Modified Blalock-Taussig Shunt in Palliative Cardiac Surgery

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Background: Cyanotic congenital heart diseases present early in life with poor general condition of the patient. Majority of deaths occurs within one year of life before surgical intervention due to severe cyanosis and metabolic acidosis. Modified Blalock-Taussig Shunt (MBTS) is one of the palliative cardiac surgeries done for cyanotic congenital heart diseases. It improves the general condition of the patient before definitive surgery is done. The aim of this study was to determine the commonest indications, post-operative anticoagulation and early complications following MBTS at CARE Hospital, India.
Methods: This was a retrospective study from January 2004 to December 2006 including all patients who underwent Posterolateral Thoracotomy for MBTS. All patients had deep cyanosis, oxygen saturation of 65% or less and small pulmonary vasculature due to congenital heart defects. Acyanotic patients and those with oxygen saturation more than 65% were excluded from the study. All patients received a single dose of heparin intra-operatively and oral aspirin as anticoagulant regimen post-operatively. No heparin given post-operatively.
Results: A total of 20 children with a mean age of 27.4 months were studied. Two patients had pre-operative ICU admission due to severe cyanosis (both had oxygen saturation of 35%), hypotension and severe body weakness. The commonest indications for MBTS included Tetralogy of Fallot (70%), pulmonary atresia (10%) with or without Ventricular Septal Defect (VSD), tricuspid atresia (10%) with pulmonary atresia or stenosis and Double Outlet Right Ventricle (DOVR) with pulmonary atresia or stenosis (10%). Mean duration of ICU stay was 2 days, mean duration of mechanical ventilation was four and half hours, mean duration of hospital stay was 7 days and mean systemic oxygen saturation improved significantly from 46% to 84% (x^2 = 7.03, p = 0.0080). No post-operative bleeding, seroma, shunt thrombosis or death occurred in this study.
Conclusion: The commonest indication for MBTS is TOF. Intra-operative single dose of heparin followed by post-operative oral aspirin as anticoagulant regimen was not associated with a major complication in terms of bleeding, seroma, shunt thrombosis, or death.

Introduction

Modified Blalock-Taussig Shunt is a common palliative surgery done for cyanotic congenital heart diseases associated with reduced pulmonary blood flow prior to definitive surgery[1,2]. It is one of the systemic to pulmonary artery shunts whereby a synthetic conduit mainly Polytetrafluoroethylene - PTFE (Gore Tex) is anastomosed mainly between right subclavian artery and right pulmonary artery or left side occasionally. Cyanotic children present with poor nutritional status, desaturation, metabolic acidosis and low cardiac output[3,4]. Haemodynamic and biochemical unstable patients require ICU admission for resuscitation and haemodynamic stabilization prior to MBTS[5]. The issue of post-operative heparin as anticoagulant to prevent shunt thrombosis has remained controversial as it differs from one center to another[6,7].

MBTS significantly improve growth of main, left and right pulmonary arteries and pulmonary valve annulus due to improved pulmonary blood flow[4].

Consequently, these improve the general condition of the patient with good haemodynamic and biochemical status prior to definitive correction[4,5]. The commonest complications following MBTS include shunt thrombosis leading to obstruction, shunt stenosis, infection, peri-shunt (graft) seroma, pseudoaneurysm and pulmonary artery distortion[2]. This retrospective study was aimed at determining the indications, post-operative anticoagulation and immediate complications following MBTS at Care Hospital, Hyderabad-India.

Patients and Methods

A retrospective study was undertaken from January2004 to December 2006. The study population included all patients who had Modified Blalock-Taussig Shunt (MBTS) at Care Hospital, India. The Theatre Register and Medical Records were used to obtain the necessary information from the patients' files till the day of discharge from the hospital. MBTS was indicated for all patients with deep cyanosis, oxygen saturation of 65% or less and small pulmonary vasculature by 2D echocardiography. Acyanotic patients and those with oxygen saturation above 65% were planned for definitive (primary) correction and therefore excluded from this study. Two patients had pre-operative ICU admission due to severe cyanosis (both had oxygen saturation of 35%) and hypotension. They were stabilized by ventilation, hydration, cardiac support with inotropic and ductal dilatation with Prostaglandin E_1 infusion (0.05 µg/kg/min). Surgical approach was through conventional postero-lateral thoracotomy. All patients received heparin, 1 mg/kg intravenously stat just before shunt anastomosis. The size (diameter) of the shunt depends on the weight of the patient such that, neonate less than 2.0 kg = 3.0 mm diameter, infancy between 2.0 - 3.5 kg = 3.5 mm diameter and infancy above 3.5 kg = 4.0 mm diameter as well as intra-operative vascular assessment. Oral aspirin, 5mg/kg/day were started immediately on the arrival to ICU. No post-operative heparin given. Control Chest X-Ray and control 2D-echocardiography were done while in the ICU to exclude haematoma, to determine shunt patency, pulmonary artery anatomy and left ventricular function.

Results

During this study, a total of 20 patients studied. Male to female ratio was 1.9:1 and 55% of all patients belong to infancy age group (Table 1). Two patients had pre-operative ICU admission for stabilization prior to MBTS.

The commonest indication for MBTS was Tetralogy of Fallot which accounted for 70% of cases. Other indications were pulmonary atresia with or without VSD, tricuspid atresia with pulmonary atresia or stenosis and DORV with pulmonary atresia or stenosis (Table 2). Right MBTS accounted for 95% versus 5% for left MBTS. Mean duration for ICU stay was 2 days, mean duration for mechanical ventilation was four and half hours, mean hospital stay was 7 days, mean pre-operative oxygen saturation was 46% (Std Dev.= 7.20) and mean post-operative oxygen saturation was 84% (Std Dev.= 6.20){Table 3}. No post-operative bleeding, shunt thrombosis, peri-shunt seroma or death occurred in this study.

Table1. To determine the age group per sex

Age(months)/sex	Male	Female	Total	%
0-12	9	2	11	55
13-60	3	5	8	40
> 61	1	0	1	5

Total	13	7	20	100

Male: Female = 1.9:1 Mean age = 27.4 (SD=28.91)

Table2. To determine the Indications for MBTS

Diagnosis	Number
Tetralogy of Fallot	14 (70%)
Pulmonary atresia with/without VSD	2 (10%)
Tricuspid atresia + Pulmonary atresia/stenosis	2 (10%)
DORV + Pulmonary atresia/stenosis	2 (10%)
Total	20(100%)

Table3. To determine the surgical outcome of MBTS

Surgical outcome	Number
Mean duration of ICU stay(days)	2 (Std= 0.68)
Mean duration of mechanical ventilation (hours)	4.30 (Std= 3.27)
Mean duration of Hospital stay (days)	7 (Std=4.88)
Mean preoperative Oxygen saturation (%)	46 (Std=7.20)
Mean postoperative Oxygen saturation (%)	84 (Std=6.20)
Bleeding	0
Shunt thrombosis	0
Peri-shunt seroma	0
Re-operation	0

Discussion

A total of 20 children underwent MBTS. The Male: Female ratio was 1.9:1. Their mean age on presentation was 27.4 months. Infants above one month of age accounted for about 55% of all children. Two patients had pre-operative ICU admission for haemodynamic and biochemical stabilization prior to MBTS. Study by Sivakumar et al[5] revealed 10 out of 20 neonates who underwent MBTS had pre-operative ICU admission for stabilization prior to MBTS. Gladman et al[8] performed a MBTS in 65 children with a mean age of 58 days and 95% were done on the right side. Majority of patients in this study, 95% underwent right MBTS and only 5% done on the left side. Right MBTS make shunt ligation during definitive surgery easier compared to the left side. Left MBTS is mainly indicated for small left pulmonary artery anatomy compared to the right side.

The commonest indications for MBTS in this study included Tetralogy of Fallot (70%), pulmonary atresia with or without VSD (10%), tricuspid atresia with pulmonary atresia or stenosis (10%) and DORV with pulmonary atresia or stenosis (10%). Similar findings were obtained by other studies with a single ventricle physiology anomaly associated with pulmonary atresia in addition [5,9].

In this study no patient received post-operative heparin as an anticoagulant to prevent shunt thrombosis except aspirin. No shunt failure in terms of shunt thrombosis, peri-shunt (graft) seroma or bleeding. No patient who underwent thoracotomy for re-

exploration and no death occurred in this study.

The role of heparin in MBTS has remained controversial. Berger et al (6) found heparin as an independent risk factor for peri-graft seroma following MBTS but other studies concluded that heparin has no role post-operatively. Mullen et al (7) studied on 23 patients who underwent MBTS using a single dose of heparin intra-operatively and no post-operative heparin given. The findings revealed no post-operative bleeding or seroma developed, no shunt failure occurred during a mean follow-up of 18 months. It was concluded that shunt thrombosis is more likely related to intra-operative technical difficulty or extremely small pulmonary artery size. Gladman et al (8) found pulmonary artery distortion in about 33% of children who underwent MBTS and shunt stenosis was common and correlated with a younger age at palliation.

MBTS improve the general condition of the patient. Our study revealed a remarkable improvement in terms of oxygen saturation, duration of mechanical ventilation, ICU and hospital stay and mortality. In this study, mean oxygen saturation was significantly improved from 46% to 84% (x^2 =7.03, p = 0.0080), mean ICU stay was 2 days, mean duration of mechanical ventilation was 4 hours and 30 minutes, and mean hospital stay was 7 days post-operatively. Other studies had mean oxygen saturation improvement from 66% to 77% (4, 5), mean ICU stay of 5 days (5), peri-graft seroma less than 3% (2, 6, 8), shunt patency of 80% to 89% (5, 10) and mortality from 0 to 15% (4, 5, 10).

Conclusion

The commonest indication for MBTS is TOF. Intra-operative single dose of heparin followed by post-operative oral aspirin as anticoagulant regimen was not associated with a major complication in terms of bleeding, seroma, shunt thrombosis or death.

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