

Transcatheter valve repair in congenitally corrected transposition of the great arteries

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Introduction

In congenitally corrected transposition of the great arteries (CCTGA) the right ventricle (RV) is the systemic ventricle. RV dysfunction and significant regurgitation of the systemic tricuspid valve are common and associated with worse outcomes. Management of tricuspid regurgitation (TR) in CCTGA is challenging. In acquired cardiovascular disease, percutaneous repair of mitral valve regurgitation (MR) is established. Data on CCTGA with TR are limited¹. We report our experience with this technique in these patients.

Methods

CCTGA patients with moderate-severe TR were eligible if surgery was deemed high-risk. Interventional therapy was offered, and patients provided written informed consent. Percutaneous TR repair was performed according to protocols for MR repair. In two patients (dextrocardia n=1, situs inversus n=1), clip insertion was performed 180° counter-clockwise. Transoesophageal echocardiography (TOE) served to localise the implantation site, and confirmed the correct grasping of the leaflets and appropriate TR

reduction. At the site of the maximal regurgitation jet the first clip was placed (4/6 antero-septal, 2/6 posterior septal leaflet). If no satisfactory reduction was achieved, another clip was placed (1/6 posterior septal, 2/6 antero-septal leaflet). Procedural success was defined as TR reduction of at least one grade or to TR grade ≤2.

This study complied with the Declaration of Helsinki and was approved by the local ethics committee.

Results

Between June 2016 and January 2018 six patients were included (Table 1). Percutaneous repair of TR was safe and successful in all (Figure 1). A reduction to TR grade ≤2 was achieved in five patients and to 3 in one, in whom further reduction was not possible due to leaflet abnormalities. The procedure time was longer than for percutaneous MR repair due to the complex anatomy.

After twelve months, severe TR reoccurred in one patient and two additional MitraClips (MitraClip®; Abbott Vascular, Santa Clara, CA, USA) were implanted to close a posterior leaflet cleft and stabilise the initial clip with TR reduction to grade 3. After

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Table 1. Baseline characteristics and details of the catheter interventions.

Patient		1	2	3	4	5	6
Age, years		47	38	61	34	35	60
Sex		M	F	F	M	F	M
BMI		26	26	34	29	22	25
Logistic EuroSCORE		2.8	1.9	9.7	2.8	1.9	12.4
NT-proBNP, pg/ml		736	695	6,520	320	112	2,680
Previous ICD implantation		1	0	1	0	0	0
Medication	Beta-blocker	1	1	1	1	0	1
	ACE/angiotensin receptor inhibitors	1	1	1	1	0	1
	Loop diuretics	0	1	1	0	0	0
	Mineralocorticoid antagonists	1	0	1	1	0	1
Number of MitraClips		1	1	2	2	2	2
Location of MitraClips	Anterior-posterior	0	0	0	1	0	1
	Anterior-septal	0	0	2	1	1	1
	Posterior-septal	1	1	0	0	1	0
Procedure time, min		386	294	330	480	397	278
Fluoroscopy time, min		41	44	32	N/A	18	38
Radiation dose, mGy		1,105	847	1,560	N/A	360	1,293
Post-procedural TR severity		3	1-2	2	2	1-2	1-2
Duration of ICU stay, days		1	1	4	1	1	1
Duration of hospital stay, days		3	4	10	10	7	4

ACE: angiotensin-converting enzyme; BMI: body mass index; ICD: implantable cardioverter-defibrillator; ICU: intensive care unit; N/A: not available; NYHA: New York Heart Association; TR: tricuspid regurgitation

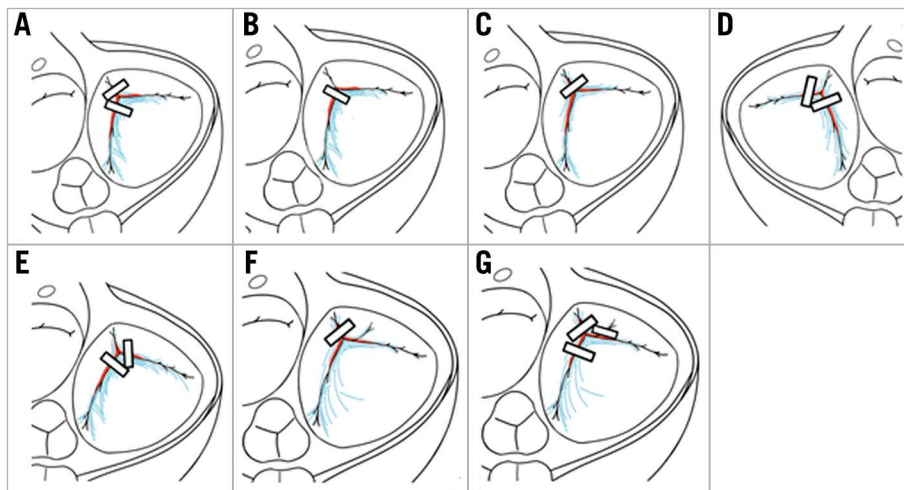


Figure 1. MitraClip positions in six patients (A-F). One patient had a reintervention (initial procedure shown in panel F, reintervention in panel G).

one week, partial leaflet detachment occurred. Surgery was not an option, and the patient was treated medically. NYHA class at baseline was \geq III in all patients and improved to \leq II in all (Table 2).

Discussion

Percutaneous repair of TR is feasible in CCTGA, and provides a reduction in TR severity and heart failure symptoms over a one-year follow-up.

Treatment with the MitraClip has already shown promising results for TR in acquired cardiovascular disease². Additionally, the safety and efficacy of a modified TriClip™ (Abbott) system has been demonstrated³. Data regarding percutaneous repair of TR in CCTGA are limited¹. In our cohort, it was feasible. The majority of patients showed an improvement in NYHA class and reduced TR severity. Interestingly, RV ejection fraction improved, as reported in patients with MR

Table 2. Clinical parameters at baseline and follow-up.

Patient		1	2	3	4	5	6
Baseline	TR severity	4	3	4	4	4	4
	RV ejection fraction, %	35	35	35	25	34	20
	Reg. vol, ml/beat	48	33	58	57	43	42
	EROA, cm ²	0.3	0.2	0.7	0.3	0.3	0.4
	NYHA class	III	III	III	IV	III	III
30 days	TR severity	3	1-2	1-2	2-3	1-2	2
	RV ejection fraction, %	35	35	35	35	45	29
	Reg. vol, ml/beat	51	7	32	13	5	4
	EROA, cm ²	0.32	0.04	0.2	0.08	0.03	0.02
	NYHA class	I	I	II	II	I	II
12 months	TR severity	3	2	2	2-3	1	1
	RV ejection fraction, %	44	36	35	39	45	29
	Reg. vol, ml/beat	36	18	28	13	5	5
	EROA, cm ²	0.25	0.12	0.2	0.08	0.03	0.03
	NYHA class	I	I	II	II	I	II

EROA: effective regurgitant orifice area; NYHA: New York Heart Association; Reg. vol: regurgitant volume; RV: right ventricle

and reduced left ventricular ejection fraction⁴. Whether this translates into a long-term improvement remains speculative. However, it is reassuring that RV function did not deteriorate.

The timing of intervention for severe TR is crucial in CCTGA, since ventricular dysfunction and TR are determinants of outcome. Valve repair is often not feasible, while valve replacement can be associated with significant mortality if severe RV dysfunction is present⁵. Other treatment options include pulmonary artery banding and cardiac resynchronisation therapy, with limited and sometimes divergent evidence⁶. Often, only heart transplantation remains. An interventional approach could provide a much needed alternative.

The use of the MitraClip on the tricuspid valve aims to clip together two of the three leaflets to create a double orifice. The choice of leaflets depends on the location of the regurgitation jet and ease of imaging. Optimal grasping views may require significant modifications of standard TOE views. 3D-TOE imaging is helpful for positioning and orientation of the clip, but the leaflet insertion/grasping attempts require 2D imaging or X-plane mode due to the better image and temporal resolution. Nevertheless, leaflet insertion may be difficult to assess. Moreover, the use of multiple clips may be required.

Limitations

Limitations of our study are the small number of patients and the fact that exercise tests were not performed in all.

Conclusions

Percutaneous valve repair with MitraClips is safe and feasible in CCTGA with severe TR. Optimal timing and long-term outcome need to be studied. It should be reserved to centres experienced in both congenital heart disease and transcatheter valve repair.

Impact on daily practice

In CCTGA with severe TR, percutaneous edge-to-edge repair is safe, feasible and effective. This might open the door to interventional treatments of atrioventricular valve regurgitations in adult congenital heart disease.

Conflict of interest statement

P.M. Rumpf reports lecture fees from Abbott and proctor fees from Edwards Lifesciences. The other authors have no conflicts of interest to declare.

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