

## Surgical and postoperative follow-up results for day case ligation of patent ductus arteriosus in 20 low weight premature patients

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### Summary

**Aim:** We aimed to evaluate premature babies who were referred to us for closure of patent ductus arteriosus (PDA) and who were then transferred back in the early postoperative period.

**Material and Method:** 20 preterm babies from six centers underwent PDA closure in the operating room. After obtaining approval from the local ethics committee, the cases were evaluated retrospectively. The mean weight was 650-1850 (1248,6±398,3) grams. The distance to these centers was 5-50(23,4±20,29) kilometers and the mean travel time was 2,5-28(12,57±11,44) minutes. In statistical analysis; correlation analysis, t and Mann-Whitney U tests were used.

**Results:** There was no surgical or early mortality. All patients were transferred back within 24 hours. In the first two weeks, 13 (65%) babies were successfully weaned from mechanical ventilation support. 3 (15%) babies were lost in the late term due to sepsis and intracranial bleeding. There was no morbidity and mortality except for the one patient who had pneumothorax. All other patients were sent back to their reference centers in the first 24 hours after surgery.

**Conclusions:** As the technology of patient transport vehicles and instruments develops and the skills of the medical personnel improve, the cardiac centers have the opportunity to safely operate low birth weight babies followed up in other centers. (*Turk Arch Ped* 2011; 46: 117-21)

**Key words:** Day case surgery, patent ductus arteriosus, prematurity

### Introduction

Patent ductus arteriosus (PDA) is the most commonly seen morbidity in premature babies with low birth weight and symptomatic PDA is found in approximately half of the babies with a birth weight below 1500 grams (1,2). Studies performed on these babies for more than 30 years have revealed that PDA with a finding of severe left-right shunt is associated with congestive heart failure (CHF), bronchopulmonary dysplasia (BPD), necrotizing enterocolitis (NEC) and intracranial bleeding (ICB) and increases the morbidity and mortality rates (3,4).

Early closure of symptomatic PDA is recommended (5,6). Early closure of symptomatic PDA decreases development of chronic lung disease, mechanical ventilation times,

nutritional deficiency, frequency of NEC and ICB (7,8). In contrast to the defenders of early closure of symptomatic PDA, there are also studies reporting that early closure does not affect clinical outcomes (9, 10).

The accepted approach for patent ductus arteriosus from 1970's to the present time is as follows: fluid restriction in the first place and then medical treatment. If medical treatment is not successful or contraindicated, surgical ligation is indicated (3,11).

PDA closure was firstly published in 1938. Since that time surgical procedure has been performed with a high success rate and a low complication rate including premature babies with low birth weight (9,12). Surgical ligation of PDA can also be performed at bedside in the intensive care unit in babies with

critical general status who are frequently dependent on mechanical ventilation and drug infusions and whose transfer is risky (13). Management of newborns followed up in neonatal clinics where surgical intervention can not be performed because of inadequate operational conditions or absence of surgical teams can be performed as day case surgical ligation by transferring the patient with competent healthcare workers and vehicles (14,15). In our study, we aimed to evaluate the follow up results in addition to surgical mortality and morbidity rates in premature babies with low birth weight who were referred to us from neonatal clinics where pediatric cardiac surgical interventions could not be performed for surgical closure of PDA and who were sent back in the early period after surgical operation to the center where they were followed up.

### Material and Method

Transfer course, intervention of PDA closure under operation room conditions and early results were

investigated in 20 premature babies with low and very low birth weight referred from six different neonatal intensive care clinics in the provincial borders of İstanbul to our clinic between 2007 and 2010. All families of the subjects included in the study were informed and informed consent was obtained from each of them.

Indication for surgical operation was determined according to echocardiographic examination in addition to clinical picture requiring surgical intervention in 20 babies with symptomatic PDA in whom medical treatment was unsuccessful or contraindicated and angiographic closure with device could not be performed because of body weights. Echocardiographic findings determined in the centers from which the subjects were referred were confirmed by in our center by our pediatric cardiology team on the day of operation and the subjects were operated.

Preoperative echocardiographic examination, clinical and demographic findings of the babies are shown in Table 1 and 2.

**Table 1 : Demographic properties of the subjects**

Properties of the subjects:		Percentile n:20	Lowest-Highest (Mean±standard deviation)
Gender:	Female	60% (n:12)	
	Male	40% (n:8)	
Gestational week			24-34 (27±2.8)
	24-26	45% (n:9)	
	27-28	40% (n:8)	
	29-30	-	
	31-32	10% (n:2)	
	>32	5% (n:1)	
Birth weight (g)			650-1400 (898±234.6)
	< 1000	70% (n:14)	
	> 1000	30% (n:6)	
Preoperative medical treatment time (days)		90% (n:18)	7-31 (19.2±10.8)
Size of patent ductus arteriosus (mm)			2-5 (3.1±1.9)
Additional cardiac abnormality		10% (n:2)	
<b>(Atrial septal defect, minor ventricular septal defect)</b>			
Time of preoperative mechanic ventilation (days)			0-61 (27.16±16.79)
	0	15% (n:3)	
	1-10	5% (n:1)	
	11-20	25% (n:5)	
	> 21	55% (n:11)	
Preoperative inotropic support			
	Low dose	5% (n:3)	
	Therapeutic dose	60% (n:12)	
Age at the time of operation (days)			2-71 (39.9±18.1)
Weight at the time of operation (g)			650-1850 (1248.6±398.3)
	< 1000	45% (n:9)	
	> 1000	55% (n:11)	

The length and width of PDA, the direction of the shunt and accompanying cardiac anomalies were recorded. All subjects were operated on the day they were referred. The operation was performed under preheated (26-27 °C) sterile operation room conditions, general anesthesia, endotracheal intubation, nasopharyngeal heat and with mechanical ventilation support keeping saturation values at about 85% under interventional or uninterventional monitorization by performing mini thoracotomy in the 4.intercostal space following left posterior lateral incision (Picture 1,2). In the last six subjects, brain oxygen saturation monitoring (FORE-SIGHT; Cerebral Oximeter CAS Medical Systems, Branford, CT, USA) was also included in the monitoring variables. For all subjects, previous blood preparation was done, blood sample for compatibility was sent and appropriate erythrocyte suspension was provided to be available in the operation room before PDA closure. A thoracic drainage tube was placed in all subjects and intercostal block was applied in eight subjects. Postoperative early follow up of the subjects was done in Pediatric Cardiac Surgery Intensive Care Unit in open pediatric beds with heating property connected to a monitor and mechanical ventilator and the subjects were monitored with arterial blood gases.

For statistical analyses SPSS 13.0 (Chicago, IL, USA) package program was used. For statistical evaluation correlation analysis, t test and Mann-Whitney U test were used. P values below 0.05 were considered to be statistically significant.

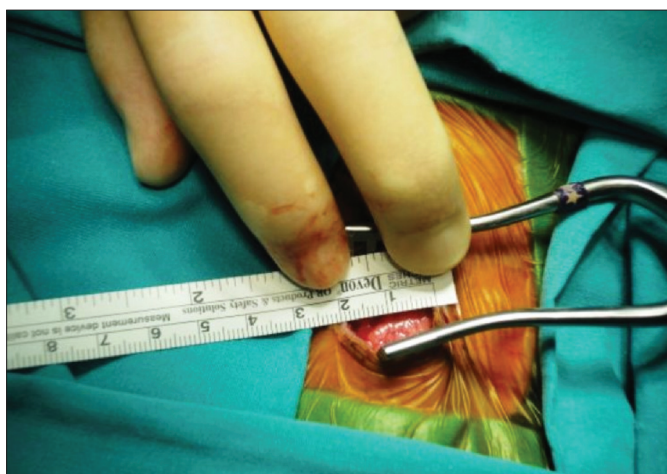
### Results

The subjects were transferred with a fully equipped ambulance under supervision of a physician and assistant healthcare worker from six different intensive care clinics in the province with a distance of 5-50 (23.4±20.29) kilometers in 2.5-28 (12.57±11.44) minutes. In none of the subjects, problems related to the referral course were observed and all were taken over with stable hemodynamic status and respiratory indicators.

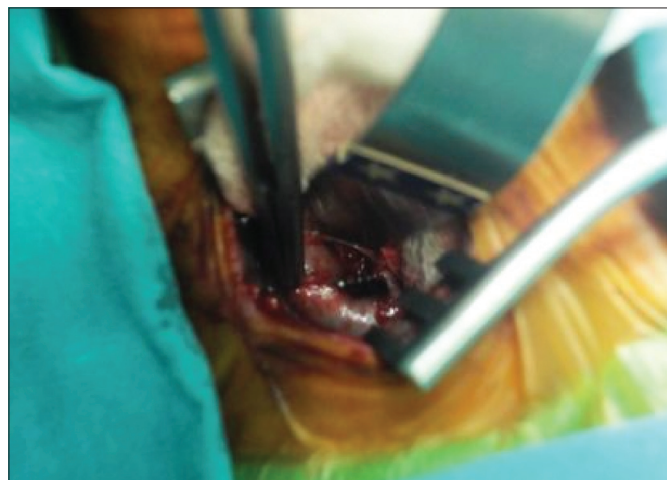
14 of the subjects (70%) were directly taken to the operation room following echocardiographic examination,

since they came with the results of preoperative investigations. Six of the subjects (30%) were taken to the operation room after preoperative investigations were performed and the results were obtained. Dissection was done by left posterior mini thoracotomy and PDA was revealed. According to anatomical structure and size, ligation was performed in 2 subjects (10%), ligaclips were placed in 8 subjects (40%) and both techniques were used in 10 subjects (50%) (Picture 2). There was no statistically significant relation between the diameter of patent ductus arteriosus and the technique used. The number of subjects who received preoperative inotropic support was 15 (75%). This figure was found to be 14 (70%) in the postoperative early period. In all subjects, underwater drainage was done by placing chest tubes of 10-14 mm. Operations were performed in a time period of 40-90 (54±11.65) minutes.

Following operation chest drainage tubes could be removed in the first 12 hours in the subjects whose arterial blood gases, chest graphies and drainages were monitored connected to mechanical ventilation in the Cardiothoracic



**Picture 1: Intraoperative appearance of posterior lateral mini thoracotomy incision**



**Picture 2: Intraoperative appearance of ductus arteriosus closed with ligaclips**

**Table 2: Morbidities observed in the preoperative period in premature babies with low and very low birth weight**

	<1000g (% , n:14)	>1000g (% , n:6)
Sepsis	28.5% (n:4)	16.6% (n:1)
Respiratory distress syndrome	85.7 % (n:12)	66.6% (n:4)
Lung hemorrhage	21.4% (n:3)	16.6% (n:1)
Intracranial bleeding	21.4% (n:3)	33.3% (n:2)
Hyperbilirubinemia	28.5 % (n:4)	16.6% (n:1)
Renal failure	28.5% (n:4)	50 % (n:3)
Necrotizing enterocolitis	21.4% (n:3)	33.3% (n:2)
Other	42.8% (n:6)	50% (n:3)

Intensive Care Unit except for one subject whose chest drainage tube remained for 48 hours because of pneumothorax. The subject who was found to have pneumothorax on chest graphy was transferred with the chest drain and it was removed by the surgical team in the intensive care unit where the patient was followed up. The subjects were sent back after a follow up period of 5-21 (11.4±5.04) hours. Morbidity and mortality related to the surgical operation and transfer course were not observed except for one subject whose underwater drainage time was lengthened because of development of pneumothorax. On follow up, 13 subjects could be weaned from mechanic ventilation support at the end of 1-173 (26.33±53.07) days. 10 of these were weaned from mechanical ventilator support in the first 10 days postoperatively and 3 were weaned in the first day postoperatively. 3 babies were lost in the late period postoperatively. Total mortality rate was found to be 15%. Reasons for death included premature birth and complications related to premature birth. The most commonly seen reason was sepsis which was observed in 3 subjects. The clinical and demographic properties of the subjects who were lost are shown in Table 3. In our study, no statistically significant relation was found between age, body weight, size of PDA and death. A relation was found between the subjects who had preoperative morbidities which are shown in Table 2 and the mortality rate (r:0.612, p:0.038) . On postoperative follow up of the surviving babies, no problem related to "residual shunt" and wound healing was observed.

## Discussion

In premature babies, the presence of PDA can rise up to 50% especially in babies with low birth weight and may lead to severe morbidity and mortality (1,2,16). In premature babies, surgical closure of PDA is generally accepted in cases where PDA can not be closed medically or medical treatment is contraindicated (11,17). In 18 of our subjects (90%), medical treatment was given and treatment failure was observed. In 2 subjects (10%), surgical intervention was decided to be performed, since medical treatment was contraindicated.

The time of surgical closure of patent ductus arteriosus is a debated subject. While some studies have suggested that early operation is significantly related to improvement in clinical picture, others have reported that there is no

difference between medical and surgical treatments in terms of survival (3,18). The ages of our subjects ranged between 2 and 71 (39.9±18.1) days and were compatible with late-term operation according to the criteria accepted in the references. While some studies defended that there was no relation between timing of surgical operation and clinical course, in other studies better results were obtained with the first early intervention in cases where indication was acceptable (1,3,8). Although four of five subjects who were weaned from mechanic ventilation in the first three days in our study group were 25 days old or younger, no statistically significant relation was found with the subjects who were operated in a later period.

Conditions including mainly respiratory distress syndrome are observed in premature babies especially weighing below 1000 grams in the preoperative period. In our study, a relation was found between mortality and the subjects who had a preoperative morbidity in addition to PDA. Although mortality and significant morbidity were not observed in the early postoperative period in the follow up of our subjects, a statistically significant relation was found between late-term mortality and late-term surgical operation supporting the view noted in similar publications available in the references (13,18).

Development of patient transfer vehicles and equipment and increase in education and experience of healthcare workers provide interventions which are necessary for low birth weight infants followed up in centers where cardiac surgery can not be performed to be realized by transferring the patients with support of experienced healthcare workers and modern transfer vehicles. Our study revealed that surgical closure of PDA can be safely performed as day case surgical intervention in patients with an indication for operation. In none of the 20 subjects referred to our clinic from six different centers, mortality or morbidity related to transfer were observed. No morbidity or mortality related to surgical operation was observed except for one case where chest tube was removed in the second day in the center where the patient was transferred back because of pneumothorax postoperatively. All babies could be sent back to their centers in the first 24 hours. The results we obtained showed that the procedure of surgical PDA closure can be safely performed by referring the patients to centers where pediatric cardiac surgery is intensively performed and treatment can be maintained in the clinics where the patients were referred from.

**Table 3: Clinical and demographic properties of the three babies who died**

Subject	G	GW	BW (g)	ATO (days)	WTO (g)	Preoperative clinical condition	Reason of death
1	F	25	666	32	830	RDS, sepsis, ICH, severe HF	Sepsis, ileal perforation
2	M	28	700	61	930	RDS, sepsis, HF	Sepsis, ICH, RDS
3	F	28	1030	65	1600	RDS, akciğer kanaması	Sepsis, RDS

G: Gender; GH.: Gestational week ; BW: Birth weight; ATO: Age at the time of operation; WTO: Weight at the time of operation; RDS: Respiratory distress syndrome; ICH: Intracranial hemorrhage; HF: Heart failure.



**Conflict of interest: None declared**

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