Beneficial Effects of Surgical Closure of Atrial Septal Defect Outweigh Potential Complications in Sick Infants

Takeshi Tsuda¹,²*, Abdul M. Bhat¹,²

¹Nemours Cardiac Center, Alfred I. duPont Hospital for Children, Nemours Children’s Health System, 1600 Rockland Road, Wilmington, DE 19803, USA
²Department of Pediatrics, Sidney Kimmel Medical College at Thomas Jefferson University, 11th and Walnut, Philadelphia, PA 19107, USA

*Correspondence should be addressed to Takeshi Tsuda; ttsuda@nemours.org

Received date: February 10, 2021, Accepted date: May 18, 2021

Abstract

Infants and children with isolated atrial septal defect (ASD) usually do not develop clinical signs or symptoms. However, infants with premature birth complicated by chronic lung disease may develop certain problems including respiratory distress, dependency upon supplemental oxygen and/or mechanical ventilation, failure to thrive, and prolonged hospitalization; these are induced largely by excessive pulmonary blood flow through ASD. Although transcatheter approach is less invasive than surgery, its feasibility is often limited by anatomical conditions of ASD and the size of the patients. In these circumstances, surgical closure can be performed safely and effectively even in sick infants to improve clinical status. When transcatheter approach is not feasible, the surgical closure of ASD results in a favorable outcome by eliminating excessive pulmonary blood flow, mitigating the need of positive pressure ventilation more quickly, and promoting better physical growth.

Keywords: Atrial septal defect (ASD), Infants, Prematurity, Bronchopulmonary dysplasia (BPD), Cardiac surgery, Pulmonary hypertension

Surgical Closure of Atrial Septal Defect in Infants and Young Children

Atrial septal defect (ASD) is a common congenital heart disease diagnosed during childhood. Persistently increased pulmonary blood flow and dilated right atrium (RA) and right ventricle (RV) result in multiple symptoms and morbidities in adulthood; untreated adults may develop exercise intolerance, congestive heart failure, atrial tachyarrhythmias, pulmonary hypertension (PH), embolic stroke, or even death [1,2]. Asymptomatic children with ASD are commonly referred for elective ASD closure around 3 to 6 years of age [2,3].

Closure of ASD during infancy has been controversial. An isolated ASD in infants and young children with chronic lung disease of prematurity or bronchopulmonary dysplasia (BPD), tracheo-bronchomalacia, chronic recurrent aspiration, or chromosomal anomalies can cause substantial medical problems, including persistent respiratory distress, dependency of respiratory support, failure to thrive, and or pulmonary hypertension. These conditions inevitably mandate long hospitalization. Early closure of ASD, either by transcatheter approach or by cardiac surgery, is beneficial in these circumstances as it instantaneously normalizes pulmonary blood flow [4-9]. On the other hand, there is a potential for spontaneous closure, and some have recommended conservative medical management even for symptomatic ASD in young children [10-13].

Transcatheter ASD device closure appears less invasive than cardiac surgery and should be considered first, but certain underlying ASD anatomy precludes its feasibility [14-16]. Possible surgical morbidities and mortality in clinically unstable infants historically remain considerable concerns among referring providers [5]. However, these concerns are, in fact, not applicable in a contemporary...
era. Surgical ASD closure can be safely accomplished in infants and younger children with a similar incidence of complications as reported in older children [3,17,18]. Lammers et al. emphasize the importance of surgical closure of ASD in symptomatic infants with multiple comorbidities without significant incidence of surgery-related complications [7]. This important therapeutic option for sick infants has been under-recognized despite its established effectiveness and safety.

**Hemodynamic Improvement Granted by ASD Closure**

The question is whether benefits provided by hemodynamic improvement exceed a potential risk of invasive interventions in small, clinically unstable infants. Recently, we published our institutional experience of the benefits and safety of surgical ASD closure in 31 symptomatic infants and young children less than 2 years of age who had significant clinical problems due to existing comorbidities and who were not candidates for transcatheter device closure due to anatomical restrictions of ASD and small body size [19]. Of 31 symptomatic patients presenting with respiratory symptoms (22 patients), failure to thrive (24 patients), and/or pulmonary hypertension (9 patients), 26 patients (84%) showed significant clinical improvement upon surgical ASD closure. Four of 8 ventilator-dependent infants were successfully weaned from positive-pressure ventilation within 3 days to 1 month after surgical ASD closure. In 14 patients with mild to moderate respiratory symptoms, 93% showed complete resolution of symptoms. No patient developed direct surgery-related major complications. Two patients died late after surgery (108 and 145 days); deaths were not related to surgical procedure or postoperative complications but due to complexity of underlying medical problems. For clinically complicated patients, the defect is best closed sooner to prevent the development of further pulmonary vascular damage, and it perhaps may improve their clinical outcomes [6,20].

The incidence of postoperative complications in symptomatic patients in our study was low [19] and comparable with reports in older asymptomatic patients [18,21,22]. Tanghoj et al. studied risk factors for adverse events following transcatheter and surgical ASD closure in children born preterm and concluded that prematurity was not a risk factor for post-procedural complications despite earlier procedural age, larger ASD size, and higher comorbidity than term infants [23,24].

**Indications for ASD Closure in Premature Infants with BPD and Pulmonary Hypertension**

We recommend a proactive approach in eliminating excessive pulmonary blood flow in premature infants with BPD when the patient’s clinical status is not improving despite maximum medical treatment. The presence of ASD may lead to multiple pulmonary pathologies in premature infants with BPD [9]: 1) excessive pulmonary blood flow into underdeveloped lung vasculature that worsens lung mechanics (compliance) [25] and stimulates adverse vascular remodeling causing pulmonary hypertension [26], and 2) RV volume overload and dilatation resulting in secondary LV filling abnormality via ventriculo-ventricular interaction causing pulmonary edema [27]. These interrelated cardiopulmonary events may be responsible for persistence of the pathological condition.

Pulmonary hypertension worsens the prognosis of premature infants with BPD. A small or moderate increase in pulmonary blood flow can induce unfavorable effects for which earlier closure of shunts can improve the outcome [28]. A meta-analysis by Vyas-Read et al. showed that low birth weight infants with ASD are more than two-fold more likely to develop late PH in the first 250 days of life than infants without ASD [29]. However, a high rate of spontaneous closure or decrease in size of the defect is known to occur in the first few months of life, during which continuous close echocardiographic screening efforts are warranted [28]. Whereas catheter-guided ASD closure has become feasible for this population [30,31], surgical ASD closure can be performed just as safely as in older children when catheter-guided intervention is not achievable.

**Where We Stand**

Although some small secundum-type ASD and patent foramen ovale (PFO) are known to close spontaneously, large secundum-type ASD, sinus venous-type ASD, and primum-type ASD will never close without intervention. Prompt decision-making for ASD closure is imperative when young children cannot be weaned from ongoing respiratory support or require escalation of care. The decision to perform transcatheter intervention or surgical repair should be assessed carefully depending upon the underlying ASD anatomy and the patient size as the transcatheter procedure has its specific limitations and complications [32,33]. Surgical ASD closure remains as a safe and effective treatment option for symptomatic infants and young children despite the fact that the patients are exposed to cardiopulmonary bypass. Ventilator-dependent premature infants with chronic respiratory failure due to BPD and ASD are encouraged to transfer to a tertiary-care pediatric cardiac center for ASD closure for better clinical outcome and shorter hospital course rather than continuing conservative medical management.

**References**


