Double-Balloon Aortic Valvuloplasty at Queen Sirikit National Institute of Child Health

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Background: *Balloon aortic valvuloplasty is the treatment of choice in moderate and severe valvular aortic stenosis. In order to reduce the risk of vascular complications, a double-balloon technique has been used with good results.*
Objective: *To present the results of double-balloon aortic valvuloplasty at QSNICH.*
Material and Method: *Consecutive cases of severe valvular aortic stenosis treated with double-balloon aortic valvuloplasty at QSNICH were recruited in the study. Data were obtained from the medical records starting from the day of presentation to December 2011.*
Results: *There were six cases of severe valvular aortic stenosis treated with double-balloon aortic valvuloplasty at QSNICH from 2004 to 2011. The age and weight ranged from 7 months to 12 years and 6 to 53.8 kilograms, respectively. The presenting symptoms were dyspnea in 3 (50%) and asymptomatic heart murmur in 3 cases (50%). Peak-to-peak pressure gradient (PG) before the procedure ranged from 48-104 mmHg (mean 70.00, SD 18.92 mmHg). Immediately after the procedure, PG significantly decreased to 15-52 mmHg (mean 34.33, SD 14.98 mmHg, $p<0.01$). On the following day after the procedure, peak instantaneous pressure gradient (PIPG) obtained from echocardiogram ranged from 17-47 mmHg (mean 36.50, SD 10.93 mmHg). PIPG were not significantly different from PG immediately after valvuloplasty. There were two cases with partial femoral occlusion. The duration of follow-up ranged from 6-54 months (median 24 months). In the follow-up period, all of the patients were asymptomatic with functional class I. Echocardiogram after the procedure revealed no significant aortic regurgitation in any of the cases.*
Conclusion: *Double-balloon aortic valvuloplasty can be performed safely with very good intermediate term outcome in selected patients. Long-term outcome in Thai children should be further studied.*

Keywords: *Double-balloon, Balloon valvuloplasty, Aortic*

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Balloon aortic valvuloplasty is the treatment of choice in moderate and severe valvular aortic stenosis[1,2]. In order to reduce the risk of vascular complications, a double-balloon technique has been used with good short and long term results for more than 25 years[3-5]. The first case of double-balloon aortic valvuloplasty for aortic valvular stenosis in Thailand was reported from Queen Sirikit National Institute of Child Health (QSNICH) in 2008[6]. Since then, there have been five more cases treated with this procedure.

Objective

To present the results of double-balloon aortic valvuloplasty at QSNICH.

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Material and Method

Consecutive cases of severe valvular aortic stenosis treated with double-balloon aortic valvuloplasty at QSNICH were recruited in the present study. Epidemiologic data, presenting symptoms and echocardiographic data at the presentation were collected from the medical record. Parents of all cases gave informed consent before the procedure. Routine pre- and postoperative care for cardiac catheterization was performed in all of the cases. Double balloon valvuloplasty was performed under general anesthesia in those who were under 5 years of age or those cases who were not co-operative. The remaining cases required local anesthesia with a light intravenous sedation. The technique is the same technique as previously reported[6].

1. The procedure was started with right and

left heart catheterization via the right femoral vein and artery.

2. Heparin (50-100 IU/kg) was administered via the femoral artery after femoral artery access.

3. Complete hemodynamic evaluation including left ventricular and ascending aorta pressures was performed.

4. An end-hole-catheter (Pigtail or Gensini) was inserted in retrograde from femoral artery to the left ventricle.

5. Left ventricular angiogram was performed to confirm the diagnosis of valvular aortic stenosis. Aortic valve annulus was measured in antero-posterior and lateral view.

6. The 0.035 exchange (Terumo, Tokyo, Japan) guide wire was inserted into the left ventricle and used to guide the first balloon catheter.

7. The sizes of the balloon catheter was judged by the operator in each case with the condition that sheath size did not exceed 6 French in children under 5 years of age and 7 French in those who were 5 years of age or older.

8. After placing the catheter at the aortic valve, the balloon was inflated several times until there was no waist.

9. The second balloon catheter was inserted via the left femoral artery in a similar manner as the first balloon catheter placement.

10. After both balloon catheters were in the proper place as determined by fluoroscope, they were inflated simultaneously. The balloons were inflated several times until there was no waist left.

11. Hemodynamic status including left ventricular and ascending aorta pressures was re-evaluated after the procedure.

12. Post-procedural hemostasis was achieved and the dorsalis pedis pulses were assessed for possible occlusion. In cases of partial occlusion, continuous heparin infusion was administered and the patient was re-evaluated every 30 minutes until stable. Progression of the occlusion or severe occlusion was an indication for open re-vascularization.

13. Complete medical evaluation together with echocardiogram was repeated on the day after the procedure and every 6 months thereafter.

All data from the day of presentation to December 2011 were studied.

Results

There were 6 cases of severe valvular aortic stenosis treated with double-balloon aortic valvuloplasty at QSNICH from 2004 to 2011. The age ranged from 7 months to 12 years. The weight ranged from 6 to 53.8 kilograms. Epidemiologic data is shown in the Table 1. The presenting symptoms were dyspnea in 3 (50%) and asymptomatic heart murmur in 3 cases (50%). Two cases had been previously diagnosed as severe aortic stenosis and unsuccessfully treated with a single balloon aortic valvuloplasty (case No. 3 and 5).

Peak-to-peak pressure gradient (PG) before the procedure ranged from 48-104 mmHg (mean 70.00, SD 18.92 mmHg). The diameter of aortic valve annulus ranged from 11-22 mm (mean 17.83, SD 5.78 mm).

The sum of the balloon catheter size compared to the diameter of aortic annulus ranged from 0.91 to 1.25 (mean 1.06, SD 0.13). The sizes of balloon catheter used are shown in Table 2.

Immediately after the procedure, PG had significantly decreased to 15-52 mmHg (mean 34.33, SD 14.98 mmHg, $p<0.01$). On the following day after the procedure, peak instantaneous pressure gradient (PIPG) obtained from echocardiogram ranged from 17-47 mmHg (mean 36.50, SD 10.93 mmHg). PIPG were not significantly different from PG immediately after valvuloplasty.

There were no major complications during the hospital stay. There were two cases with partial femoral occlusion (case No. 1 and 4) but they responded well to continuous heparinization within 24 hours. Case No. 3 had a large groin hematoma that needed close

Table 1. Epidemiologic data

Case No.	Age	Sex	Weight (kg)	Presenting symptoms
1	7 month	Male	6	Murmur
2	4 year	Female	13.4	Dyspnea
3	12 year	Male	53.8	Murmur (previous balloon)
4	1 year	Female	9	Dyspnea
5	8 year	Male	36	Dyspnea (previous balloon)
6	9 year	Male	26.6	Murmur

observation for another 24 hours without residual problems.

The duration of follow-up ranged from 6-54 months (median 24 months). In the follow-up period, all the patients remained asymptomatic with functional class I. Echocardiogram after the procedure revealed no significant aortic regurgitation in any of the cases. PIPG were not significantly changed during the follow-up period as shown in Fig. 1.

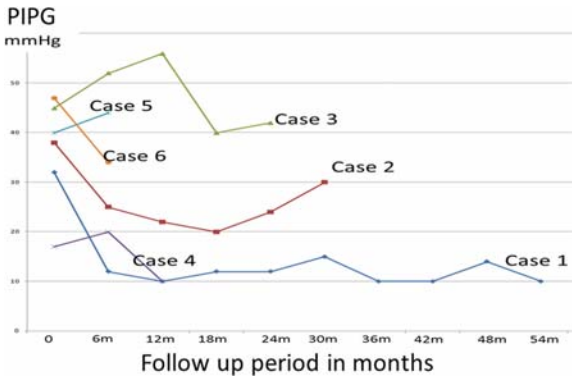

Fig. 1 Peak instantaneous pressure gradient from the first day after balloon valvuloplasty (0) to the last follow-up date.

Discussion

Double-balloon aortic valvuloplasty has been used for the treatment of severe valvular aortic stenosis with good short and long-term results for more than 25 years[3-5]. The previous report from QSNICH demonstrated only a good short term outcome[6]. Consecutive cases in the present study demonstrated that the good ultimate outcome of the procedure was not by chance.

Vascular complications are the most common complications encountered in balloon aortic valvuloplasty especially in infancy[2,7]. Double-balloon technique used in the present study decreased these complications[3-6]. A case of a large groin hematoma serves as a reminder to ensure meticulous post procedural hemostasis especially in obese children.

Aortic regurgitation is another significant complication of balloon aortic valvuloplasty. Careful selection of the balloon catheter is the most important measure to reduce this complication. In the present study, the sum of the sizes of the balloon catheter diameter used was no more than 1.25 times the aortic annulus diameter.

Conclusion

Double-balloon aortic valvuloplasty can be

Table 2. The diameter of aortic annulus and balloon catheter

Case No.	Annulus diameter (mm)	Balloon diameter (mm)		Annulus diameter/ Sum of balloon diameter
		Balloon 1	Balloon 2	
1	11	5	5	0.91
2	17	10	8	1.06
3	27	18	12	1.11
4	14	8	8	1.14
5	16	10	10	1.25
6	22	10	10	0.91

Table 3. Cardiac catheterization and echocardiographic data

Case No.	Annulus diameter (mm)	PG (mmHg)		PIPG (mmHg) on the following day
		Pre-balloon	Post-balloon	
1	11	104	46	32
2	17	68	40	38
3	27	67	35	45
4	14	48	18	17
5	16	59	15	40
6	22	74	52	47

performed safely with very good intermediate term efficacy in selected patients. Long-term outcome in Thai children should be further studied.

Potential conflicts of interest

None.

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การสวนหัวใจด้วยสายสวนหัวใจชนิดที่มีลูกโป่ง 2 สายพร้อมกันในการรักษาลิ้นหลอดเลือดแดงใหญ่ตีบรุนแรงในสถาบันสุขภาพเด็กแห่งชาติมหาราชินี

ชัยสิทธิ์ แสงทวีสิน, ธนะรัตน์ ลยางกูร, ธวัชชัย กิระวิทยา, วรการ พรหมพันธุ์

ภูมิหลัง: การสวนหัวใจด้วยสายสวนหัวใจชนิดที่มีลูกโป่งเป็นทางเลือกที่ดีที่สุดในการรักษาลิ้นหลอดเลือดแดงใหญ่ตีบรุนแรง เทคนิคสวนหัวใจด้วยสายสวนหัวใจชนิดที่มีลูกโป่ง 2 สายพร้อมกันเป็นเทคนิคที่พัฒนาขึ้นเพื่อลดภาวะแทรกซ้อนและได้ผลดี

วัตถุประสงค์: เพื่อเสนอผลการสวนหัวใจด้วยสายสวนหัวใจชนิดที่มีลูกโป่ง 2 สายพร้อมกันในการรักษาลิ้นหลอดเลือดแดงใหญ่ตีบรุนแรงในสถาบันสุขภาพเด็กแห่งชาติมหาราชินี

วัสดุและวิธีการ: ศึกษาย้อนหลังจากเวชระเบียนผู้ป่วยลิ้นหลอดเลือดแดงใหญ่ตีบรุนแรงทุกราย ที่รักษาด้วยการสวนหัวใจโดยใช้สายสวนหัวใจชนิดที่มีลูกโป่ง 2 สายพร้อมกันในสถาบันสุขภาพเด็กแห่งชาติมหาราชินีตั้งแต่เริ่มเข้ามาเป็นผู้ป่วยในสถาบันฯ จนถึงเดือนธันวาคม พ.ศ. 2554

ผลการศึกษา: ผู้ป่วยจำนวนทั้งสิ้น 6 ราย เริ่มรายแรกใน พ.ศ. 2547 อายุตั้งแต่ 7 เดือน ถึง 12 ปี น้ำหนักตั้งแต่ 6 ถึง 53.8 กิโลกรัม อาการนำมาด้วยการหายใจลำบาก 3 ราย (ร้อยละ 50) และไม่มีอาการ มีเพียงเสียงฟู่ที่หัวใจอีก 3 ราย (ร้อยละ 50) ความแตกต่างระหว่างความดันระหว่างรอยตีบที่ลิ้นหลอดเลือดแดงใหญ่ก่อนทำอยู่ระหว่าง 48-104 มม.ปรอท (เฉลี่ย 70.00, ส่วนเบี่ยงเบนมาตรฐาน 18.92 มม.ปรอท) หลังทำความแตกต่างระหว่างความดันระหว่างรอยตีบลดลงอย่างมีนัยสำคัญทางสถิติเหลือระหว่าง 15-52 มม.ปรอท (เฉลี่ย 34.33, ส่วนเบี่ยงเบนมาตรฐาน 14.98 มม.ปรอท, $p<0.01$) ในวันแรกหลังสวนหัวใจวัดความดันระหว่างรอยตีบจากการตรวจด้วยคลื่นเสียงสะท้อนหัวใจเหลือระหว่าง 17-47 มม.ปรอท (เฉลี่ย 36.50, ส่วนเบี่ยงเบนมาตรฐาน 10.93 มม.ปรอท ไม่แตกต่างจากเมื่อสวนหัวใจเสร็จใหม่ๆ ผู้ป่วย 2 รายมีภาวะแทรกซ้อนคือ หลอดเลือดแดงใหญ่ที่ขาดีบติดตามอาการหลังการรักษา 6-54 เดือน ทุกรายไม่มีอาการตรวจด้วยคลื่นเสียงสะท้อนหัวใจทุกรายไม่มีรายใด เกิดลิ้นหลอดเลือดแดงใหญ่รั่วที่รุนแรง

สรุป: การรักษาลิ้นหลอดเลือดแดงใหญ่ตีบรุนแรงด้วยการสวนหัวใจโดยใช้สายสวนหัวใจชนิดที่มีลูกโป่ง 2 สายพร้อมกันได้ผลดีในระยะเวลาหลายปีหลังการรักษาผลระยะยาวยังต้องติดตามต่อไป