Pain Management after Cardiac Surgery: Are We Underestimating Post Sternotomy Pain?

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Objective: *Good pain management can improve the outcome of patient care after cardiac surgery. The intensity of pain after cardiac surgery is often underrated. Inadequate pain control can result in increased morbidity and length of hospital stay as well as lead to chronic pain. Therefore, the authors conducted a study to identify the prevalence and risk factors of moderate to severe pain after cardiac surgery including treatment and complication.*
Material and Method: *The present study was prospectively performed in the patients undergoing cardiac surgery with median sternotomy in Siriraj Hospital, a tertiary care center, between July 2009 and November 2010. Pain was assessed by numerical rating scale (NRS, 0-10) whilst NRS ≥4 was defined as moderate to severe pain. Pain score was recorded until 48 hours after surgery. Demographic data, history of previous cardiac and non-cardiac surgery, chronic pain history, details of the operation, and intra-and postoperative analgesia were recorded, including complication of pain treatment. In addition, pain expectation and experience were compared and the patient satisfaction was evaluated.*
Results: *Two hundred ninety patients were enrolled, 95.5% ASA physical status III, with mean duration of surgery 243.8 minutes (95-600) and cardiopulmonary bypass time 112.8 minutes (33-500). The prevalence of moderate to severe pain in the patients after cardiac surgery was 61.4%. The duration of cardiopulmonary bypass less than 60 minutes decreased numbers of patients with moderate to severe pain with adjusted OR ratio of 0.40, 95% CI = 0.16,1.004, ($p<0.001$). Complications of pain treatment were respiratory depression (0.7%), nausea (25.6%), vomiting (11.4%), pruritus (4.1%), and urinary retention (0.3%). The majority of the patients were satisfied with pain control (81.4%).*
Conclusion: *The prevalence of moderate to severe pain in the present study was high and duration of cardiopulmonary bypass was the only factor affected. Still, most patients were satisfied with the pain treatment.*

Keywords: *Postoperative pain, Sternotomy, Cardiac surgery*

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Nature and intensity of postoperative pain depend on size and extent of the incision, as well as the procedure itself. The concept of procedure specific pain is that each type of the procedure has different tissue injury and nerve damage. Consequently, the characters of postoperative pain and pain treatment are varied on types of surgery[1,2]. In addition, pain perception depends on individual patient due to ethnicity, culture, belief, personal pain experience, and patient's personality[3].

Improper pain control after cardiac surgery can result in respiratory complication, increase stress response, prolongs recovery, and high incidence of turning to chronic post-sternotomy pain syndrome. This syndrome is difficult to cure and impair patient and relatives' quality of life in the long-run[4-6].

In medical personnel opinion, post sternotomy patients have not much pain because the operation itself has less tissue injury with minimal movement postoperatively. However, the Lahtinen et al study has revealed the prevalence of moderate to severe postoperative pain in cardiac surgery (pain score 4-10) as high as 75% in the first 48 hours[7]. This may be due to fragile and complicated patients with multiple co-morbidities made physicians and nurses scared of pain treatment complications. Hence, the patients received inadequate pain control.

The methods of pain control after cardiac surgery in Siriraj Hospital are varied and depend on doctors and patients preferences. Therefore, the present study was conducted to identify the prevalence and risk factors of moderate to severe pain after cardiac surgery including treatment and complication.

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Material and Method

The present prospective study was performed in the Faculty of Medicine, Siriraj Hospital, Mahidol University between July 2009 and November 2010. After the local IRB (Siriraj Hospital, Bangkok, Thailand) approval [Si306/2009], and registered in advance at clinicaltrials.gov [NCT00949429], all patients provided written informed consent. Patients, age ≥18, undergoing cardiac surgery with median sternotomy were included. The patients who were unable to communicate or unable to rate pain score were excluded from the present study. Pain was assessed and recorded using numerical rating scale (NRS, 0-10) until 48 hours after surgery; every 1 hour for 4 hours, then every 2 hours for 8 hours, followed by every 4 hours until 48 hours postoperatively. The NRS ≥4 was defined as moderate to severe pain, which was determined by the patient having any recorded pain score equal or more than 4 once at any time in 48 hours postoperatively. Pain assessment was done by ICU and ward nurses who had trained before. When the patient was sleep, the pain was rated as 'S' and calculated as missing data. The patients' demographic data, history of previous cardiac and non-cardiac surgery, chronic pain history, details of the operation and intra-and postoperative analgesia were recorded, including complication of pain treatment. In addition, pain expectation and experience were compared and the patients' satisfaction was evaluated.

Sample size calculation was performed by the formula $n = z^2p\ (1\text{-}p)/d^2$, using data available from the literature[7] that shows the incidence of moderate to severe pain (NRS = 4-10). With the incidence of moderate to severe pain of 75%, the sample size of 290 required to determine such pain prevalence. The data was analyzed using SPSS for windows version 13.0. The prevalence of moderate to severe pain was calculated and risk factors were analyzed by Chi-square test for qualitative variables and student t-test for continuous variables. The multiple logistic regressions were implied to analyze multiple risk factors. The preoperative pain expectation and pain experience were compared by Wilcoxon signed rank test, while p-value ≤0.05 considered statistical significant.

Results

Two hundred and ninety patients were included in the present study. The mean age was 57.3±15.3 years (18-87) with 152 male and 138 female patients. Patients scheduled for cardiac surgery with median sternotomy under general anesthesia at Siriraj Hospital between July 2009 and November 2010 were enrolled. Two hundred and seventy eight patients were in ASA physical status class III (95.5%) with the mean surgical time 243.8 minutes (95-600). The cardiopulmonary bypass (CPB) was used in 286 patients (98.6%) with the mean duration of CPB of 112.8 minutes (33-500). Types of surgery including 125 coronary artery bypass graft (CABG; 43.1%), 93 valve(s) surgeries (32.1%) and others (24.8%) e.g. aortic surgery, closing of septal defect, and combined surgeries. The demographic data and patients characteristics are presented in Table 1.

Recorded pain scores at different time are shown in Fig. 1, presented as median pain score with inter-quartile ranges, with overall missing data of 30.25%. The maximum pain occurred in the first hour after surgery with the median pain score of 5 (inter-quartile ranges 0.25-5), and lessened over time, reaching the level of 'mild pain' after the forth hours, then remained low until 48 hours postoperatively.

Table 1. Baseline characteristics of the 290 patients

Variables	Results n (%)
Age	
<60 years	132 (45.5)
≥60 years	158 (54.5)
Mean ± SD (range)	57.3±15.3 (18-89)
ASA physical status	
II	12 (4.1)
III-IV	278 (95.9)
Sex	
Male	152 (52.4)
Female	138 (47.6)
Previous non-cardiac surgery	131 (45.2)
Types of surgery	
Mediansternotomy, no CPB	1 (0.3)
Mediansternotomy, on CPB	141 (48.6)
Mediansternotomy, on CPB, venous graft	145 (50.0)
Mediansternotomy, no CPB, venous graft	3 (1.0)
Redo sternotomy	35 (12.1)
Duration of surgery	
<180 minutes	67 (23.1)
≥180 minutes	233 (76.9)
Duration of CPB	
<60 minutes	40 (13.8)
≥60 minutes	250 (86.2)
IMA harvest	128 (44.1)

ASA = indicates American Society of Anesthesiologists; CPB = cardiopulmonary bypass; IMA = internal mammary artery

The prevalence of moderate to severe pain (NRS ≥4) in 48 hours postoperatively was 61.4%, calculated by any recorded pain score equal or more than four onces at any time was defined as patient having moderate to severe pain. In the first 12 hours, there were 12.3% of patients who had severe pain and 24.7% had moderate pain, and decreased by time as shown in Fig. 2.

The intraoperative analgesics used were fentanyl 560±232.6 micrograms (ranges 100-1,500 micrograms) and morphine 8.92±7.6 milligrams (ranges 0-40 milligrams).

Postoperative analgesia was morphine and paracetamol, with the mean dose of morphine for the first 24 hours and 24 to 48 hours, 8.5±4.7 and 1.6±3.2 milligrams respectively. The dose of paracetamol was 1.6±1.1 grams and 3.2±1.3 grams for the first 24 hours and 24 to 48 hours postoperative respectively.

The side effect of pain treatment was diminutive. The majority of the patients had no side effects. There were 0.7% of patients who had mild respiratory depression, which required no treatment, 4.1% had pruritus and 0.3% had difficult urination, 26.5% developed nausea, and 11.4% actually vomited, however, most of the symptoms improved after treatment.

The pain expectation of the patient, which was asked preoperatively, was moderate to severe, with the median expected pain score of 6 (inter-quartile range 5-8). However, the real pain experienced postoperatively was less, with the median pain score of 4 (inter-quartile range 2.75-5) for the first 24 hours, and 2 (inter-quartile range 0-3) for 24-48 hours after surgery. There was statistical significance in reduction when calculated by Wilcoxon signed rank test ($p<0.01$) as shown in Fig. 3.

The majority of the patients were satisfied with the pain treatment (81.4%), 18.3% had moderate satisfaction and 0.3% were not satisfied.

There was no patient factor such as age, sex, ASA physical status and history of previous surgery associated with prevalence of moderate to severe pain. Whereas, when surgical factors were analyzed, the duration of cardiopulmonary bypass less than 60 minutes decreased numbers of patients with moderate to severe pain with adjusted OR ratio of 0.40, 95% CI = 0.16, 1.004, ($p<0.001$).

Discussion

The present study evaluated the postoperative pain after cardiac surgery with median sternotomy in

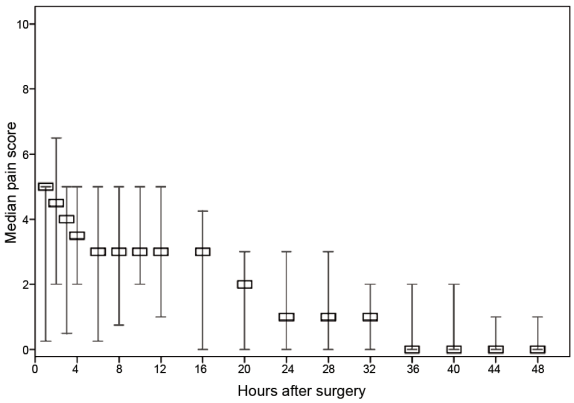

Fig. 1 Recorded pain scores at different times after surgery; data presented in median with inter-quartile ranges.

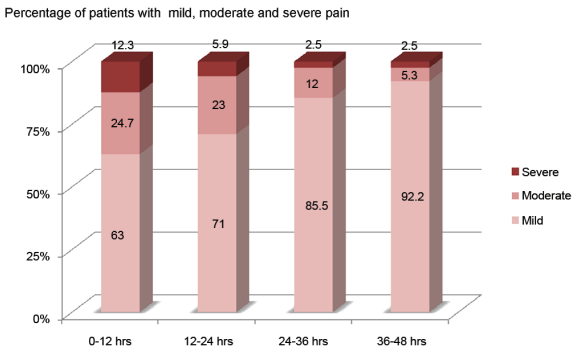

Fig. 2 Percentage of patients with mild, moderate and severe pain with time after surgery.

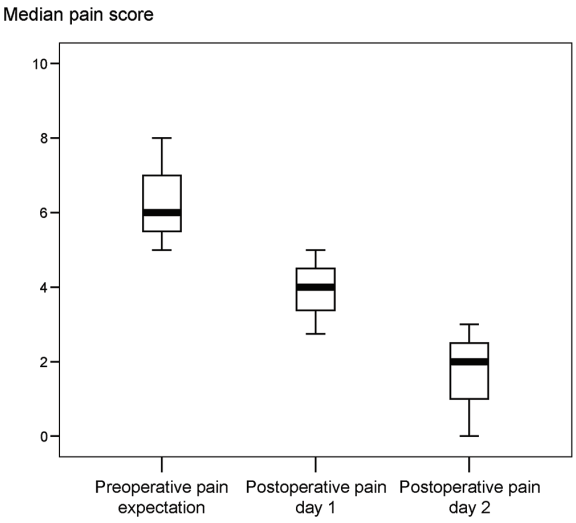

Fig. 3 Comparison of preoperative pain expectation and postoperative pain experienced.

the first 48 hours. The maximum pain occurred in the first hour after surgery (median pain score of the first hour = 5, inter-quartile ranges 0.25-5) and decreasing over time. The prevalence of patients experienced moderate to severe pain (NRS ≥4) was 61.4%.

When compared to the Lahtinen's study[7], their prevalence of the patients with pain score ≥4 after cardiac surgery was 75%, the present study had less pain prevalence in spite of quite a similar patient population. This may be due to the different ethnicity and culture, which affected the individual pain perception[3]. Moreover, Lahtinen's study does not mention about analgesic therapy given, which could make these two studies difficult to compare.

The risk factors analysis in the present study revealed that the cardiopulmonary bypass (CPB) time is the only factor affecting pain level. When the CPB time was shorter than 60 minutes, the number of patients with moderate to severe pain decreased. The other factors were not statistically related to the pain prevalence. From the previous studies regarding risk factors of acute pain, the factors varied widely but the common factors were age less than 60, duration of surgery longer than two hours, and site of surgery e.g. thoracic surgery[5,8]. The present findings that CPB time shorter than 60 minutes resulting in less pain still has no supportive evidence. As we know the effect of CPB in releasing various types of cytokines which were recognized to be pro-inflammatory mediators contributing to pain[9]. This could be the reason that duration of CPB is the risk factor of pain, which requires further study to support the hypothesis.

Incidence of pain treatment complication in the present study was low, only 26.5% had nausea and 11.4% vomited. The results was different from Mace study[10], which had incidence of nausea after cardiac surgery 66.5% and vomiting 34%, even the study group were comparable. Their study as well revealed the effect of morphine dosage on nausea and vomiting postoperatively. The more morphine given, the more nausea and vomiting occurred. In the Mace study[10], the overall morphine dose was 34 milligrams recorded until 72 hours postoperatively, while the present study the patients received a mean dose of 14.5±9.6 milligrams (until 48 hours postoperatively).

Preoperative pain expectation in the present study was moderate to severe with the median pain score of 6. The actual pain experienced postoperatively was not as much as the other study. This may be due to the perception of the patients that cardiac surgery is extensive and frightening. The previous study of Nay et al[11] showed the same direction of pain expectation and experienced in the patients after coronary artery bypass surgery. This also applied to other types of surgery as in Svensson's study[12], where the population is orthopedic and abdominal surgical patients, most of the patients expected more pain than the real pain experienced.

In conclusion, the prevalence of moderate to severe pain after cardiac surgery in the present study is high, which can lead to deprived patients quality care. However, the majority of the patients had less pain than they expected and were very satisfied with the pain treatment. The only risk factor affecting the pain level the authors found was the duration of CPB less than 60 minutes, which reduced the level of pain. The further study would be very valuable.

Potential conflicts of interest

None.

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การระงับปวดในผู้ป่วยหลังการผ่าตัดหัวใจ: เราประเมินความปวดหลังการผ่าตัดหัวใจต่ำไปหรือไม่?

กษณา รักษมณี, วันชัย วงศ์กรรัตน์, ภารดี ศิริบูรณ์, ณัฏฐาพร ปันติสวัสดิ์

วัตถุประสงค์: *การผ่าตัดหัวใจที่ลงแผล median sternotomy นั้นมีความเชื่อกันว่าไม่เจ็บปวดมากหลังผ่าตัด และมักได้รับการประเมินและดูแลรักษาต่ำกว่าความเป็นจริง การรักษาความเจ็บปวดที่ไม่ดีพออาจส่งผลให้การเจ็บป่วยเพิ่มขึ้นและเพิ่มระยะเวลาของการนอนโรงพยาบาลนานขึ้น ตลอดจนการนำไปสู่อาการปวดเรื้อรังหลังผ่าตัด การศึกษานี้จัดทำขึ้นเพื่อระบุความชุกและปัจจัยเสี่ยงของอาการปวดระดับปานกลางถึงรุนแรงหลังการผ่าตัดหัวใจ*

วัสดุและวิธีการ: *เป็นการศึกษาแบบ prospective observational study ในผู้ป่วย 290 ราย ที่เข้ารับการผ่าตัดหัวใจของโรงพยาบาลศิริราชในช่วงระยะเวลาตั้งแต่ เดือนกรกฎาคม พ.ศ. 2552 ถึงเดือนพฤศจิกายน พ.ศ. 2553 บันทึกคะแนนความปวดในช่วง 48 ชั่วโมงแรก หลังผ่าตัดโดยใช้ numerical rating scale (NRS) และกำหนดให้ NRS ตั้งแต่ 4 ขึ้นไป เป็นความปวดระดับปานกลางถึงรุนแรง บันทึกข้อมูลอื่นได้แก่ ข้อมูลทั่วไปของผู้ป่วย ประวัติการผ่าตัดในอดีต และข้อมูลเกี่ยวกับการผ่าตัดและการให้การระงับความรู้สึก ยาระงับปวดที่ได้รับ และบันทึกผลข้างเคียงของการให้ยาระงับปวด ผู้ป่วยจะได้ประเมินความคาดหวังต่อความเจ็บปวดก่อนการผ่าตัด และประเมินซ้ำหลังผ่าตัดเพื่อนำผลมาเปรียบเทียบ รวมทั้งสอบถามความพึงพอใจต่อการระงับปวดที่ได้รับ*

ผลการศึกษา: *มีผู้ป่วยเข้าร่วมการศึกษาจำนวน 290 ราย ผู้ป่วย 95.5% จัดอยู่ใน ASA physical status class III ระยะเวลาผ่าตัดเฉลี่ย 243.82 นาที (95 ถึง 600 นาที) และระยะเวลาที่ใช้เครื่องหัวใจและปอดเทียมเฉลี่ย 112.8 นาที (33 ถึง 500 นาที) พบความชุกของความปวดระดับปานกลางถึงรุนแรง (NRS ≥4) ใน 48 ชั่วโมง หลังการผ่าตัด 61.4% พบว่าระยะเวลาของการใช้เครื่องหัวใจและปอดเทียมนานกว่า 60 นาที มีผลต่อความเจ็บปวดระดับปานกลางถึงรุนแรงอย่างมีนัยสำคัญทางสถิติ ($p<0.01$) ผลข้างเคียงต่าง ๆ ของการให้ยาระงับปวดพบว่ามีภาวะแทรกซ้อนจากการให้ยาระงับปวดน้อยมาก และผู้ป่วยส่วนมาก (81.4%) มีความพึงพอใจต่อการระงับปวดที่ได้รับ*

สรุป: *พบความชุกของความปวดระดับปานกลางถึงรุนแรงในผู้ป่วยหลังการผ่าตัดหัวใจค่อนข้างมาก และระยะเวลาในการใช้เครื่องปอดและหัวใจเทียมมากกว่า 60 นาที เป็นปัจจัยเดียวที่มีผลเพิ่มระดับความปวดปานกลางถึงมากอย่างมีนัยสำคัญทางสถิติ อย่างไรก็ตามผู้ป่วยส่วนมากมีความพึงพอใจสูงต่อการระงับปวดที่ได้รับ*