group S compared to group C, **Table(3)**.

Mean time till 1st ambulation was significantly shorter, (Z=2.070, p=0.038) in group S compared to group C, **Figure(6)**. Also, mean time till 1st oral fluid intake was significantly, (Z=2.397, p=0.017) shorter in group S compared to group C, **Figure(7)**. Only 7 patients had PONV, 4 in control and 3 in study group with non-significant (p>0.05) difference between both groups. One patient in control group required stoppage of oral intake, but all patients responded well to antiemetic therapy. No patient developed allergic manifestations to bupivacaine and all patients were discharged after removal of the irrigation catheter.

Table (1): Patients' data and duration of surgery.

Data	Control group	Study group	Total
Age (years)	33.6±3.5 (28-41)	34.5±3.2 (26-43)	34.1±3.4 (26-43)
ASA; I:II	15:5	16:4	31:9
Weight (kg)	82.5±6.9 (72-94)	85.5±3.8 (76-92)	84±5.7 (72-94)
Height (cm)	164.6±3.2 (155-168)	162.9±3.5 (156-169)	164±3.4 (155-169)
BMI (Kg/m2)	30.4±2.2 (26.8-34.2)	32.3±2.2 (26.6-34.7)	31.3±2.3 (26.6-34.7)
Duration of surgery(min)	46.8±5.2 (38.5-55)	46.2±5.5 (35.8-53.5)	46.5±5.3 (35.8-55)

Data are presented as mean±SD, ratio and ranges are in parenthesis BMI: Body mass index.

Table (2): Patients' vital data recorded at end of 1st 24 hours after surgery compared to their baseline data.

Data		Control group	Study group
SAP (mmHg)	Baseline	122.7±5.8	120.1±3.9
	End of PO 24-hrs	120.8±3.7	118.3±4.4
Heart rate (beat/min)	Baseline	81.5±2.5	79.9±2.9
	End of PO 24-hrs	84.6±2.1	83.1±2.3
Respiratory rate (breath/min)	Baseline	19.3±1.6	19.6±2.1
	End of PO 24-hrs	19.6±2.2	19.7±1.1
SpO_2 (%)	Baseline	97.9±1.6	96.7±3.4
	End of PO 24-hrs	98.4±1	98±1.3

Data are presented as mean±SD.
SAP: Systolic arterial blood pressure. SpO2: Partial arterial oxygen saturation.

Table (3): Patients' postoperative pain data.

Data		Control group	Study group	
Duration of analgesia (hours)		0.8±0.2 (0.5-1.2)	2.4±0.5 (2-3)	Z=3.926, p<0.001
Frequency of requests of rescue analgesia	Once	0	12 (60%)	X^2=7.807, p<0.01
	Twice	12 (60%)	7 (35%)	
	Thrice	8 (40%)	1 (5%)	
Total rescue analgesia consumed (mg)		120±25.1 (100-150)	72.5±30.2 (50-150)	Z=4.359, p<0.001
Total pain VAS score		2.24±0.17 (1.9-2.5)	2.01±0.2 (1.5-2.3)	Z=3.735, p<0.001

Data are presented as mean±SD & numbers; ranges and percentages are in parenthesis.

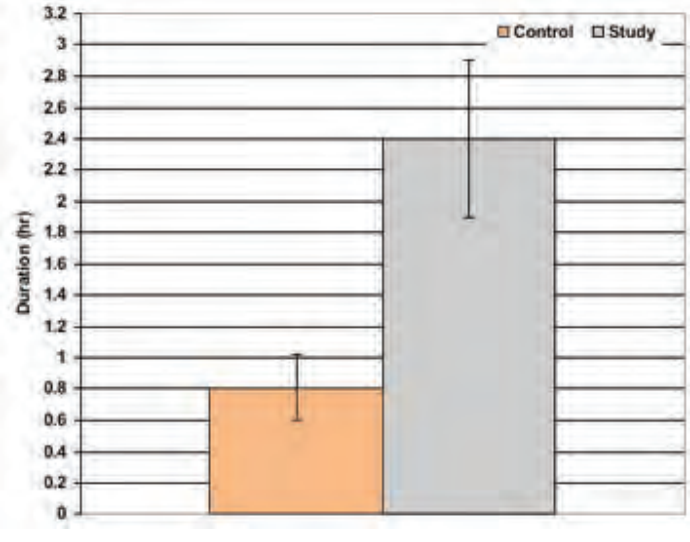

Figure (5): Mean (±SD) duration of postoperative analgesis.

Figure (6): Mean (±SD) duration till first ambulation.

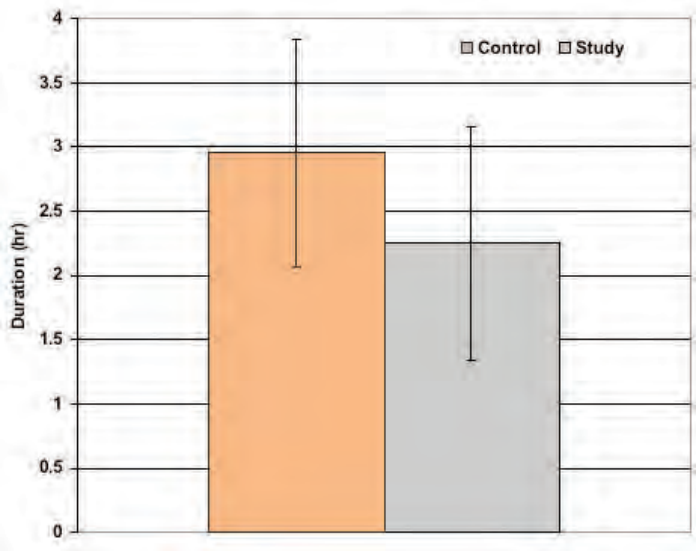

Figure (7): Mean (±SD) duration till first oral intake.

Discussion:

Considering the primary outcome of the current study as the efficacy of local anesthetic wound irrigation as a modality for provision of postoperative analgesia; patients received irrigation showed significantly lower pain VAS scores with longer duration of postoperative analgesia and lower consumption of rescue analgesia. These data illustrated the beneficial effect of such modality for pain management and supported that previously reported in literature.

Bamigboye & Hofmeyr[13] searched the Cochrane Pregnancy and Childbirth Group's Trials Register and found women who had Caesarean section performed under regional analgesia and had wound infiltration and women under general anesthesia, with Caesarean section wound infiltration and peritoneal spraying with anesthetic had a decrease in morphine consumption at 24 hours compared to placebo. Sostaric et al.[14] evaluated the analgesic effect of catheter continuous infusion of local anesthetic for patients who had Port Access heart surgery with the catheter placed in the surgical wound at the end of the operation and reported that such analgesic modality provided acceptable level of postoperative pain control and catheter insertion in surgical incision and application of local anesthetic through it does not increase the risk for wound infection nor interfere with wound healing. Also, Gottschalk & Gottschalk[15] reported that continuous wound infusion of local anesthetics is able to reduce postoperative opioid requirements and results in decreased pain scores.

Heil et al.[16] found ultrasound-guided transversus abdominis plane perineural catheter insertion and subsequent management of ambulatory local anesthetic infusions after inguinal hernia repair provided minimal pain during the forty-eight hours of infusion without the need for any supplemental opioid analgesics, high satisfaction with postoperative analgesia, and no infusion-related complications. Wang et al.[17] reported that local anesthesia infusion at the fascial plane after laparotomy provided effective analgesia, significantly decreased consumption of opioids, and improved patient recovery through significantly earlier independent mobilization, return of bowel function and reduced post-operative ileus. Aizenberg et al.[18] found postoperative wound irrigation with 0.1-0.2% solution of ropivacaine in combination with non-steroidal anti-inflammatory drugs (NSAIDs) is effective analgesic modality after surgical correction of scoliotic spinal deformities with reduction of vomiting after surgery and the best effect is achieved with the constant introduction of 0.2% solution of ropivacaine.

On contrary to the results of the current study, Talbot et al.[19] tried to determine the influence of anesthetic of axillary drains on

postoperative pain during the first 24 h following a modified Patey mastectomy versus placebo irrigation and found no statistical differences in morphine requirements or pain scores between the two groups, nor supplemental analgesic consumption and concluded that bupivacaine used in this manner does not appear to offer an effective contribution to postoperative analgesia. This discrepant result could be attributed to the more extensive type of surgery requiring tissue dissections and sacrificing of multiple sensory nerves with the resultant of release of large number of nociceptive stimuli, secondly, such type of surgery limits movement of shoulder joint which must be moved for daily activities and to guard against stiffness and this in virtue is a painful movement which aggravates wound pain sensation, thirdly, through the current study the neurovascular bundle was clearly dissected through a clean new wound prior to proper surgical interference to protect it against trauma and fourthly, the site of catheter insertion being partly underneath of muscles and partly under the skin so irrigation included both muscles and skin nerves and was directly on the neurovascular bundle blocking it.

In support of the obtained results, Singh et al.[20,21] found continuous infusion of 0.5% Marcain at the iliac crest bone graft harvest site significantly reduced chronic dysesthesias with significantly better overall satisfaction, number of painful days per month, and VAS scores at 4 years with no long-term complications. Sidiropoulou et al.[22] compared the analgesic efficacy of continuous wound infiltration of local anesthetic versus paravertebral analgesia after mastectomy with axillary dissection and reported that despite the better outcome of paravertebral analgesia during the first postoperative hours, continuous wound irrigation provided lower pain scores and lower frequency of painful restricted movement at 16 and 24 hours after surgery.

As a further support for the feasibility and effectiveness of local wound irrigation using local anesthetic, Zhirkova et al.[12] and Zhirkova & Marganiia,[23] evaluated the effectiveness of postoperative analgesia in neonates using local anesthetic wound irrigation as rated by CRIES postoperative pain control scale, monitoring of skin conductance, cardiointervalogram and hormone level control in the blood and found the use of catheter for continuous postoperative analgesia provides effective level of analgesia in newborns, which is comparable with the introduction of opioid analgesics without postoperative complications and recommended this method of analgesia for postoperative analgesia in newborns, especially during major surgeries. Panaro et al.[24] reported that surgical wound infusion with ropivacaine was safe and seemed to improve pain relief and accelerate recovery and discharge, reducing the overall costs of care after laparoscopic living donor nephrectomy.

It could be concluded that wound irrigation with bupivacaine significantly improved the outcome of open cholecystectomy and could be advocated for various open surgical procedures. Additionally, the applied modality was safe, effective and cost reducing with significant opioid sparing effect.

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