Acute Pain after Upper Abdominal Surgery in Post-Anesthesia Care Unit

Abbreviated title: Acute pain in PACU

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Abstract

Background and objectives:
Inadequate control of postoperative pain after major surgery results in untoward consequences. This study was designed to find out the incidence of severe first pain score in post-anesthesia care unit after upper abdominal surgery among patients receiving general anesthesia combined with epidural analgesia, and to determine consequences and factors affecting severe pain intensity.

Methods:
This retrospective study was conducted on patients aged > 18 who underwent elective upper abdominal surgery before 31st October 2012. The severity of pain was classified using verbal numeric rating scale. Secondary outcomes of interests, i.e., time managed by Acute Pain Service, length of stay in PACU, discharge pain score, patient satisfaction score and risk factors were compared between the two groups: the severe pain (pain scores 8-10) and the other (pain scores 0-7).

Results:
685 medical records were included in the analysis. 134 patients (19.6%, 95% confident interval (CI) = 0.17, 0.23) reported severe first pain scores. Patients who reported worse pain scores spent more time in PACU. Discharge pain score and patient satisfaction score were unfavorable when compare with the other group. As for risk factors of severe pain, BMI $\geq$ 25 kg/m^2 (adjusted odds ratio (OR) 1.62, 95% CI 1.04, 2.48), intermittent bolus method for epidural analgesia (OR 1.68, 95% CI 1.07, 2.63) and stomach and bowel surgery (OR 3.25, 95% CI 1.29, 8.22) were associated with severe pain scores.

Conclusion:
Incidence of severe first pain scores in our institution was high. Attention should be paid to patients with the identified risk factors for better outcomes.
Key words: acute pain, upper abdominal surgery, post anesthesia care unit, PACU.

Introduction

Continuous epidural analgesia provided better postoperative analgesia when compared to parenteral opioid analgesia.[1,2] Focusing on clinically oriented outcomes, there was significant data demonstrated that epidural anesthesia and analgesia associated with reduction of overall morbidities and mortality.[3] Although perioperative pain was not a sole cause of physiologic perturbations[4], inadequate control of pain after major surgery resulted in many untoward consequences such as respiratory dysfunction[5], decrease quality of recovery[6] and increase incidence of chronic postsurgical pain[7].

Around 40,000 inpatients surgical procedures were performed in our institution annually, with epidural analgesia used as a common form after major surgery. To properly determine the favorable effects of immediate postoperative analgesia, intraoperative epidural analgesia should be administered adequately.[8]

Nevertheless, insufficient analgesia associated with other factors such as patient age[9], body weight[10] or type of surgical procedures[9]. Previous data showed that around 20% of patients who had undergone major surgery with combined general anesthesia and epidural analgesia reported moderate postoperative pain and 7.85 % of patients reported severe postoperative pain.[11]

We conducted this retrospective study for 3 objectives. First, to estimate the incidence of first severe pain score reported in post-anesthesia care unit (PACU). Second, to observe consequences of unwanted severe first pain score, and third to determine the factors associated with severe pain.

Methods

Study design and data sources

After Institution Review Board approval, a retrospective study involving patients underwent upper abdominal operations before 31th October 2012 was performed. Data sources were Siriraj Hospital's electronic medical records, department and acute pain service database.

Study population

The medical records utilized in this study comprised data of consecutive adult patients (>18 years old) who underwent elective upper abdominal under general anesthesia combined with epidural analgesia, and admitted to post-anesthesia care unit after an operation. Incomplete or missing data of pain score and sedation score were excluded.

Conventional method for epidural catheter placement and pain management

Before general anesthesia was conducted, an epidural catheter was placed by a resident or an attending anesthesiologist in a patient who was seated upright or lies in lateral decubitus position. Identification of a specific vertebral interspace was generally based on palpitation at the surface landmarks of the spine. A Tuohy needle was inserted via a midline or paramedian approach. An epidural catheter was then advanced into the epidural space, and was dressed with a transparent film. A 3-mL test dose of 2% lidocaine with epinephrine 5 μg/ mL was injected. Delivery modality and type of analgesic regimen for epidural analgesia were chosen at the discretion of the anesthesiologist based on the estimated needs of the patient. If hypotension (systolic blood pressure ≤ 90 mmHg) occurred, a bolus of intravenous fluid and vasopressor (ephedrine or norepinephrine) was administered. Intravenous narcotics could be provided for supplemental intraoperative analgesia. After completion of surgery, tracheal extubation was performed after reversal of neuromuscular block. All patients were transferred to the PACU and observed for one to two hours.

In the PACU, epidural analgesia was managed by the Acute Pain service. Pain was assessed at rest using self-report numeric rating scale. Generally, patients were asked to describe their pain intensity every 15 minutes. The patients were discharged when Postanesthetic recovery score ≥ 9.

Outcomes

Primary outcome of this study was the incidence of severe first pain score. The severity of pain intensity was defined by using the verbal numeric rating scale, classified as the following: 0= no pain, 1-3 = mild pain, 4-7 = moderate pain and 8-10 = severe pain.[12, 13]

As for secondary outcomes, there were 7 possible factors associated severe pain obtained from reviewing literature as the following; ASA status[14], overweight[10,14], type of operation[9], long operative time[14], catheter incision incongruence (our recommended site for catheter placement was at T6-8 levels for upper abdominal incision, and at T8-12 levels for the extended incision to middle and lower abdomen), methods of drug delivery via epidural catheter[8] and duration of loading morphine via epidural catheter before the operation was done[15].

According to consequences of severe first pain score, data on the following was collected: adverse events which were hypotension (systolic blood pressure ≤ 90 mmHg), respiratory depression (respiratory rate < 8/ minute), nausea vomiting and itching, time managed by Acute Pain Service, length of stay in PACU, discharge pain score and patient satisfaction scores.

Statistic analysis

Sample size calculation for the primary objective was based on an expected incidence of severe pain score of 7%, obtained from a previous

study[11]. To obtain a 95% confidence interval of 2%, a sample of at least 626 subjects was required. The sample size was inflated by 15% prepared for incomplete information in records; therefore, 695 subjects were enrolled in this study. Sample size was also calculated for secondary objective which based on the current recommendation of statistician for multiple logistic regression analysis, i.e., that the number of patients with severe pain score is five to ten time of the number of risk factors. Therefore, approximately 35 -70 cases with PS 8-10 were needed. Using the previous incidence report of severe pain, thus, the calculated sample size would be adequate.

Descriptive statistics were used to examine preoperative characteristics, perioperative variables and the incidence of severe pain. The patients were then assigned to 2 groups, the PS 0-7 group and PS 8-10 group. Outcomes (APS service time, time to discharge from PACU, discharge pain scores and patient satisfaction score) were compared, using the Chi-square test for categorical variables. Continuous, normally distributed variables were compared with the Student's t-test, and for non-normal distributed, Mann Whitney U test was used. Statistical analysis was conducted using a software program, SPSS version 18, SPSS Inc., Chicago, IL, USA. Data was presented as mean ± standard deviation (SD) or number (percent) or 95% CI, as appropriate. $P < 0.05$ (2-sided) was considered to indicate statistically significant differences.

To examine risk factors for severe pain in the PACU, multiple logistic regression was used to analyze the data. Clinically meaningful variables were included in the study. We categorized possible risk variables to 2 or more levels; ASA 1-2 , ASA 3 (1, 0), BMI< 25 kg/m^2, BMI ≥ 25 kg/m^2 (0,1), types of operation (gynecology = code 0, hepato-biliary-pancreas = code 1, stomach-bowel = code 2, urology = code 3), operative time ≤ 180 minutes , operative time > 180 minutes (0, 1), catheter-incision congruent, catheter-incision incongruent (0, 1), methods of drug delivery via epidural catheter (continuous infusion = code 0, intermittent bolus = code 1), duration of loading morphine via epidural catheter before the operation was done (loading time > 60 minutes before the operation was done = code 0, not loading or loading time ≤ 60 minutes before the operation was done = code 1).

Univariate differences between PS 0-7 and PS 8-10 were tested using the chi square test or Fisher's exact test. Variables with $p < 0.2$ from univariate analysis were entered into a multiple logistic regression model of severe pain. Crude odds ratio, adjusted odds ratio and 95%CI were reported to consider the strength of association between possible factors and severe first pain scores.

Results

Total 695 medical records between 16th July 2009 and 11th October 2012 were enrolled in the study. However, data of first pain score was missed in 10 records, therefore 685 patients were included in the final analysis. The mean age of patients was 54 years old, with 51.5% of patients were male and 48.5 patients were female. Most patients had at least one coexisting disease, and common diseases were diabetic mellitus and hypertension. The majority of patients had no previous surgery or underwent minor operations. There was 5 cases reported preoperative severe pain score, and 17 cases received analgesic drugs. Surgical procedures, epidural technique, Delivery modality and type of analgesic are detailed in table 1 and 2.

One hundred and thirty four awaken patients (19.6%, 95% CI 0.17, 0.23) reported severe first pain scores. In patients with severe pain scores, the incidence of hypotension was found significantly increase when compared to the group without severe pain (7.5% versus 3.4%; p = 0.038). Other adverse events, which were respiratory depression, nausea, vomiting and itching, were not difference between 2 groups. Those with severe pain had a significant higher number of intervention and management from acute pain service, resulted in longer time to discharge. Furthermore, discharge pain scores and 24-hour patient satisfaction scores were worse when compared to another group. (Table 3) As for risk factors of severe pain; age, preoperative pain scores, ASA classification, site epidural catheter, length of catheter left in space and type of analgesic regimen administered via epidural catheter were not associated with severe pain (data presented in parts). Seven meaningful

factors which probably associated with severe pain were included in univariate analysis and multiple logistic regressions. Three factors were found to be independently related to severe pain: overweight, intermittent bolus method for epidural analgesia and stomach and bowel surgery. (Table 4)

Discussion

The main finding of this study is that around one fifth of patients underwent upper abdominal surgery were suffered from severe immediate pain in PACU. As a result of severe pain, patients needed higher number of intervention and management from acute pain service, and they spent longer time in PACU. Furthermore, discharge pain scores and 24-hour patient satisfaction scores were unfavorable. Independent risk factors were overweight, intermittent bolus method for epidural analgesia and stomach and bowel surgery.

The numeric rating scale is often used to divide patients into patients who are in need of postoperative analgesia and those who are not. Gerbershagen et al demonstrated that the optimal cut-off point for pain treatment was NRS $\geq$ 4 as identifying patients with moderate and severe pain.[12] In our institution, patients underwent upper abdominal surgery were considered the high risk of severe postoperative pain, defined by NRS 8-10. We recommend epidural analgesia with local anesthetic and opioid for this condition. Nevertheless, insufficient analgesia among patients underwent epidural analgesia occurred frequently in our clinical practice. We found 134 patients suffered from severe pain in PACU. The number was higher than previous data reported by Block et al (19.6% VS 7.8%).[1] This may be because the authors included all types of surgery, not only upper abdominal surgery. Focusing on failure of epidural analgesia in upper abdominal surgery, the incidence of insufficient analgesia were similar to our study which ranged between 14% and 41.4%.[8]

Severe postoperative pain correlated with nontraditional patient-oriented outcomes such as health related quality of life, economic outcomes and patient satisfaction.[3] Wu et al performed a prospective observational study to examine the correlation of severe postoperative pain on quality of recovery using a validated 9 item instrument. They found that an increase of pain significantly correlated with a decrease in quality of recovery within 2 weeks after elective radical retropubic prostatectomy.[6] In an ambulatory setting, patients with severe pain in the PACU had longer duration of stay and longer time to discharge when compared to patients without severe pain.[14] In our study, patients with severe pain had a longer time to discharge. Discharge of these patients could be potentially delayed because acute pain service staff must check epidural catheter location, tested levels of analgesia and gave supplemental analgesia. In our experience, hypotension following administering test dose of lidocaine frequently occurred after upper abdominal surgery. Patients were discharged from PACU when they reached optimal hemodynamic status and they accepted pain management. Nevertheless, discharge pain scores and 24-hour patient satisfaction scores were worse when compared to those without severe pain.

In heterogeneity of target population and timing of pain scores assessment, preoperative status such as age, ASA classification, chronic pain[16] or protocol for conduct of anesthesia and analgesia[8,14,17] could be predictors for intense acute postoperative pain. Our study focus on patients underwent upper abdominal surgery who received epidural analgesia. With a multiple logistic regression model, we demonstrated that the adjusted odds of overweight, intermittent bolus method for epidural analgesia and stomach and bowel surgery was associated with sever first pain scores in PACU. Other factors related to epidural techniques such as site of epidural catheter insertion, timing of loading morphine or analgesic regimens were not risk factors in our study. This was maybe because we assessed the pain scores in the very early postoperative period. The effects of anesthesia and other route of analgesia were not absolutely fading away.

Our study has some limitations. Firstly, this was a retrospective study. Secondly, we have limited data regarding the mechanical problems of failure of epidural analgesia such as kinks and knots, breakage or malposition of epidural catheters. Motamed et al confirmed the situations by using computed tomography epidurography.[18]

In conclusion, inadequate analgesia reported in PACU after upper abdominal surgery under epidural analgesia was common in our study. Aggressive pain treatment should be considered for patients with high body mass index and those who undergoing stomach-bowel surgery. Apart of the methods of epidural drugs administration (intermittent bolus VS continuous confusion); we need more information to improve our protocol for best practice for this group of patients.

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Conflict of interests

The authors have not disclosed any potential of conflict of interest.

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Table 1 Clinical characteristics

Variables	Mean ± SD or median (min, max) or number (%)
Preoperative data	
Age (yr)	58.2 ± 13.0
Gender	
Male	353 (51.5)
Female	332 (48.5)
Body mass index (kg/m^2)	23.2 ± 4.1
ASA Classification	
1	119 (17.4)
2	448 (65.4)
3	118 (17.2)
Preoperative pain score	
0	591 (86.3)
1-3	71 (10.4)
4-7	18 (2.6)
8-10	5 (0.7)
Concurrent pain control	
No	668 (97.5)
Yes	17 (2.5)
Previous surgery	
None	271 (39.6)
Major surgery	19 (2.8)
Minor surgery	395 (57.7)
Intraoperative data	
Type of operation	
Hepato - biliary - pancreas	378 (55.2)
Stomach - bowel	199 (29.1)
Urology	51 (7.4)
Gynecology	57 (8.3)
Operative time (min)	175 (15, 607)
Hypotension and received vasopressor	410 (59.9)

Table 2 Epidural data

Techniques	Mean ± SD or median (min, max) or number (%)
Epidural location	
T6 - T8	85 (12.4)
T8 - T12	424 (61.9)
T12 - L5	176 (25.7)
Approach	
Midline	209 (30.5)
Paramedian	476 (69.5)
Length of catheter in space (cm)	5.0 ± 1.2
Delivery modality and type of analgesic regimen for epidural analgesia	
Not use	29 (4.2)
Intermittent bolus	181 (26.5)
≤ 0.1% Bupivacaine	4 (2.2)
≤ 0.1% Bupivacaine with narcotic	8 (4.4)
>0.1% - 0.25%Bupivacaine	49 (27.1)
>0.25%Bupivacaine	22 (12.2)
1-2% Lidocaine	98 (54.1)
Continuous infusion	475 (69.3)
≤ 0.1% Bupivacaine	40 (8.4)
≤ 0.1% Bupivacaine with narcotic	226 (47.6)
>0.1% - 0.25%Bupivacaine	195 (41.1)
>0.25%Bupivacaine	4 (0.8)
1-2% Lidocaine	10 (2.1)
Loading narcotics and doses	
Not load	43 (6.3)
Fentanyl 25 - 100 μg	15 (2.2)
Morphine 1.5 - 4 mg	627 (91.5)
Interval time of EB narcotics before finish (min)	99 (1, 563)

Table 3 Postoperative data in PACU

Variables	Mean ± SD, number (%) or median (min, max)		p value
	PS 0 – 7 (n = 551)	PS 8 – 10 (n = 134)	
Adverse events			
Hypotension	19 (3.4)	10 (7.5)	0.038
Respiratory depression	1 (0.2)	0	-
Nausea, vomiting	4 (0.7)	1 (0.7)	0.980
Itching	9 (1.6)	1 (0.7)	0.443
Acute pain service time	5 (0, 165)	47.5 (0, 240)	< 0.001
Time to discharge	95 (30, 235)	115 (30, 270)	< 0.001
Discharge pain scores	0 (0, 7)	3 (0, 10)	< 0.001
Patient satisfaction scores	98.4 ± 6.1	96.1 ± 9.1	0.006

Table 4 Factors associated with severe first postoperative pain score

Factors	Number (%) or mean±SD		Crude OR (95% CI)	Adjusted OR (95% CI)	p value
	PS 0 – 7 (n=551)	PS 8 – 10 (n=134)			
Age (yr)	57.9 ± 13.1	59.1 ± 12.6	-	-	0.343
Preoperative pain score					
0-3	534 (80.7)	128 (19.3)	1	-	0.424
4-10	17 (73.9)	6 (26.1)	1.47 (0.57, 3.81)		
Body mass index (kg/ m^2)					
< 25	402 (81.9)	89 (18.1)	1	1	0.032
≥ 25	149 (76.8)	45 (23.2)	1.36 (0.91, 2.05)	1.61 (1.04, 2.48)	
ASA					
1-2	450 (79.4)	117 (20.6)	1.54 (0.89, 2.68)	1.68 (0.90, 3.11)	0.102
3	101 (85.6)	17 (14.4)	1	1	
Type of operation					
Gynecology	51 (89.5)	6 (10.5)	1	1	-
Urology	45 (88.2)	6 (11.8)	1.13 (0.34, 3.76)	1.61 (0.47, 5.60)	0.451
Hepato-biliary - pancreas	307 (81.2)	71 (18.8)	1.97 (0.81, 4.76)	1.97 (0.79, 4.88)	0.143
Stomach - bowel	148 (74.4)	51 (25.6)	2.93 (1.19, 7.23)	3.25 (1.29, 8.22)	0.013
Operative time (min)					
0-180	295 (78.2)	82 (21.8)	1.37 (0.93, 2.01)	1.22 (0.78, 1.91)	0.390
>180	256 (83.1)	52 (16.9)	1	1	
Catheter-incision congruency					
Congruence	98 (88.3)	13 (11.7)	1	1	0.132
Incongruence	453 (78.9)	121 (21.1)	2.01 (1.09, 3.71)	1.71 (0.85, 3.42)	
Delivery modality for epidural analgesia					
Continuous infusion	400 (84.2)	75 (15.8)	1	1	0.024
Intermittent bolus	135 (74.6)	46 (25.4)	1.82 (1.2, 2.8)	1.68 (1.07, 2.63)	
Morphine via EB: time before finish(min)					
> 60	335 (83.1)	68 (16.9)	1	1	0.479
≤ 60 and not use	204 (76.4)	63 (23.6)	1.52 (1.04, 2.24)	1.17 (0.75, 1.83)	