

ARTÍCULOS ORIGINALES

“Low Birth Weight Neonates with Congenital Heart Disease: Surgery Update”

Pedro J. del Nido, M.D.
Dept. of Cardiac Surgery
Children's Hospital Boston, Harvard Medical School

Prematurity or low birth weight (LBW) has often been viewed as an indication for delay in corrective surgery or use of palliative procedures rather than anatomic corrections to manage newborns with congenital heart disease. The rationale is based on experience in the 1980's and early 1990's with attempts at repair of complex defects in newborns where a gestational age lower than 34 weeks and a birth weight less than 2500gms. were identified as a risks for mortality and morbidity.

More recent studies however have shown that although still a risk factor, with current surgical techniques and with optimal timing of surgery, LBW neonates can undergo corrective surgery with only modest or even minimal increase in morbidity and mortality compared to term or non-LBW neonates (Bove et al, Haas et al, Oppido et al, Reddy et al). More importantly, when compared to results of palliative management or delay in repair with only medical management, early repair results in a substantial improvement (Bove et al, Wernovsky et al). Improved outcomes have also been demonstrated in smaller centers with corrective procedures in neonates and early palliation for neonates requiring single ventricle palliation (Kopf et al). The one disadvantage of early corrective surgery hat has been documented is a higher incidence of reintervention in the early and intermediate term, particularly in aortic arch surgery (Bove et al, Bacha et al).

LBW neonates with single ventricle disease pose a greater challenge since their physiology is inherently unstable, and particularly in premature infants, the rapid fall in pulmonary vascular resistance often forces early intervention to balance the systemic and pulmonary circulation (Chang et al). Attempts at medical management with low

inspired oxygen concentration to maintain elevated vascular resistance are particularly dangerous in this patient group due to the risk of severe hypoxemia. Furthermore, lack of pulmonary vascular musculature limits the effectiveness of such maneuvers. For these reasons, most centers prefer to proceed with staged palliation in these patients and have obtained reasonably comparable results (Pizarro et al).

Other considerations in planning surgical procedures in premature and low birth weight infants includes the accuracy and safety of diagnostic studies. Cardiac catheterization carries significant risk in these patients, however, in some anatomic defects such as pulmonary atresia, VSD, and major aorto-pulmonary collaterals, delineation of the pulmonary vascular anatomy may require catheterization. With increasing use of MRI, even in these patients catheterization may be avoided. While most neonatal diagnosis can be reliably made by echocardiography, recent studies evaluating its accuracy in this patient population indicate that for certain anatomic and physiologic defects, echocardiography may not be as reliable as previously believed (Dorfman et al)

Timing of Surgery

Optimal timing of surgery is often very difficult to achieve. Balancing the circulation in a premature infant who is prostaglandin dependent places them at significant risk for complications of unstable or poor systemic perfusion such as necrotizing enterocolitis, and cerebral intra-ventricular hemorrhage. Thus, in a premature infant with very limited ability to regulate cerebral blood flow and pressure, the additional risk imposed by hemodynamic instability is significant (Roland et al).

Management of Cardiopulmonary Bypass

Due to the small size of the heart and great vessels, many surgeons have advocated use of particularly of the cerebral vasculature is a serious potential problem. Great care must be taken to maintain perfusion pressure low and in an appropriate range for gestational age particularly during rewarming. Obstruction of venous return from poorly positioned venous cannulae can be equally harmful as systemic venous obstruction can lead to venous hypertension and result in capillary hemorrhage.

Surgeons have begun using alternative perfusion techniques to maintain perfusion while still providing the bloodless surgical field which is needed to achieve optimal repair (Pigula et al). Additional maneuvers to prevent complications that are frequently used include: antifibrinolytic agents such as Aprotinin, steroids pre-bypass, surfactant administration during bypass and maintenance of positive end-expiratory pressure (PEEP) to prevent atelectasis since attempts at lung re-expansion may result in parenchymal air leaks. The efficacy of these interventions however, has not been demonstrated but alternatively, no complications have been reported from these therapies either.

The results of corrective surgery and staged palliation for single ventricle disease, although not comparable to that of term infants, have rapidly improved over the last decade to the point where for some lesions they pose little additional operative risk. Late complications often appear to be related to the effects of prematurity itself, or to the lack of anastomotic growth in great vessel surgery.

References

1. Bacha EA, Almodovar M, Wessel DL, et al. Surgery for coarctation of the aorta in infants less than 2kg. *Ann Thorac Surg* 2001;71:1260-4.
2. Bove T, Francois K, De Groote K, Suys B, De Wolf D, Verharren H, Matthys D, Moerman A, Poelaert J, Vanhaesebroeck P, Van Nooten G. Outcome analysis of major

- cardiac operations in low weight neonates. *Ann Thorac Surg* 2004;78:181-7.
3. Chang AC, Hanley FL, Lock JE, Castaneda AR, Wessel DL. Management and outcome of low birth weight neonates with congenital heart disease. *J Pediatr* 1994;124:461-6.
4. Dorfman AL, Levine JC, Colan SD, Geva T. Accuracy of echocardiography in low birth weight infants with congenital heart disease. *Pediatrics* 2005;115:102-7.
5. Haas F, Goldberg CS, Ohye RG, Mosca RS, Bove EL. Primary repair of aortic arch obstruction with ventricular septal defect in preterm and low birth weight infants. *Eur J Surg* 2000;17:643-7.
6. Kopf GS, Mello DM. Surgery for congenital heart disease in low-birth weight neonates: a comprehensive statewide Connecticut program to improve outcomes. *Conn Med* 2003;67:327-32.
7. Oppido G, Napoleone CP, Formigari R, Gabbieri D, Pacini D, Frascaroli G, Gargiulo G. *Eur J Cardiothoracic Surg* 2004;26:44-53.
8. Pigula FA. Arch reconstruction without circulatory arrest: Scientific basis for continued use and application to patients with arch anomalies. *Semin Thorac Cardiovasc Surg Pediatr Card Surg Annu* 2002;5:104-15.
9. Pizarro C, Davis DA, Galantowicz ME, Munro H, Gidding SS, Norwood WI. Stage I palliation for hypoplastic left heart syndrome in low birth weight neonates. *Eur J Cardiothoracic Surg* 2002;21:716-20.
10. Reddy VM. Cardiac surgery for premature and low birth weight neonates. *Semin Thorac Cardiovasc Surg Pediatr Card Surg Annu* 2001;4:271-6.
11. Roland EH, Hill A. Germinal matrix-intraventricular hemorrhage in the premature newborn: management and outcome. *Neurol Clin* 2003;21:833-51.
12. Wernovsky G, Rubenstein SD, Spray TL. Cardiac surgery in the low-birth weight neonate. New approaches. *Clin Perinatol* 2001;28:249-64.