



SURGICAL MANAGEMENT OF PATENT DUCTUS ARTERIOSUS IN PRETERM INFANTS: A 10 YEARS' EXPERIENCE

Yesser Elghoneimy¹, Mousa Alhaddad^{2*}, Hussain Aljabran², Mustafa Albattat², Haidar Alyaseen²
and Ahmed Aleissa²

¹King Fahd Hospital of the University, Saudi Arabia

²Imam Abdulrahman Bin Faisal University, Saudi Arabia

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ABSTRACT

Background: Patent ductus arteriosus (PDA) is a very common condition among preterm infants. Currently, it is managed with three different approaches, conservative, pharmacological and surgical approaches. However, most of these approaches have failed to improve the outcomes.

Objective: The aim of this study was to evaluate the results of the surgical management of PDA in preterm infants in King Fahd Hospital of the University (KFHU).

Materials and Methods: The medical records of the premature infants (<35 weeks of gestation) treated surgically for having a symptomatic PDA during the period from January 2006 to December 2015 were reviewed to evaluate patients' morbidity and mortality.

Results: 12 premature infants were included. The mean (\pm SD) gestational age at birth was 27.8 \pm 1.8 weeks, while the weight at birth was 879 \pm 348 gm. 4 (33%) babies underwent surgical treatment only while 8 (67%) babies underwent both surgical and medical treatment. The surgical procedure had no contraindications, and closure of PDA was successful in all babies. Pneumothorax was seen in 1 (8.3%) case. 2 (16.7%) babies were died in the follow up period.

Conclusion: The surgical ligation of PDA is a favorable modality of management in preterm infants. It has a high rate of success and a low rate of complications among which pneumothorax is the most common one.

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INTRODUCTION

Congenital heart diseases (CHD) represent, generally, a burden on the children and their families.(Amirah *et al.*, 2015) They are defined as gross structural abnormality of the heart or/and in the intrathoracic great vessels that are associated with significant functional impairments. (Mitchell *et al.*, 1971) Patent ductus arteriosus (PDA) is a subtype of CHD that results from a failure of ductus arteriosus closure after birth. (Chiruvolu and Jaleel, 2009) In Saudi Arabia, the epidemiological studies highlight a changing prevalence of PDA over the past years. It was estimated to be about 8% of the studied children with CHD in 1993.(Jaiyesimi *et al.*, 1993) In 2001, however, it reached 11.6% of the sample studied in another study. More recently, the prevalence of PDA was found to be 9.5% in 2011. (Alabdulgader, 2006; Amirah *et al.*, 2015) Compared to the term infants, PDA in preterm infants is associated with increased morbidities and mortalities, and this

demands a focused management for clinically significant cases. (Alabdulgader, 2006) As opposed to the prophylactic surgical management in the preterm, a definite surgical intervention is indicated when the child is not fit to start the medical management or when the medical management has failed. (Mirea *et al.*, 2012; Mosalli and AlFaleh, 2008) According to a retrospective study of four years, the surgical treatment of PDA who meet the criteria is a safe procedure and is associated with rare surgical morbidities. (Eggert *et al.*, 1982) Thus, the aim of this study is to further evaluate the results of the surgical management of patent ductus arteriosus in preterm infants.

METHODS

The study was a retrospective study. We reviewed the medical records of the premature infants (<35 weeks of gestation) treated surgically at King Fahd University Hospital for having a symptomatic PDA during the period from January 2006 to December 2015 and evaluated the outcomes of the surgical management in terms of patients' morbidity and mortality. The diagnosis of PDA was established by echocardiography. The criteria for surgical PDA ligation were failure of complete

*Corresponding author: Mousa Alhaddad

Imam Abdulrahman Bin Faisal University, Saudi Arabia

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medical treatment or having a contraindication for the medical treatment. A left posterolateral thoracotomy approach was used, and the PDA was either clipped or ligated.

The treatment strategy for all the preterm infants consisted of a period of conservative therapy and the standard 3-dose course of indomethacin treatment followed by the surgical ligation unless the infant has any contraindication to the medical treatment. The contraindications included active bleeding, sepsis, and oliguria.

Patients' clinical and demographic variables included gestational age, birth weight, sex, necessity of ventilator assistance, surfactant use, and comorbid conditions as well as age at surgery, weight at surgery, postsurgical complications (e.g. pneumothorax and death), days of assisted ventilation, days of total parenteral nutrition and length of hospital stay.

The data was coded and entered into the SPSS software version 21. Categorical variables were compared with Chi-square tests, and continuous variables were compared with 2 sample t tests and presented as means and standard deviations. A p value of less 0.05 was considered as significant. The necessary permission was granted by the department of surgery at KFHU, and all data was used only for research purpose.

RESULTS

The study included a total of 12 premature babies who were treated surgically for persistent ductus arteriosus. The demographical and clinical characteristics of the patients are summarized in Table-I. The mean (\pm SD [range]) gestational age at birth was 27.8 ± 1.8 [26-31] weeks, while mean (\pm SD) weight at birth was 978.1 ± 190.4 [750-1280] gm. Majority 8 (66.7%) of babies were male. Surfactant was used in 7 (58.3%) cases and 6 (50%) babies were ventilator dependent.

Table I Demographic and Clinical Information of the Study Patients (n = 12)

Gestational Age (weeks)	27.8 \pm 1.8
Birth Weight (grams)	978.1 \pm 190.4
Gender	
Male	8 (66.7%)
Female	4 (33.3%)
Respiratory Distress Syndrome	8 (66.7%)
Surfactant Use	7 (58.3%)
Ventilator Dependence	6 (50%)
Antenatal Steroid	2 (16.7%)

Out of 12 cases, 4 (33%) babies underwent surgical treatment only while 8(67%) babies underwent both surgical and medical treatment. Figure-I

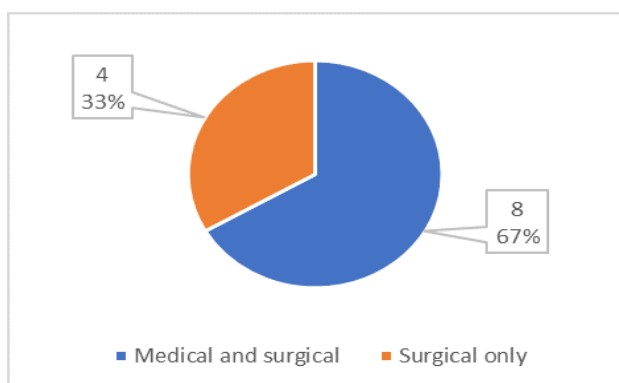


Figure 1 Management of PDA In Preterm Infants (n=12)

Contraindications to medical treatment are presented in Figure-II. Active bleeding was seen in 2 (16.7%) cases, sepsis was found in 1 (8.3%) and oliguria was seen in 1 (8.3%) case.

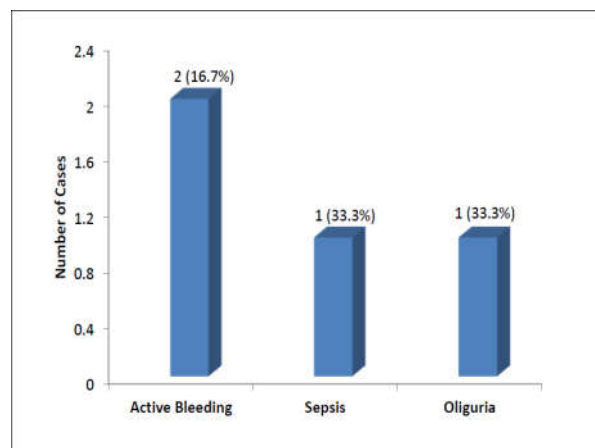


Figure 2 Contraindications To Medical Treatment (n=12)

Indications and type of surgery are presented in table-II. In 8 (66.7%) cases, surgery was done due to failure of medical treatment while 4 (33.3%) cases underwent surgical procedure due to contraindication to medical treatment. Mean \pm SD [range] age of cases at the time of surgery was 85 ± 150 [5-517] days while mean \pm SD [range] weight of cases was 5.4 ± 4.9 [1.2-10.5] kg.

Table II Indications and Characteristics of Surgery (n = 12)

Indication of Surgery	Number of Cases
Failure of Medical Treatment	8 (66.7%)
Contraindication to Medical Treatment	4 (33.3%)
Age at Surgery (Days)	
Mean \pm SD	85 \pm 150
Weight at Surgery (Kg)	
Mean \pm SD	5.4 \pm 4.9

The surgical procedure had no contraindications and closure of PDA was successful in all babies. Clinical outcome of surgical procedure is shown in Table-III. Pneumothorax was seen in 1 (8.3%) cases while another 1 (8.3%) baby developed retinopathy of prematurity. 2 (16.7%) babies were died in the follow up period. Mean length of hospital stay was 58.5 ± 55.2 [3-170] days and mean follow-up duration 1.6 ± 0.9 [1.5-36] (months).

Table III Outcomes (n = 12)

Pneumothorax	1 (8.3%)
Retinopathy of prematurity	1 (8.3%)
Death	2 (16.7%)
Use of Assisted Ventilation (days)	12.7 \pm 9.1
Days of Total Parenteral Nutrition	32 \pm 21.7
Length of Hospital Stay (days)	58.5 \pm 55.2
Follow-up Duration (months)	1.6 \pm 0.9

DISCUSSION

The management of patent ductus arteriosus (PDA) in preterm infants poses a dilemma for neonatologists with a lot of controversies in the field. The reason for the dilemma is that current evidence cannot answer the three major questions regarding PDA management in preterm infants: should we observe or treat? how to treat if treatment is necessary? and when to do so? (Abdel-Hadjet *et al.*, 2013) Both surgical ligation

and medical treatment with cyclooxygenase inhibitors can result in an early closure of PDA in preterm infants, but the preferred initial treatment has not been well established. Each modality has its own benefits and harms, and the evidence is insufficient to decide the best one of the two. (Malviya MN *et al.*, 2013)

The mean gestational age at birth for the patients presented in our study was 27.8 weeks. Only one neonate aged more than 30 weeks of gestation (31 week) which reflects that the risk of PDA is inversely proportional to gestational age and that PDA in larger premature infants (> or = 30 weeks of gestation) is relatively uncommon. (Reller *et al.*, 1993; Nemri, 2014). All our patients were very low birth weight infants (birth weight below 1500 g). Those infants have an eightfold higher risk of death when they have a persistent patent ductus arteriosus. (Graham, 2010) The increased rates of respiratory distress syndrome and the decreased use of antenatal glucocorticoids in our sample are in accordance with the results of the studies that examined for the risk factors of persistent PDA. (Chorne *et al.*, 2007; Kim *et al.*, 2010)

In this study, 4 (33%) babies underwent a primary surgery to close their persistent PDA due to having contraindications to the medical treatment while 8 (67%) babies underwent the surgeries after the failure of medical treatment. The percentage of infants in which the medical failed in this study is higher than it in other studies (67% vs 42%). The rates of each contradiction (active bleeding, proven infection, renal dysfunction, and necrotizing enterocolitis) also differs. (Satur *et al.*, 1991; Ekici *et al.*, 2006) These differences can be attributed to the small sample sizes of each study that looked for the surgical management of PDA in preterm infants. The poor quality of records in retrospective studies might have also influenced the results.

With a mean age of cases at the time of surgery of 85 days, most our patients were managed with late ligation (after 3 weeks of birth). Earlier surgical ligation of the PDA in preterm infants has a more favorable nutritional and ventilatory outcomes of an earlier achievement of full oral feeding and a shorter duration of assisted ventilation, respectively. (Ibrahim *et al.*, 2015)

The incidence of pneumothorax is similar to that reported by others. (Benjacholmas *et al.*, 2009; Hutchings *et al.*, 2013; McNamara and Weisz, 2014) One infant developed retinopathy of prematurity (ROP). A study that was conducted at two tertiary centers in Jeddah, Saudi Arabia found that the incidence of ROP in preterm infants is 33.7% -which is comparable to the international data-, and that PDA is a risk factor for ROP. (Al Hazzani *et al.*, 2011; Waheeb and Alshehri, 2016) Nevertheless, controversies about the association between surgical management of PDA and retinopathy of prematurity exist in the literature. (Weisz *et al.*, 2017) In a Cochrane Review, however, there was a statistically significant increase in incidence of retinopathy of prematurity stage III and IV in the surgical group compared to the preterm infants who were treated medically. (Malviya MN *et al.*, 2013)

Though two patients subsequently died after surgery, patent ductus arteriosus ligation among preterm neonates is not associated with the outcome of death. (Weisz *et al.*, 2017)

In our perspective, our study had many limitations. Firstly, the number of cases included in our study was relatively small,

and it is perhaps lower than the actual number of the cases we operated on. Moreover, we were concerned only about the surgical cases of preterm infants with PDA, and we did not take in account the patients who were managed with the other modalities of treatment. Thus, this study cannot prove the superiority of the surgical management over the conservative approach or the medical treatment, and vice versa. The results of this study are also limited for the fact that all operations of PDA ligation were performed at a single theater by the hands of a single surgeon.

CONCLUSION

The surgical ligation of patent ductus arteriosus is a favorable modality of management in preterm infants. It has a high rate of success. It has also a low rate of complications among which pneumothorax is the most common one.

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