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Routine chest drainage after patent ductus arteriosis ligation is not necessary

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ABSTRACT

Introduction: Chest drain insertion after surgical patent ductus arteriosus (PDA) ligation creates significant morbidity in terms of pain, pleural space infection, reduced mobility as well as prolonged hospital stay. We investigated the safety and efficacy of performing drainless thoracotomy closure following PDA ligation in a paediatric population. **Materials and Methods:** Retrospective analysis of data collected from 13 paediatric patients undergoing PDA ligation at RIPAS hospital by a single surgeon over a period of five years (2001 to 2006) was performed. All continuous data were presented as mean ± standard deviation. **Results:** PDA ligation was performed via a left thoracotomy in 13 paediatric patients with a mean age of 2.24 ± 2.03 years (ten females and three males). Mean duration of the procedures was 67 ± 12 minutes. There was minimal blood loss and no transfusions were required. Postoperatively, ten patients required only oral paracetamol for pain relief. Two patients required additional non steroidal anti-inflammatory drugs (NSAIDs). One patient had one dose of pethidine immediately post-operatively. Post-operative chest radiographs confirmed full expansion of the left lung except in one patient who had a small apical pneumothorax. Two other patients developed mild surgical emphysema despite full expansion of the left lung. All three complications resolved spontaneously after a day. Median post-operative stay was two days. There were no cases of left recurrent nerve injury and no mortality. **Conclusion:** Routine chest drainage is not necessary following uncomplicated surgical PDA ligation and patients recovered more quickly and were discharged earlier.

Keywords: Chest drains, ligation, patent ductus arteriosus, paediatric, surgery, thoracotomy

INTRODUCTION

Surgical closure of patent ductus arteriosus (PDA) is conventionally performed via a left thoracotomy incision, which requires the insertion of chest drain after completion of the procedure to evacuate both air and blood in the pleural space. However, this creates significant morbidity in terms of pain, risk of infection, reduced mobility as well as prolonged hospital stay for the patients. [1] In our unit, we have started performing drainless thoracotomy closure following surgical PDA ligation and have found it to be safe and effective in terms of reducing morbidity related to pre–

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sence of intercostal drains postoperatively. We present here our results in 13 paediatric patients who underwent drainless thoracotomy closure following PDA ligation.

MATERIALS AND METHODS

We retrospectively reviewed the notes of paediatric patients referred to our unit who underwent surgical PDA ligation without postoperative chest drain insertion, by a single surgeon, from November 2001 to March 2006. A total of 13 paediatric patients were identified.

Surgical Techniques

All paediatric patients were anaesthetised and intubated using a single lumen endotracheal tube. The median size of the endotracheal tube was 4.5Fr (range 3.5 to 5.0). Induction was generally achieved using a combination of an inhalational agent such as halothane with oxygen combined with analgesia such as fentanyl with tracrium. Maintenance of anaesthesia was achieved using oxygen, nitrous oxide and isoflurane. Once anaesthetised, all patients were placed in a right lateral decubitus position. A single dose of intravenous amoxicillin-clavulanic acid (Augmentin) 25 mg/kg body weight was given preoperatively. A pulse oxymeter and a blood pressure cuff were attached to each patient's toe and thigh respectively to ensure good oxygenation and blood pressure upon clamping of the PDA prior to ligation. A five centimetre left lateral mini-thoracotomy incision was made and pleura entered via the fifth intercostal space. Parietal pleura over the arch of the aorta was divided up to the origin of the left subclavian artery and anchored with 4/0 silk stay sutures. The left recurrent laryngeal nerve was located and isolated to avoid injury during dissection.

Once the PDA had been dissected clear of surrounding tissues, a non-traumatic Debakey forceps was used to occlude the PDA and the oxygen saturation of the left big toe, followed by the calf blood pressure were recorded. Usually both these parameters should remain unchanged on occlusion of the PDA. If anything, the systemic blood pressure should elevate slightly. However a large drop in either parameters should alert the surgeon to the possibility of occlusion of a structure other than the PDA

Once confirmed the PDA was then doubly ligated using two linen sutures. Following this, haemostasis was performed meticulously and the pleural edges re-approximated and sutured over the descending thoracic aorta. The left lung was allowed to re-expand and a 13ch nalaten catheter was inserted into the thoracic cavity via the seventh intercostal space. After the ribs and muscle layers had been closed, the nalaten tube was submerged in a beaker of water and the anaesthetist was asked to inflate the lung manually up to a pressure of 30 to 40mmHg. Once all the air had been evacuated, the nalaten tube was withdrawn and the entry point in the chest wall was closed using a vicryl 2/0 purse-string. In the later period of the study, we altered this technique by connecting the nalaten tube to a low vacuum suction to evacuate all the air. The skin was then closed using subcuticular 4/0 vicryl suture. Patients were extubated on table and transferred to recovery for observation before transferring back to the general ward. Chest radiograph was performed in the recovery room to ensure full expansion of the left lung.

Clinical endpoints

Data retrieved from patients notes included age, sex, anaesthetic induction and maintenance agents, duration of operative procedures, blood loss, analgesia used, postoperative chest radiograph findings, length of postoperative hospital stay and complications. All continuous data were presented as mean ± standard deviation.

RESULTS

The mean age of all the 13 paediatric patients (ten females and 3 males) was 2.24 **±** 2.03 years (range six months to six years). The mean duration of the procedures was 67 **±** 12 minutes. There was minimal blood loss in all patients and no transfusions were required in all 13 cases. Postoperatively, ten patients required only oral paracetamol for pain relief while two required mefenemic acid (Ponstan) in addition to paracetamol. Only one patient had a single dose of pethidine immediately for postoperative pain relief. The total postoperative paracetamol requirements up to the time of discharge ranged from zero to 1,512 mg only.

Postoperative chest radiographs confirmed full expansion of the left lung except in one patient who had a small apical pneumothorax of less than five percent. No active intervention was carried out and the patient was observed for an extra day. The small pneumothorax resolved spontaneously the next day which was confirmed on chest radiograph prior to discharge. Two other patients developed non-significant surgical emphysema around the wound site despite full expansion of the left lung on immediate postoperative chest radiographs. However these resolved spontaneously after a day. The median postoperative length of hospital stay for all patients was only two days. None of the patients required postoperative suture removal as there were no drain site sutures. There were no documented cases of left recurrent nerve injuries immediately postoperatively nor during clinic follow up. There was no mortality in all 13 patients.

DISCUSSION

Chest drains are routinely inserted following thoracotomy procedures, particularly when pulmonary resection has been carried out where the risk of air leak is high. However the use of chest drains is not without significant morbidity such as postoperative pain requiring opiate analgesia, ineffective inspiration due to the presence of the drain as well as pain from drain sites, risk of pleural infection which may result in empyema and reduced mobility particularly when the drainage bottle is attached to low vacuum negative suction in order to expand the lung.[1] All these will result in prolonged hospital stay and increased cost, not to mention risk of deep vein thrombosis and pneumonia.

The safety of avoiding chest drain insertion after videoscopic assisted thoracotomy (VATs) wedge lung resections has been well documented by two studies, provided certain criteria were met (Table 1).[2, 3] Two other studies have also reported the safety of avoiding chest drainage in patients leaving the operating room after congenital cardiovascular procedures.[1, 4] In our unit, we have found that certain procedures which do not involve pulmonary resection or where there is minimal bleeding such as PDA ligation, these criteria are all met and chest drainage is generally not required.

Table 1: Criteria for safe drainless thoracotomy closure. [2, 3]

1	Absence of air leaks during intra-operative alternative sealing test
2	Absence of bullous or emphysematous changes on inspection
3	Absence of severe pleural adhesions
4	Absence of prolonged pleural effusion requiring chest drainage preoperatively

We started performing drainless thoracotomy closure in patients undergoing PDA ligation as the procedure was quick, bloodless and does not involve any resection of pulmonary tissue hence the risk of air leak is minimal. We have performed this procedure in 13 paediatric patients so far and all have recovered well with no significant postoperative morbidity or mortality.

Postoperative thoracotomy pain has been shown to affect pulmonary function resulting in poor inspiratory effort and hence post-operative atelectasis.[5] For most cases, the presence of chest drains can further exacerbate postoperative thoracotomy pain.[6] Hence the avoidance of chest drains can alleviate such morbidity with better and quicker post-operative recovery. In all 13 patients, regular paracetamol analgesia was prescribed postoperatively with added NSAIDs or pethidine intramuscularly as required. Post-operative analgesia requirement was minimal with most patients requiring only paracetamol for pain relief. Opiate based analgesia is generally very potent analgesia and its use is associated with respiratory centre depression. Hence the avoidance of such analgesia post-operatively provides significant benefit. The avoidance of postoperative chest drains also means that there is no need for chest drain removal. In the paediatric patients, removal of chest drains can be distressing for both parents and patients, not to mention for the medical officer who has to perform the procedure. Usually a significant amount of sedation and pain relief is required to ensure that the patients are cooperative and the procedure goes smoothly without any complications. Occasionally in a very distressed child, a short general anaesthesia may be required. Furthermore, paediatric patients also tend not to follow instructions and there is risk of post-drain removal pneumothorax which can be significant. There is also the exposure to unnecessary radiation for post drain removal chest radiograph.

With the drainless thoracotomy closure, only one postoperative chest radiograph was required to confirm full expansion of the chest whereas in routine closure with chest drains, at least two chest radiographs are required, one immediately post-perative and another following chest drain removal. In our patients, as there were no chest drains post-operatively, none of our patients required postoperative suture removal.

Although three of our patients had complications, all were non-significant consisting of small apical pneumothorax and wound site surgical emphysema. These complications were due to incomplete evacuation of thoracic cavity air when the nalaten tubes were submerged underwater. Since then we have converted to connecting the nalaten tube to a low vacuum suction which has been

more effective in emptying the thoracic cavity of air.

The avoidance of chest drains in all 13 patients also meant a shorter postoperative stay with a median stay of only two days. Reported median length of postoperative stay after thoracotomy PDA ligation is four days, which is two days longer due to the presence of intercostal drains. [7] The majority of our 13 patients could have been discharged on the first postoperative day but were kept in for an extra day as we were assessing this new technique in our unit.

In conclusion, drainless thoracotomy closure following surgical PDA ligation is both safe and effective with minimal postoperative morbidity, less post-operative pain due to the absence of chest drains, quicker recovery and shorter hospital stay allowing for fast tracking of these patients.

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