**Anesthesia for Mitral Valve Replacement Surgery:**

**Impact of Thoracic Epidural Analgesia on Extubation Time and Pain Scores**

**Raafat A. Salem\*, Ahmed M.A., Abd Elmaabood\*, and Ayman M. Abdel-Ghaffar\*\***

Departments of Anesthesia \* and Cardiothoracic Surgery\*\*, Sohag Faculty of Medicine, Sohag University

**Abstract**

**Background:** Thoracic epidural analgesia (TEA) after thoracic surgery provides the most effective analgesia, influences the neurohumoural stress response and cardiovascular pathophysiology.

**Aim:** To evaluate the impact of TEA, via a catheter placed pre-operatively, on extubation time and pain scores in patients undergoing mitral valve replacement surgery.

**Methods:** In this prospective, randomized study, eighty four patients scheduled for elective mitral valve replacement surgery were randomly allocated into two groups (42 patients each). Patients in the first group (TEA) subjected to combined general anesthesia and TEA while those in the second group (opioid based) received opioid-based general anesthesia. Extubation time was recorded, hemodynamic stability and pain scores were assessed up to 48 h after surgery. The total dose of fentanyl consumed over 48 hr postoperatively was recorded.

**Results:** There was a statistically significant decrease (P<0.001) in extubation time in TEA group compared with that in opioid based group. In addition, there was significantly lower mean pain scores (P<0.01) throughout the postoperative observational period in the TEA group compared with those in the opioid based group. The total dose of fentanyl consumed over 48 hours was higher in opioid based group than that of TEA group (P<0.001).

**Conclusion:** From surgical perspective, early extubation, amelioration of severity of postoperative pain and rapid regaining physical activity obtained via TEA improves the surgical outcome via reduction of postoperative complications, shortening of intensive care and hospital stay and saving financial resources.

**Keywords:** Early Extubation; Thoracic Epidural Anesthesia; Mitral Valve Surgery.

**Introduction**

Thoracic epidural analgesia (TEA) carries potential benefits to patients undergoing surgical procedures **(1)**. In cardiac surgery the advantages of TEA include early recovery of consciousness and spontaneous breathing**(2)**, hemodynamic stability**(3)**, better analgesia**(2)**, diminished oxygen demand, improved coronary blood flow**(4)**, reduced risk of depression and posttraumatic stress**(5)**, ameliorated pulmonary function**(6)**, and early extubation**(7)**. Adequate post-operative analgesia ensures optimal pain-free recovery. It may also diminish morbidity, postoperative hospital stay and cost. Moreover, inadequate postoperative analgesia may increase morbidity via adverse hemodynamic, metabolic, immunologic, and haemostatic derangements**(8)**. Therefore, sufficient control of postoperative pain may improve outcome in high-risk patients after non-cardiac surgery**(9)**, as well as in cardiac surgery**(10-11)**.

Post-operative analgesia may be attained via a wide variety of techniques. IV opioid use is associated with definite detrimental side effects, and long-acting opioid may delay tracheal extubation during the immediate postoperative period**(12)** During the last decade, intrathecal and epidural techniques have been increasingly utilized.

High thoracic epidural anesthesia in cardiac surgery is currently an area of interest since a number of studies showed that central neuroaxial blockade decreases the response to surgical stress (sternotomy and cardiopulmonary bypass lead to enhanced catecholamine response) and improves myocardial metabolism, and therefore enables earlier extubation and more comfortable postoperative course. **(13)**

**Aim of the study**

The aim of this study was to assess the impact of thoracic epidural analgesia, via a catheter inserted pre-operatively, on extubation time, and postoperative pain scores in patients undergoing mitral valve replacement surgery.

**Patients and Methods**

This is a prospective randomized study. It was conducted at Sohag University Hospital from August 2009 to July 2011. Eighty four patients scheduled for elective mitral valve replacement surgery and aged 20 years or older were enrolled. The study was approved by the Local Ethics Committee. A written informed consent was obtained from all patients. Exclusion criteria were severely depressed left ventricular ejection function (LVEF<30%), congestive heart failure, preoperative hemodynamic instability, emergency surgery, acute myocardial infarction (MI), moderate to severe pulmonary hypertension (systolic >50 mm Hg), previous cardiac surgery, and patient disagreement. All routine cardiac medications were continued on the morning of surgery. Heparin infusion was discontinued at least 6 hours before surgery. Contra-indications for epidural catheterization were patient refusal, pre-existing coagulopathy, prothrombin time >40 s, a low platelet count (<100,000), the use of anti-platelet drugs within 5 days before surgery (excluding aspirin), sepsis and presence of a skin infection at the site of the catheter.

Patients were randomly allocated into two groups (42 patients each). Patients in the first group (TEA) subjected to combined general anesthesia and TEA while those in the second group (Opioid basedreceived opioid-based general anesthesia.

**Anesthetic protocol**

One hour before anesthesia, all patients were premedicated with midazolam 1-2 mg intravenous (IV) to assist the institution of invasive monitoring and wide pore (14-gauge) peripheral IV cannula.

In the operative theatre, in the TEA group, 20 gauge epidural catheter was inserted through an 18 gauge Tuohy needle into the epidural space between T3 and T5 interspaces and the epidural space was confirmed by the hanging drop method. The catheter was advanced 3 cm cephalad into the epidural space. After an aspiration test for blood and cerebrospinal fluid, a test dose with 2% lidocaine (3ml) was injected through the catheter

Intraoperative monitoring included pulse oximetry, electrocardiography and observation of central venous pressure (CVP), invasive arterial blood pressure, end tidal CO2, core body temperature and urinary output.

For TEA group, 7 mL/kg of crystalloid solution was given over 20 minutes then; a bolus dose of 8-12 ml of bupivacaine 0.25% with 50-100µg fentanyl injected in the epidural catheter (one hour before induction of the general anesthesia), was given as individual doses of 2 ml every 10 minutes. The extent of neural blockage was checked by a pinprick. General anesthesia was induced for TEA group with fentanyl (2µg/kg) plus thiopentone (5mg/kg) followed by propofol infusion at 6mg/kg/hour and pancuronium 0.1mg/kg was used for muscle relaxation until the end of cardiopulmonary bypass (CPB). In the opioid based group, general anesthesia was induced with fentanyl (15µg/kg) plus thiopentone (5mg/kg) followed by propofol infusion at 6mg/kg and pancuronium 0.1mg/kg for muscle relaxation until the end of CPB. After weaning from CPB, anesthesia was gradually reduced and terminated after the last skin stitch. Minute ventilation was gradually reduced to allow carbon dioxide levels to increase and stimulate respiration. Spontaneous respiration was allowed after closure of the chest. At the end of the operation, residual neuromuscular block was not reversed, and the patients were not extubated if there was prolonged cardiopulmonary bypass > 2.5 hours, hemodynamic instability, arrhythmias, morbid obesity, core temperature below 36° C, bleeding requiring platelet or clotting factor transfusion, or where adequate spontaneous ventilation was not achieved by the end of the operation (tidal volumes <5-7ml/kg; oxygen saturation < 95%; respiratory rate > 25 breaths/min; or end-tidal CO2 tension > 50 mm Hg). After the operation, the patients were transferred to the intensive care unit.

Two analgesic regimens were used in this study. For the TEA group, a continuous infusion of 0.125% bupivacaine and 2µg/mL of fentanyl was used to maintain a dermatomal spread of T1–T10. The infusion rate varied from 5 to 15 ml/h and continued for 48 hours postoperatively, after which most patients required only oral analgesics. Patients of the opioid based group were given intravenous fentanyl infusion at a rate of 50 µg/h. In both groups sternotomy wound and chest tube sites were infiltrated with 20 to 30 ml of 0.5% bupivacaine to a maximum dose of 2 mg/kg. The patients were asked to rate the severity of pain via a visual analog scale (VAS) ranging from no pain (0 cm) to worst possible pain (10 cm) at rest and on coughing. The use of these measures was explained to all patients before surgery. If the VAS was greater than 3, 25 µg fentanyl administered IV and could repeated on demand and total doses of postoperative fentanyl were recorded over 48 hours. Pain score was monitored as the earliest possible time after extubation and every 2 hours till 6 hours, then every 6 hours till 48 hours after surgery.

**Operative technique:**

 Median sternotomy and standard cardiopulmonary bypass with aortic and bicaval venous cannulation was carried out for all patients. Moderate hypothermia (28-32ºC) and intermittent perfusions of cold blood cardioplegia in an antegrade cannula were used for myocardial protection. Posterior mitral valve apparatus preservation was our preferred technique and the anti anatomical position was chosen for valve implantation. St Jude bileaflet mechanical valves (St Jude medical, MN, USA) were implanted in all patients.

**Statistical analysis**

Results were tabulated and statistical analysis was performed using IBM-SPSS (version 19 Chicago Illinois) software. Parametric data were represented as mean± standard deviation and numbers. Comparison between groups was done using Mann-Whitney rank sum test for non parametric data and unpaired t- test for parametric ones. Proportions were compared using Chi-Squared test. P value of <0.05 was considered statistically significant.

**Results**

The age, sex, weight, height, ejection fraction and pulmonary artery pressure were comparable in the two groups (Table 1). Aortic cross-clamp time, cardiopulmonary bypass time and core body temperature at extubation were comparable in the two groups (Table 2). There was a statistically significant (P<0.001) decrease in extubation time in TEA group compared with the opioid based group. No cases needed reintubation and ventilation and there was no mortality. Likewise, the total dose of fentanyl consumed over 48 hours was higher in opioid based group than that of TEA group (Table 3). Throughout the postoperative observational period, the pain scores were significantly lower in TEA group (P<0.01) than in the opioid based group. The greatest difference (\*) was seen at 2, 4, and 6 hours postoperatively (P<0.001) in the pain scores measured at rest and on coughing, and the least differences (•) between the two groups were observed at 36, 42, and 48 hrs postoperatively both at rest and on coughing (P<0.05) (figure I and II).

Although the blood pressure, CVP, and heart rate were lower in TEA group than that of opiod based group, this was not statistically significant.

No complications of high thoracic epidural anesthesia were detected e.g: neurological deficit resulted from possible epidural hematoma, bronchospasm due to sympathetic blockade of the bronchial tree or diaphragmatic paralysis due to pherenic nerve palsy.

**Table 1:** Patients characteristics

|  |  |  |  |
| --- | --- | --- | --- |
|  | **TEA group (n=42)** | **Opioid bases group (n=42)** | **P value** |
| **Age (years)** | 22.47±5.21 | 23.52±3.96 | 0.301 |
| **Sex (M/F)** | 19/23 | 18/24 | 0.826 |
| **Weight (kg)** | 52.32±11.12 | 54.11±10.14 | 0.443 |
| **Height (cm)** | 169.45±11.23 | 171.13±10.24 | 0.476 |
| **Ejection fraction** | 57±4.5 | 55±5.1 | 0.060 |
| **Pulmonary artery pressure** | 45±3.7 | 44±2.9 | 0.172 |

**Table 2:** Surgical details

|  |  |  |  |
| --- | --- | --- | --- |
|  | **TEA group** | **Opioid bases group** | **P value** |
| Cross-clamp time (min) | 62±12 | 59±11 | 0.236 |
| Cardiopulmonary bypass time (min) | 78±15 | 72±17 | 0.090 |
| Core body temperature at extubation | 36.5±0.1 | 36.8±0.1 | <0.001 |

**Table 3:** Extubation time (min) and the total dose of fentanyl (mg)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **TEA group** | **Opioid bases group** | **P value** |
| Extubation time (min) | 67.4±16.5 | 356.5±82.3 | <0.001 |
| Ambulance time (hours) | 3.08±.395 | 18.66±2.05 | <0.001 |
| Total dose of fentanyl in mg over 48 hr | 0.95±0.1 | 2.4±0.2 | <0.001 |



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**Figure I: Changes in the VAS in the both groups at rest**



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**Figure II: Changes in the VAS in the both groups on coughing**

**Discussion**

Many clinical trials were carried out to study the effect of thoracic epidural analgesia on the reduction of the total dose of fentanyl, the effect on the VAS and the feasibility of early extubation but most of them were conducted on coronary artery bypass graft (CABG) surgery**(14)**.

Contrary to CABG, surgical correction of mitral valve lesions poses some additional problems such as difficult hemodynamic stability achievement (especially after general anesthesia and epidural anesthesia induction), higher risk of sudden perioperative impairment of left ventricular function, increased bleeding; need for postoperative anticoagulation, and extensive myocardial manipulation and cardiac troponin release **(14)**.

In this study we attempted to evaluate the impact of thoracic epidural analgesia on extubation time and postoperative pain scores in patients undergoing mitral valve replacement surgery. Our results were matched with many previous studies, which revealed that epidural anesthesia, led to optimal distribution of coronary blood flow, reduced demand for oxygen, hemodynamic stability, improved pulmonary function, early recovery of consciousness, and spontaneous ventilation and early extubation are well documented**(15-16)**.

In the present study there were significant reductions in extubation time, and the total doses of fentanyl consumption in the TEA group compared with those of the opioid based group. In addition, postoperative pain scores at rest and during coughing were significantly lower in thoracic epidural patients throughout the entire postoperative time.

Early extubation has potential benefits such as decrease in intubation-related complications, regaining optimal ciliary functions, early recovery of coughing reflex, less pulmonary atelectasis, significant improvement in intra­pulmonary shunt fraction and elimination of disadvantages like deterioration of venous return, decrease in cardiac flow**(17)**. Our results are in accordance with those reported by Priestly and his colleague**(18)** who showed that TEA patients were extubated earlier than controls (3.2 h versus 6.7 h, respectively), yet this difference may have been secondary to the larger doses of intraoperative IV opioid administered to the patients. In the same line, numerous studies have previously reported that TEA decreases the extubation time**(19-23)**. Similar to our findings, Priestley et al**(18)** found lower VAS score and less number of patients who received rescue analgesia in TEA group suggesting significantly better analgesia in the TEA group. In the current study, the TEA group provided lower pain scores throughout the postoperative period with subsequent lower dosage of oral analgesic consumption when compared with the opioid based group. Priestley et al**(18)**, Shayevitz et al**(24)** and Stenseth et al**(25)** also found a lower VAS and earlier extubation.

However, substantial controversy persists regarding the safety of intrathecal and epidural instrumentation in cardiac surgical patients who subsequently receive perioperative anticoagulation therapy**(26)**. Risk for hematoma formation in this scenario is likely to increase. In this study, there was no neurological complication was reported.

**Conclusion**

TEA provides good postoperative analgesia with a marked reduction in parentral opiates, which implies a more awake and cooperative patient allowing early extubation. Consequently a better surgical and financial outcome is achieved via reduction of postoperative complications, shortening of intensive care and hospital stay and reduction of economic constrains.

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**تأثير التسكين بالحقن خارج الأم الجافية بالفقرات الصدرية على زمن نزع الأنبوبة الحنجرية بعد التخدير و مقياس الألم بعد جراحات صمام القلب الميترالي**

**رأفت أحمد سالم1 و أحمد محمد عبد المعبود1 وأيمن محمد عبد الغفار2**

قسم التخدير و العناية المركزة1 وقسم جراحة القلب والصدر2- كلية الطب- جامعة سوهاج

**المقدمة و الهدف من البحث:**

صممت هذه الدراسة العشوائية لتقييم تأثير التسكين عن طريق وضع قسطرة قبل العمليات خارج الأم الجافية فى الفقرات الصدرية على زمن نزع الانبوبة الحنجرية و مقياس الالم بعد جراحات صمام القلب الميترالي.

**الطريقة:**

تم تقسيم أربعة و ثمانين مريضا من مرضى جراحات تغيير صمام القلب الميترالي بطريقة عشوائية إلى مجموعتين ٬ تضم كل مجموعة اثنين و أربعين مريضا.

1. المجموعة الأولى: و هي مجموعة مرضى التسكين خارج الأم الجافية بالفقرات الصدرية و قد تم تخديرهم عن طريق التخدير الكلى و الحقن المسكن خارج الأم الجافية.
2. المجموعة الثانية: و هي مجموعة المرضى الذين تم تخديرهم تخديرا كليا مع استخدام المورفينات كقاعدة أساسية فى التخدير.

و قد تم حقن مرضى المجموعة الأولى بعقار البيوبيفاكين (8-12ملليتر) بتركيز 0.25% بالإضافة إلى 50 الى 100 ميكروجرام من عقار الفينتانيل عن طريق القسطرة خارج الأم الجافية بالفقرات الصدرية كجرعة ابتدائية و ذلك قبل ساعة كاملة من بداية التخدير الكلى الذي تم بإعطاء المرضى عقار الفينتانيل بجرعة 2 ميكروجرام لكل كجم و عقار الثيوبينتون بجرعة 5 ملليجرام لكل كجم متبوعين بعقار البروبوفول عن طريق التنقيط بالوريد بجرعة 6 ملليجرام لكل جرام في الساعة و استخدم عقار البانكيرونىوم كباسط للعضلات.

اما مرضى المجموعة الثانية فقد تم تخديرهم تخديرا كليا عن طريق إعطاء عقار الفينتانيل بجرعة 15 ميكروجرام لكل كجم مع عقار الثيوبنتون بجرعة 5 ملليجرام لكل كجم متبوعين بعقار البروبوفول عن طريق التنقيط الوريدى بجرعة 6ملليجرام لكل كجم في الساعة و عقار البانكيرونيوم بجرعة 0.1ملليجرام لكل كجم كباسط للعضلات.

تم تسجىل زمن نزع الانبوبة الحنجرية فى المجموعتين و تقييم مقياس الألم و حساب جرعة الفينتانيل الكلية التي استخدمت فى المجموعتين.

**النتائج:**

وجد أن زمن نزع الانبوبة الحنجرية بعد التخدير الكلي و كذلك مقياس الألم خلال فترة الملاحظة بعد العملية الجراحية كان أقل وبمدلول إحصائى ذو جدوى فى مرضى مجموعة التسكين بالحقن خارج الأم الجافية في الفقرات الصدرية عنه في مرضى مجموعة التخدير الكلى التى تعتمد على المورفينات كقاعدة اساسية فى التخدير. كما أن جرعة الفينتانيل الكلية المستخدمة فى خلال 48 ساعة بعد الجراحة أكبر فى المجموعة الثانية عن المجموعة الاولى و ذلك بمدلول احصائى ذو جدوى.

**الاستنتاج:**

الإستخدام الروتينى للتسكىن عن طريق الحقن خارج الأم الجافية فى عمليات تغيير صمام القلب الميترالى مفيد جدا إذا توفرت بعض عوامل الأمان اثناء التخدير. ومن وجهة النظر الجراحية فان ذلك يحسن نتائج الجراحة عن طريق تقليل نسبة حدوث المضاعفات بعد الجراحة و تقصير مدة الاقامة فى العناية المركزة والمستشفى وتوفير النفقات.