

Transaxillary Patent Ductus Arteriosus Ligation without Chest Drainage

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Abstract

Introduction: Chest drain insertions after patent ductus arteriosus (PDA) ligation creates significant morbidity in terms of pain, infection, reduce mobility as well as prolonged hospital stay.

Objectives: To evaluate postoperative outcomes of chest closure with or without insertion of drain following PDA ligation through transaxillary route.

Materials and Methods: Data was collected retrospectively from 48 pediatric patients underwent PDA ligation at National Institute of Cardiovascular Disease and Ibn Sina hospital over a period of 3 years (January 2015- May 2018). Participants were divided into two groups of chest closure without or with chest tube insertion. All continuous data presented as mean± standard deviation.

Result: PDA ligation was performed 48 patients through left trans axillary thoracotomy of whom 20 patients chest closure were done without drain tube and 28 patients with drain tube. Age range was 6 months to 7 years. The mean duration of surgery was 65±18 minutes in no drain tube group and 68±21 minutes with drain tube group. There were minimal blood loss and no blood transfusion require in both groups. No fluid accumulation in both groups. One patient in no drain group developed small pneumothorax and one developed surgical emphysema in drain group. Postoperative analgesia and oxygen requirement were less in no drain group than drain group. Postoperative hospital stay was 2.25±0.53 days in no drain group but 3.96±1.08 days in drain group there was no mortality.

Conclusion: Routine chest tube drain insertion is not necessary following uncomplicated surgical ligation of PDA through transaxillary route. Chest drain was associated with postoperative complications.

Key-words: Patent ductus arteriosus, Ligation, Transaxillary approach, Without chest drain.

Introduction

Patent ductus arteriosus (PDA) is one of the most common congenital heart defects accounting for 5-10% of all congenital heart disease¹. It is the persistence of the normal fetal connection between the pulmonary artery and the descending aorta. In full terms, newborn the ductus arteriosus routinely closes within 1 to 5 days after delivery². Surgical closure of PDA is done to manage complications like congestive heart failure, recurrent pneumonia, failure to thrive, pulmonary hypertension and endocarditis³. Usually it is performed via left posterolateral thoracotomy. It is a long muscle cutting produce weakness of muscle and less cosmetic. Sub axillary (horizontal) thoracotomy incision is a combination of muscle sparing and limited incision but visible area of skin. Transaxillary vertical incision is the modification of skin crease of the axilla above the 4th

rib which is hidden by the upper arm is more cosmetic less painful less traumatic⁴.

Most of the thoracotomy incision requires the insertion of chest drain after complication of the procedure to evacuate air and / or blood from the pleural space⁵. However, this is associated with a pleural reaction because the chest tube acts as a foreign body resulting in fibrin collection⁶. The chest tube with smaller diameters become obstructed early due to collection of blood clots or fibrin thus requiring replacement⁵. In addition, chest tube is associated with increased postoperative thoracotomy pain, compromised pulmonary function resulting in poor inspiratory effort, postoperative lung collapse and low oxygen saturations⁷. Research evidence also indicate that one in every five patients suffer pneumothorax after tube removal⁸⁻¹⁰. Retrospective studies indicate no added risk of complications to patients if routine chest drainage was omitted after uncomplicated ligation of the PDA^{5,11}. Recently we have started performing drainless transaxillary thoracotomy closure following surgical PDA ligation. We present here our result of 20 pediatric patients who underwent drainless thoracotomy closure following PDA ligation through transaxillary route

Materials and Methods

We retrospectively review the notes of pediatric patients referred to our center who underwent surgical PDA ligation with or without chest drain insertion through transaxillary thoracotomy route from January 2015 to May 2018. A total 49 patients were identified. Patients were divided into two groups, no drain tube and with drain tube. Patient <7 years with no pulmonary pathology, no preoperative adhesion, no rupture ductus arteriosus, clean surgery and with good lung expansion prior to the chest closure were included in this study. Patient >7 years of age with extreme adhesion, intraoperative damage of thoracic duct, rupture ductus arteriosus and severe failure to thrive were excluded from the study.

Surgical Techniques: All patients had pre-operative investigations, x-ray chest and echocardiography were assessed and undergone operation after they had been anesthetized and intubated. A radial or femoral line was used to continuously monitor arterial pressure and a pulse oximeter was used to monitor oxygen saturation. The patients were placed in right lateral position into the left hand over the head in abducted position. The patients were firmly stabilized in this position into sand bags or pads at the front, back and under the chest, left arm was elevated and fixed, optimally exposing the axillary area. A vertical incision extends between the anterior and posterior axillary fold. The incision is about 4-6 cm large from apex of axilla and over the upper border of the 5th rib. The incision cuts down to the axillary fascia, reading to fleshy fibers of the upper digits of the serratus anterior muscle. At this stage, it is quite easy to identify 3rd rib and 4th rib. Intercostal muscles were divided with

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diathermy along the upper border of the 4th rib and the chest cavity was entered through 3rd intercostal space. Two rib retractors were inserted at right angle to each other and open slowly with simultaneous dividing intercostal muscle anteriorly and posteriorly. Once pleural cavity is entered, assessment of anatomy is mandatory followed by identifying the ductus lying between aortic arch, descending thoracic aorta laterally, the left pulmonary artery tree medially. Parietal pleura is opened and the ductus is dissected as connective tissue around it, multiple ligation and transfixation of PDA were done.

The left lung was allowed to expand. A blood transfusion set or saline set tube was inserted through the edge of skin incision into thoracic cavity via 4th or 5th intercostal space and tube was submerged. The ribs were closed with polyglactin no 2 and muscles were close in 2/0 polyglactin. During subcutaneous layer were close the anesthetist was asked to inflate the lung up to pressure 20 to 30 mm Hg. Once, all the air had been evacuated, the saline tube was withdrawing and the skin were closed by fine absorbable suture (4/0 polyglactin). Prior to extubation bilateral air entry were checked and correlated with oxygen saturation. Chest x-ray done after half one hour and 24 hours after surgery. Patients were mobilized same day on mother's lap and the patients were sent home on the second postoperative day. For the patient who had a chest drain tube was removed prior to shift from intensive care unit in the absence of significant chest tube drainage or when there was no clinical or radiological evidence of pleural space accumulation.



Figure-1: Withdrawal of saline tube



Figure-2: Chest closure without drain tube

Result

Among 48 patients who had undergone transaxillary thoracotomy closure of PDA ligation 20 patients found no drain insertion and remaining 28 patients require drain tube insertion. Of the 48 participants, 30 were female. The age range was 6 months to 7 years and weight 4 to 19 kg. The mean duration of surgery was 65 ± 18 minutes in no drain tube group and 68 ± 21 minutes with drain tube group. No blood transfusion requires in both group. One patient developed superficial wound infection in no drain group compare to three patients in drain group. Postoperatively dose of analgesic (NSAID) requirements for pain relief were 2.45 ± 0.67 in no drain group but 5.07 ± 0.96 were needed in drain group which was statistically significant ($p < 0.001$). Two patients of no drain group and three patients of drain group require single dose of pethidine for post-operative pain relief (Table-I).

To maintain oxygen saturation levels $> 95\%$ all participants provide oxygen supplements 2-6 hours. No drain group use less than 1.5 L/min of oxygen compares to drain group. However, age, sex, weight, length of thoracotomy incision and duration of surgery were not statistically significant. Post-operative chest radiograph confirmed full expansion of the left lung except one patient had small pneumothorax in no drain group and one patient in drain group developed surgical emphysema and chylothorax. Pneumothorax resolves spontaneously after a day. Length of stay in ICU of the participant of the no drain group was 15.9 ± 4.02 hours and 32 ± 6.8 hours in drain group. Post-operative length of hospital stays was 2.25 ± 0.53 days in no drain group but 3.96 ± 1.08 days in drain group and these differences were statistically significant ($p < 0.001$). There was no documented case of left recurrent nerve injury immediate post operatively in both groups and no mortality (Table-II).

Table-I: Distribution of patients by age, sex, duration of surgery and NSAID requirement

| Characteristics | No drain tube group n=20 (42%) | With drain tube n=28 (58%) | p value |
|------------------------------|-----------------------------------|-------------------------------|-----------|
| Age (months) | 33.5 ± 24.8 | 34.1 ± 23.9 | > 0.05 |
| Sex | Male | 11 | > 0.05 |
| | Female | 17 | |
| Duration of surgery(minutes) | 65 ± 18 | 68 ± 21 | > 0.05 |
| NSAID requirement | 2.45 ± 0.67 | 5.07 ± 0.96 | < 0.001 |

Table-II: Distribution of patients by ICU and hospital stay

| Characteristics | No drain tube n=20 (42%) | With drain tube n=28 (58%) | p value |
|-------------------------|-----------------------------|-------------------------------|-----------|
| ICU stay (in hours) | 15.9 ± 4.02 | 32 ± 6.8 | < 0.001 |
| Hospital stay (in days) | 2.25 ± 0.53 | 3.96 ± 1.08 | < 0.001 |

Discussion

Chest drains are routinely inserted following thoracotomy procedures. Transaxillary vertical incision is muscle sparing, less traumatic and more cosmetic and incision line hidden by upper arm⁴. We started PDA ligation through transaxillary thoracotomy from 2015. This retrospective study set to find out if children who did not received a chest tube after PDA ligation were put at higher risk of

developing complications by assessing post-operative outcomes. The main outcomes evaluated in this study were retention of fluid and/ or air in the pleural cavity, incidence of surgical site infections, oxygen saturation, post-operative pain and requirement of analgesia and ICU /hospital length of stay. We found the pleural cavity remained free of fluid or air with or without the chest tube. In uncomplicated PDA ligation with minimal trauma and no damage to intrathoracic structures, the pleura effectively absorbs the minimal inflammatory fluids. This therefore, negates the use of routine chest drainage in uncomplicated PDA surgery³. Two studies have reported the safety of avoiding of chest drain insertion in patients after PDA ligation. Our study indicates the patient in the no drain did not accumulate significant pleural fluid. This was similar to a study on elective use of chest tubes in thoracotomy for congenital cardiovascular procedure^{5,12}.

Post-operative thoracotomy pain has been shown to affect pulmonary function resulting poor inspiratory effort and hence post-operative atelectasis¹³. For most cases the presence of chest drain can further exacerbate postoperative thoracotomy pain¹⁴. Hence, the avoidance of chest drains can alleviate such morbidity with better and quicker post-operative recovery. Our patient in no drain group required less amount of analgesia than drain group. The avoidance of post-operative chest drains also means that there is no need of chest drain removal. In the pediatric patients removal of chest drain can be distressing for both parents and patients. Occasionally in a very distress child a short general anesthesia may be require and there is risk of develop post drain removal pneumothorax. The requirements for oxygen amounts is less in no drain group than drain group in this study but some study shows similar requirement¹⁵.

Analysis of the data showed avoidance of chest drain tube was associated with favorable outcomes. Postoperatively dose of analgesic (NSAID) requirements for pain relief were 2.45 ± 0.67 in no drain group but 5.07 ± 0.96 were needed in drain group which is statistically significant. Length of stay in ICU of the participant with no drain group was 15.9 ± 4.02 hours and 32 ± 6.8 hours in drain group. Post-operative length of hospital stay was 2.25 ± 0.53 days in no drain group but 3.96 ± 1.08 days in drain group. Both are statistically significant. Reported median length of postoperative stay after thoracotomy PDA ligation is 4 days, which is 2 days longer due to presence of intercostal drain¹⁶. Regarding surgical wound infections, only one patient developed wound infections in no drain group compare to three patients in drain group. This is similar to another study¹⁵. Another advantages were that after few hours most children in no drain group were placed in the mother 'slap which was very reassuring both mother and baby. In addition to clinical benefits, cost saving is another advantage.

Conclusion

Drainless thoracotomy closure following uncomplicated transaxillary surgical PDA ligation is both safe and effective with minimal postoperative morbidity, less postoperative pain, quick recovery, cost saving and shorter hospital stay. On the other hand, children who routinely received a chest drain were more likely to have higher

oxygen needs, analgesia, infection at drainage site and prolonged hospital stay.

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