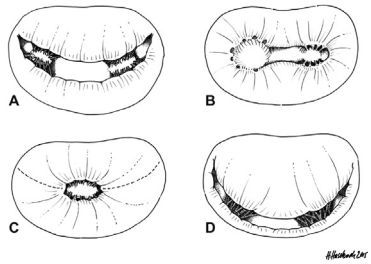
Repair of Parachute and Hammock Valve in Infants and Children: Early and Late Outcomes

Eva Maria Delmo Walter, MD, MSc, PhD, Mariano Javier, and Roland Hetzer, MD, PhD

Parachute and hammock valves in children remain one of the most challenging congenital malformations to correct. We report our institutional experience with valve-preserving repair techniques and the early and late surgical outcomes in parachute and hammock valves in infants and children. From January 1990-June 2014, 20 infants and children with parachute ($n = 12$, median age = 2.5 years, range: 2 months-13 years) and hammock ($n = 8$, median age = 7 months, range: 1 month-14.9 years) valves underwent mitral valve (MV) repair. Children with parachute valves have predominant stenosis, whereas those with hammock valves often have predominant insufficiency. Intraoperative findings included fused and shortened chordae with single papillary muscles in children with parachute valves. MV repair was performed using annuloplasty, commissurotomy, leaflet incision toward the body of the papillary muscles, and split toward its base. Children with hammock valves have dysplastic and shortened chordae, absence of papillary muscles with fused and thickened commissures. MV repair consisted of carving off a suitably thick part of the left ventricular wall carrying the rudimentary chordae. The degree and extent of incision and commissurotomy is determined by the minimal age-related acceptable MV diameter to avoid mitral stenosis. During a median duration of follow-up of 9.6 years (range: 6.4-21.4 years), cumulative survival rate and freedom from reoperation in parachute valves were 43.7 ± 1.6% and 53.0 ± 1.8%, respectively. In hammock valves, during a median duration of follow-up of 6.7 years (range: 2.7-19.4 years), cumulative survival rate and freedom from reoperation was 72.9 ± 1.6% and 30.0 ± 1.7%, respectively. Age less than 1 year proved to be a high-risk factor for reoperation and mortality ($P < 0.005$). In conclusion, children with parachute and hammock valves, repeat MV repair may be necessary during the course of follow-up. Infants have a greater risk for reoperation and mortality.

Semin Thoracic Surg 28:448–460

Keywords: parachute valve, hammock valve, mitral valve repair, children



Rare and complex mitral valve malformation.

Central Message

The rarity and complexity of parachute and hammock valves, as well as their occurrence in infants and children, make their reconstruction technically challenging. Nonetheless, repair offers a satisfactory long-term functional outcome. Repeat MV repair may be necessary until a time when an appropriately sized prosthesis can be implanted. Infants have a greater risk for reoperation and mortality.

Perspective Statement

Repair of parachute and hammock valves in infants and children is desirable. It must be assumed that these malformed valves, repaired during infancy and childhood, would eventually have to be replaced at some time in life. Valve repair allows time for annular growth and tissue maturity, and anticipating that even the primary repair is not optimal, time is gained for repeat repair until a definite prosthesis can be implanted. Durability of repair is a given major setback; however, with meticulous intraoperative assessment of valve morphology and careful performance of appropriate repair strategy, repair can be long-lasting, and functional outcome of those who survived the surgery are highly acceptable.

See Editorial Commentary pages 461-462.

INTRODUCTION

The rarity and complexity of parachute and hammock valves, as well as their occurrence in infants and children, has stimulated great interest and fascination in its surgical management. Because of their recognition and description, parachute and hammock valves in children remain one of the most challenging congenital malformations to correct. To replace the valve has been a source of controversy owing to the fact that there is hardly any valve prosthesis suitable for this age group. To repair has been likewise a great challenge surmising that a particular repair allows time for annular growth and tissue maturity, and anticipating that even the primary repair is not optimal, time is gained for repeat repair until a definite prosthesis can be implanted. Hence, various surgical repair strategies that primarily address relief of mitral stenosis (MS) or mitral insufficiency (MI) with or without anatomical correction have evolved. Multifaceted approaches to repair the mitral valve (MV) have been introduced by several surgeons.

Trauma Surgery Centre Berlin, Berlin Germany

Presented at the 54th Annual Meeting of the American Association of Thoracic Surgeons (AATS) on April 28, 2015 in Seattle, WA.

Address reprint requests to Eva Maria Delmo Walter, MD, PhD, Trauma Surgery Centre Berlin, Berlin Germany. E-mail: eva.delmowalter@googlemail.com

1043-0679/$-see front matter
http://dx.doi.org/10.1053/j.semtcvs.2016.04.011

Over the past 20 years, our institution has focused on repair of parachute and MVs with regard to preservation of valve tissues, subvalvular apparatus, and ventricular geometry with a strong conviction that this leads to optimal valve and ventricular function, especially in infants and children. Herewith, we aim to report our entire experience with valve-preserving repair techniques and the early and late surgical outcomes in parachute and hammock valves and their variations in this population.

PATIENTS AND METHODS

The Institutional Review Board approved this retrospective study and waived the need for patient consent.

Patients

From January 1990-June 2014, a total of 215 congenital MV diseases in children were seen at our institution, for which 183 MV repairs were performed. The data were obtained from the institutional congenital database, supplemented by medical and follow-up records from the Department of Clinical Studies and from referring cardiologists. Henceforth, the database was filtered to parachute and hammock MV and its variations. Patients with parachute valves and with left-sided obstructive lesions as part of Shone's anomaly[1] were excluded, and this series of 45 children have been exclusively published in 2013.[2]

Parachute MV was seen in 12 patients (median age at operation 2.5 years, range: 1 month-13 years), and 6 patients were $\leq$1 year of age. Median weight at operation was 10 kg (range: 2.8-37.4 kg). Hammock MV was seen in 8 patients (median age at operation 4 months, range: 1 month-14.9 years), and 5 patients were $\leq$1 year old. Median weight at operation is 8 kg (range: 3.0-42 kg). Associated cardiac defects, Ross/NYHA functional class, severity of MI and MS are detailed in Table.

In both groups, there were no genetic, chromosomal, or systemic syndromes present.

PREOPERATIVE EVALUATION

Preoperative valve anatomy and function, as well as the presence of associated cardiac defects, were assessed by transthoracic echocardiography according to the guidelines of European Society of Echocardiography[3,4] and its American counterpart.[5] The anatomical diagnoses of parachute valve and hammock valves were derived from the detailed echocardiographic definition and analysis of the valve

Table. Demographic Profile of Children With Parachute and Hammock Valves

	Parachute Valve (n = 12)	Hammock Valve (n = 8)
Median (range) age	2.5 years (2 months-13.0 years)	7 months (1 month-14.9 years)
Median (range) weight, kg	10 (2.8-37.4)	8 (3.0-42)
Associated diseases		
Patent foramen ovale	1	2
Patent ductus arteriosus	3	1
Ventricular septal defect	2	2
Pulmonary hypertension	1	2
Tricuspid insufficiency		2
Cardiomyopathy		2
Previous surgery		
Patch closure of sinus venosus defect	1	
Resection of patent ductus arteriosus	4	
Resection of vascular ring	1	
Closure of ventricular septal defect	1	2
Severity of mitral insufficiency		
Moderate to severe	3	2
Severe	2	6
Severity of mitral stenosis		
Moderate	7	2
Severe	5	3
Ross/NYHA functional class		
3	5	1
4	7	7