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Original Research Article

Closure of Silent Patent Ductus Arteriosus: Is it necessary?

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Abstract: The objective is to summarize our experience and outcomes of surgical and transcatheter closure of silent patent ductus arteriosus (PDA). From January 2010 to December 2012, at Affiliated Hospital of Guilin Medical University, consecutive 6 patients who underwent surgical and transcatheter PDA device closure were included in the study. Success of closure and complications were described. In 3 cases, PDA was underwent successfully surgical ligation. The other three cases received transcatheter PDA device closure. The PDA diameter ranged from 3-7 mm. There was no mortality and major complications. No recurrence during 3-year follow-up. Surgical or transcatheter occlusion of silent PDA is an effective therapeutic option with high success rate.
Keywords: Silent, Patent ductus arteriosus, Surgery, Transcatheter closure.

INTRUDUCTION

The ductus arteriosus is a normal and essential fetal communication. The ductus arteriosus is derived from the distal portion of the left sixth embryonic arch, connecting the left pulmonary artery to the descending aorta. As a common congenital heart condition, patent ductus arteriosus (PDA) accounts for approximately 7%-10% of all congenital heart defects [1-3].The loudness of the murmur depends largely on the degree of shunting. The diastolic component may not be present initially in neonatal life, but becomes apparent as the pulmonary vascular resistance falls and diastolic shunting increases. In patients with high pulmonary vascular resistance, a murmur may not be present. PDA murmurs may also become silent probably due to the direction of the jet across the ductus arteriosus when entering the pulmonary artery. Absence of the typical PDA murmur is also found not only with a very small duct but also with a larger duct.

Closure of the PDA is recommended to prevent congestive heart failure, infection and pulmonary hypertension. But there is controversial in management of silent PDA. We report our experience in identifying such a "silent duct" in 6 patients examined clinically and by ultrasonography over a three-year period. In this article, we review the published literature on the natural history and treatment outcomes in individuals with silent PDA, the epidemiology and outcomes of infective endocarditis (IE), particularly in association with silent PDA, and the rationale and evidence for closure of the silent PDA.

PATIENTS AND METHODS

Between January 2010 to December 2013, at Affiliated Hospital of Guilin Medical University, patients with silent PDA via surgical ligation and transcatheter closure were reviewed. Excluded were patients with concomitant pre-existing conditions, patients with other associated congenital heart defects who required interventions other than PDA closure. PDA diagnosis was confirmed on echocardiography. Written informed consent was obtained from all patients or guardians. The study was approved by the Ethics Committee of Guilin Medical University Hospital. The clinical characteristics see Table 1.

Table 1: The clinical characteristics of six patients

Case	Age	Gender	PDA Size(mm)	Reason for Treatment	Complication	Treatment Methods	Follow-up
1	12 days	Male	4	pneumonia	pneumonia	Surgery	No recurrence
2	13 months	Female	3.5	pneumonia	None	Surgery	No recurrence
3	2 years	Male	4	Echocardiography examination	None	Surgery	No recurrence
4	5 years	Male	3	Echocardiography examination	None	Trans Cather Closure	No recurrence
5	46 years	Female	7	Arrhythmia	None	Trans Cather Closure	No recurrence
6	7 years	Male	6	Echocardiography examination	None	Trans Cather Closure	No recurrence

Surgical ligation through conventional surgery and transcather closures in the cardiac catheter laboratory were performed under general anaesthesia. The surgical and transcather techniques used in patients have been described in previous studies [4, 5]. The clinical outcomes and complications were recorded.

RESULTS

Successful closure of PDA was achieved in all patients with good clinical outcomes. There were no operative deaths and no major perioperative complications. All patients were discharged well. Post-procedure and follow-up echocardiogram at 6, 12, 24, 36 months revealed complete ductal occlusion for all patients. Length of stay is 6-17days. Table 1 shows clinical characteristics of 6 patients.

DISCUSSION

During fetal life, the ductus arteriosus is a normal structure that connects the left pulmonary artery to the descending aorta. Eventually, the ductus is replaced by fibrous tissue, leaving a ligament-like structure with no lumen within the first 18-24 hours of birth [6].

The classic continuous murmur of PDA is at the upper left sternal border or in the left infra clavicular area, often referred to as a “machinery” murmur [7]. However, the murmur may be atypical in infancy or in the presence of pulmonary hypertension or a large shunt. The term "silent PDA" was used not only to describe the preterm infant with respiratory distress syndrome, but also refer to not evident clinically but diagnosed incidentally by echocardiography done for another reason. Doppler ultrasonography has led to the recognition of a small ductus arteriosus with normal pulmonary artery pressure which cannot be identified clinically. In patients with high pulmonary vascular resistance, there may be no murmur during systole or diastole, as shunting may be minimal. PDA murmurs become silent also probably due to the direction of the jet across the ductus arteriosus when entering the pulmonary artery. Bennhagen and his colleagues found, out of 15 children with silent PDA, 14 demonstrated a ductal flow not contacting and away from the anterior wall of the main pulmonary artery [8]. In 15 children with a continuous murmur caused by a PDA, 12 exhibited a ductal flow toward and reaching the anterior wall of the main pulmonary artery. There was no correlation between the presence of a murmur and the size of the arterial duct in this study [8].In our cases, four of 6 patients were detected by echocardiogram because of the other reasons.

In most patients, transthoracic echocardiography is the ideal choice for establishing the diagnosis of PDA. In older patients a PDA is not easily visualized with transthoracic echocardiography. Trans-esophageal echocardiography is more sensitive and of superior diagnostic value in detecting the PDA, assessing the pulmonary vascular resistance and also the vegetation’s location in case of IE. The echocardiogram is also used to identify and evaluate other associated cardiac defects. Moreover, trans esophageal echocardiography can better evaluate the perioperative result of surgical or transcather closure. In our cases, we usually used transthoracic echocardiography, because transthoracic echocardiography is accessible in our unit and more convenient without additional cost.

The most common complications of this congenital disease are heart failure and IE. The non-restrictive type of PDA is characterized by development of heart failure during the first year of life, whether restrictive PDAs usually remain asymptomatic and are accompanied with an increased risk of IE especially after the second decade of life [9].IE was a fatal complication and the most common cause of death (45%) in patients with PDA, before the introduction of antibiotic therapy and surgical closure of the ductus [10].Wide use of antibiotics and surgical closure of

PDA have drastically reduced the incidence of IE, so that it is now considered as uncommon[11].

However, the management of the "silent" PDA is still a dilemma for the physicians. It is recommended that every isolated PDA with an audible typical continuous murmur should be closed irrespective of its size because untreated PDA is a favourable site of IE and surgical or transcatheter closure of PDA virtually eliminates risk of this fatal entity [17]. It is not known if 'silent PDA' which is not detectable by cardiac auscultation but can be recognized only by coloured flow echocardiography increases the risk of IE or not. There are some reports of IE in silent PDA [12-14]. It is clear that the risk of IE is now much lower than was previously documented. Schrader and his colleague reported that IE had been previously diagnosed in six patients among 100 adults referred for consideration of transcatheter ductal closure. The minimum ductal diameter was 4.5 mm or more in all six cases [15]. From these data we might conclude that closure should be performed even in asymptomatic adults with small ductus and insignificant left-to-right shunt. But, some cardiologists suggest that routine closure of PDA for the sole purpose of eliminating the risk of IE is unnecessary [16]. The amount of flow through the ductus is so small that often it not only does not give rise to a murmur but it also probably does not produce enough turbulence to form a jet lesion and thus does not place the patient at a risk for IE.

As an inhibitor of the arachidonic acid metabolism pathways, indomethacin administered is an appropriate drug therapy [3].In 10% of patients who do not respond to indomethacin, invasive closure of the ductus need to be considered. PDA with echo evidence of volume overloaded has to be operated in order to avoid heart failure [10]. In addition, IE seems to occur more often in high shunt-flow ductules. A low shunt-flow PDA which doesn't seem to affect left ventricular volume, poses the question whether it should be closed in order to diminish the possibility of IE, which increases further with age. In our experience, the most appropriate strategy is to refer all silent PDAs. Transcatheter occlusion techniques were attempted sporadically from the early 1970s until use of the Rash kind double umbrella device was adopted widely in the late 1980s [17]. Development of percutaneous closure of PDA shows good results with minimum complications and is considered to be a safe and feasible alternative for adult patients who are either not fit for thoracotomy or who prefer a less invasive approach. Single coil transcatheter occlusion is recommended for small ducts (< 2 mm), while multiple coil approach or Amplatzer duct occluder is preferred for a larger ductus [18]. Complications include late embolization and late recanalization of the duct, leading to the recommendation that these patients require follow up for an indefinite period [19, 20]. Serious complications of transcatheter closure of PDA are rare and include device embolisation, femoral artery or vein thrombosis related to vascular access and infection. PDA closure in the present era has a very low rate of complications, although these are higher in younger children. Technical intervention-related events were more common in coil procedures compared with device procedures. Closure of "silent" PDAs remains controversial and requires further research [21].

Surgical techniques for PDA closure include simple ligation, ligation and division, hemaclip application and minimally invasive techniques, such as video-assisted thoracoscopic surgery. However, with the advent of safer, more easily delivered percutaneous implants, surgery has largely been replaced by catheter-based therapy [22, 23]. The surgical procedural success rate is 100% with a morbidity rate of 4.4% and mortality rate is <0.5% [24]. By the early 1980s, about 40% of patients undergoing surgical closure of a patent arterial duct were symptomatic infants-even when infants born prematurely were excluded—and hospital mortality was approaching zero [25]. For infants with symptomatic pulmonary over circulation weighing less than 5 kilograms, our preference is for the surgical ligation.

CONCLUSION

Surgical or percutaneous closure is preferred when duct closure is indicated for symptom relief in early infancy. The ability to diagnose a silent PDA has been greatly enhanced by the availability of color flow Doppler imaging. Because closure methods are effective and safe are associated with minimal morbidity, a strategy advocating routine closure of silent PDA appears reasonable. Even when physical signs of a small duct are detected, if echocardiographic measurement of left ventricular dimensions confirms absence of even mild left ventricular volume loading there is evidence to support a policy of duct occlusion.

CONFLICT OF INTERESTS

None declared.

AUTHOR'S CONTRIBUTION

Haiyong Wang and Qiong Liu wrote the paper. Angui Li, Fugui Ruan, Zhenzong Du, Jianfei Song, Xiaolin Sun, Xingxing Peng and Jianbin Sun supervised the composition of the paper. All authors read and approved the final paper.

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