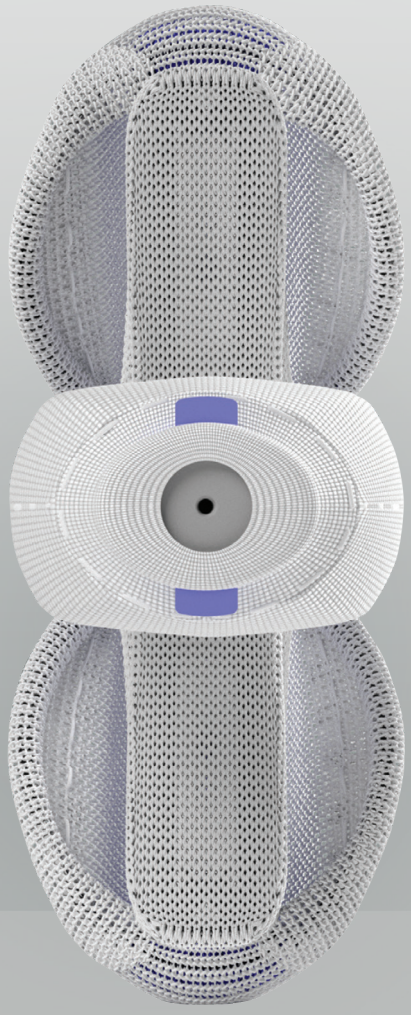
TMTT Today

Your update on Edwards' Mitral & Tricuspid innovations

New advances in the transcatheter mitral and tricuspid valve repair portfolio | PASCAL Repair System

Find out more inside ...



Issue #2 – October 2020

Edwards

Dear Reader,

Edwards Lifesciences' investment in new products and applications for our Transcatheter Mitral and Tricuspid Therapies (TMTT) portfolio continues to provide new solutions for patients. As part of our commitment to share the latest advances from TMTT, we are excited to bring you this second edition of the *TMTT Today* series focusing on the use of the PASCAL repair system for patients with mitral regurgitation (MR) and/or tricuspid regurgitation (TR). This edition builds on learnings and insights from the use of the PASCAL repair system in mitral valve repair, which were presented in the first edition of *TMTT Today*.

In this issue, we discuss the importance of achieving sustained MR reduction following mitral valve repair and highlight the recently published long-term follow-up data from the CLASP study. We also present early experiences of the PASCAL repair system in patients with TR, detailing the unique features of the system that are suited to tricuspid valve repair, including the important role of nitinol. Finally, we discuss the learning curve that is evident in early experiences with the PASCAL repair system in MR and the possibility of leveraging this knowledge when treating patients with TR.

Similar to the first edition of *TMTT Today*, each article is complemented by direct quotes from our main contributors, Professor Ulrich Schäfer, Professor Scott Lim, Professor Philipp Lurz, Dr Ralph Stephan von Bardeleben and Professor Jörg Hausleiter.

Enjoy reading!

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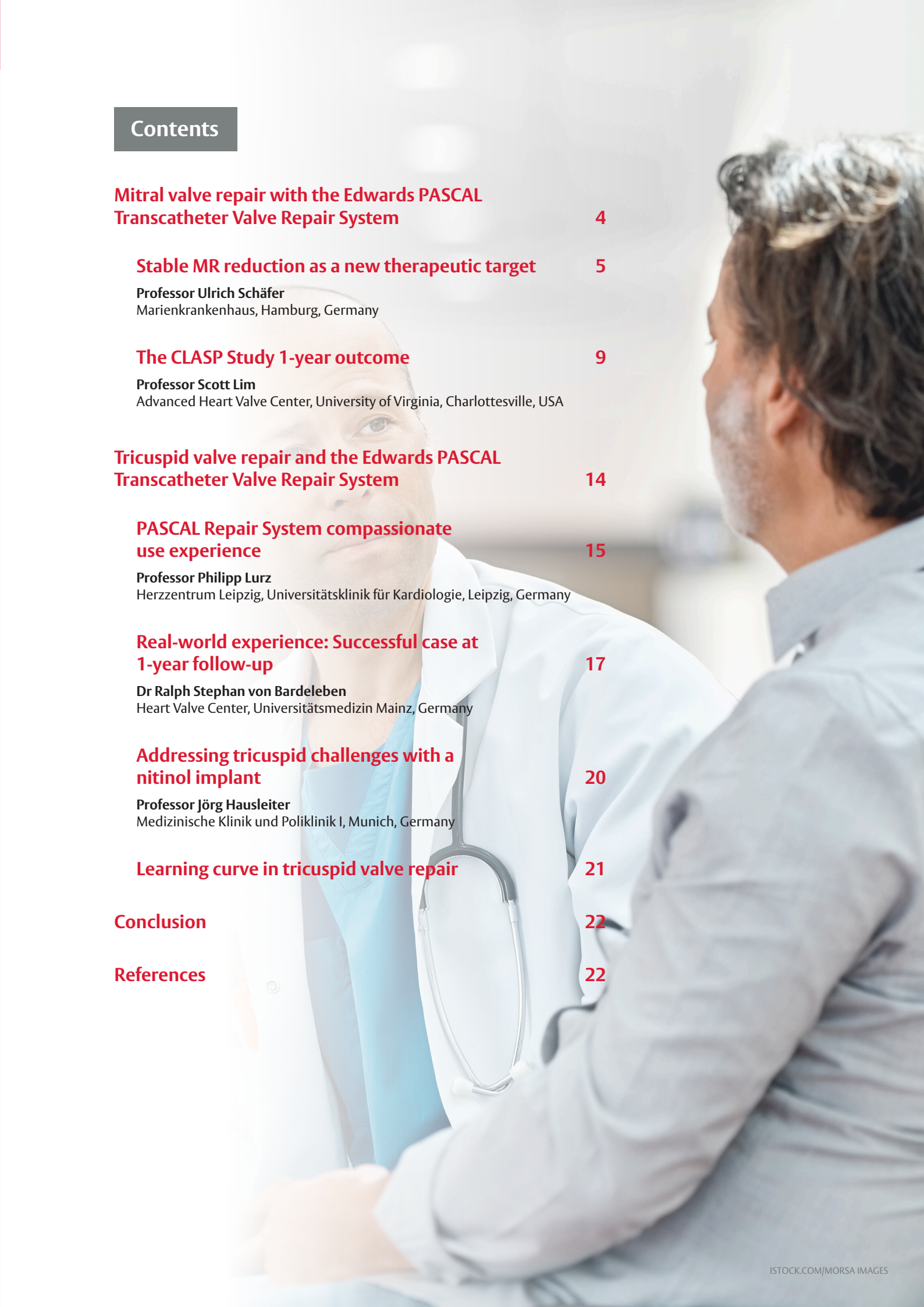

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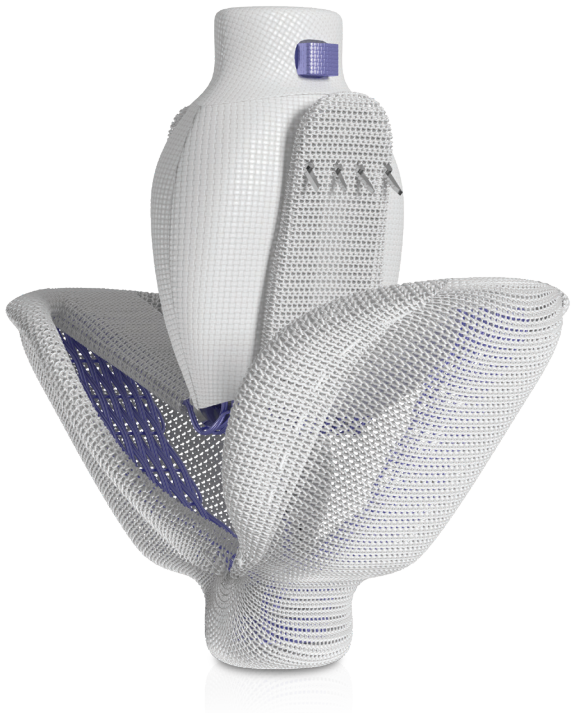
Mitral valve repair

with the Edwards PASCAL Transcatheter Valve Repair System

Mitral regurgitation is a common valvular heart disease, which, when left untreated, can result in significant overall morbidity and mortality.[1,2] Transcatheter mitral valve repair techniques have been used successfully to reduce MR grade, although the definition of acceptable MR reduction is evolving.[3-6]

The Edwards PASCAL transcatheter valve repair system gained its CE mark for treatment of MR in February 2019.[7] The system has shown its potential to expand the population of patients who can be treated successfully with leaflet repair.[8-11]



Stable MR reduction as a new therapeutic target

What should be the target for MR reduction in mitral valve repair?

Professor Dr med. Ulrich Schäfer,
Marienkrankenhaus, Hamburg, Germany | Global PI of the CLASP study

Chief Physician in the Department of Cardiology, Angiology and Intensive Care Medicine, Professor Ulrich Schäfer is a Global Principal Investigator (PI) of the CLASP study and was instrumental in the development of therapy programmes for the treatment of structural heart diseases. Professor Schäfer's special focuses include the treatment of structural heart diseases using all kinds of catheter-interventional valve therapies, interventional heart failure therapy and treatment of coronary artery disease.

Previous studies of mitral valve repair have defined procedural success as a post-procedural residual MR (rMR) ≤2+.[4] However, rMR ≥2+ correlates with poor outcomes, including recurrence of higher-grade MR and the need for redo mitral valve surgery.[12-14] A single-centre retrospective study in 458 patients with functional MR ≥3+ now suggests that achieving rMR ≤1+ at discharge and sustaining this at 12 months after mitral valve repair leads to better long-term outcomes compared with achieving rMR 2+.[6]

In the retrospective study, 458 patients (mean age 73.8 years) with functional MR who received mitral valve repair between September 2008 and December 2017 were stratified according to their rMR at discharge (rMR ≤1+, 2+ and ≥3+). The study assessed all-cause mortality as the primary outcome alongside a composite outcome that included all-cause mortality and rehospitalisation for heart failure. Baseline patient characteristics were largely similar across groups (with the exception of those shown in Table 1), and patients were followed up for up to 10 years (median 5.1 years).[6]

Table 1. Baseline patient characteristics[6]

	Residual MR grade			
	≤1+ (n=251)	2+ (n=173)	≥3+ (n=34)	p value
Age, years	74.2 ± 8.5	74.6 ± 8.4	68.2 ± 11.7	<0.001
Hypertension, %	69.7	74.0	47.1	0.008
Cardiac resynchronisation therapy, %	32.7	22.0	38.2	0.027
MR grade 3+, %	53.0	52.0	29.4	0.03
MR grade 4+, %	46.6	48.0	70.6	–
Left ventricular ejection fraction, %	34.4 ± 13.1	37.5 ± 13.3	31.5 ± 9.8	0.021
Left ventricular end-diastolic diameter, mm	64.3 ± 11.1	66.2 ± 10.8	70.7 ± 12.9	0.01
Left ventricular end-systolic diameter, mm	53.2 ± 12.5	55.0 ± 12.7	59.1 ± 12.5	0.049
Mean mitral gradient, mmHg	2.0 ± 1.0	2.4 ± 1.3	2.5 ± 1.1	<0.001
Effective regurgitant orifice area, mm^2	35.5 ± 15.1	41.8 ± 19.1	47.1 ± 26.1	0.005

'The degree of rMR is strongly and adversely correlated to outcome in patients with functional MR. There is a similar impact on long-term prognosis in degenerative MR.'

Patients with rMR ≥3+ had the highest rate of intra-procedural complications (i.e. technical device problems, failure to place the repair device, conversion to open heart surgery, cardiopulmonary resuscitation or cardiac tamponade), had a greater need for >24 hour ventilation and spent more days in the intensive care unit than patients in other rMR groups.[6]

Those patients with rMR ≤1+ at discharge achieved better outcomes than patients with rMR 2+ and rMR ≥3+. Thirty-day mortality was 4.4% in patients with rMR ≤1+, 4.0% in patients with rMR 2+, and 11.8% in patients with rMR ≥3+ at discharge (P = 0.14; the P-value refers to the log-rank test with rMR treated as an ordered category). When adjusted for clinical and echocardiographic variables using Cox regression analysis, risk of all-cause mortality was lowest in those with rMR ≤1+ at discharge based on Kaplan–Meier analyses (compared with rMR ≤1+, risk of all-cause mortality was higher with rMR 2+ and with rMR ≥3+).[6]

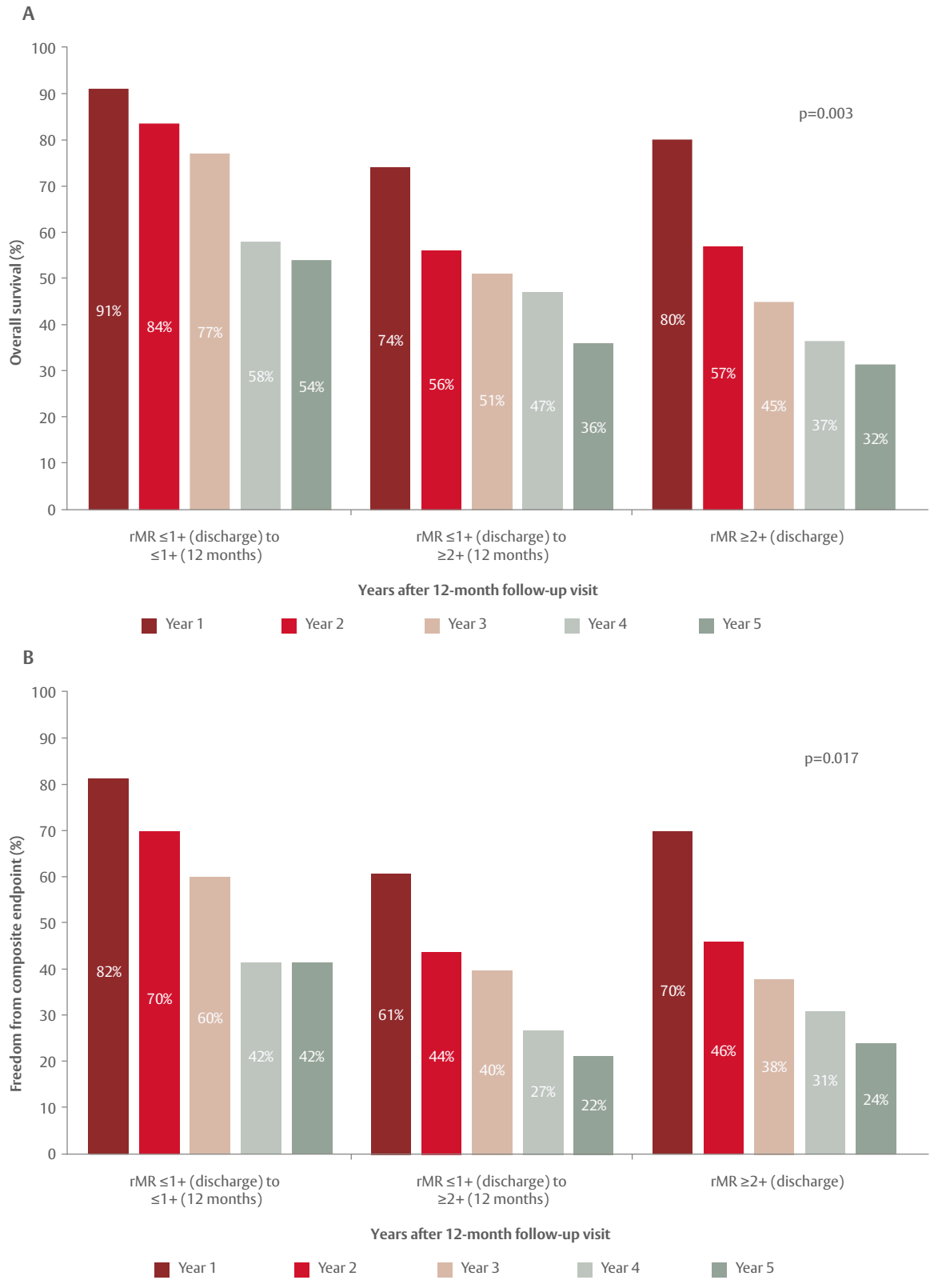
'rMR graded as moderate (2+) should not be considered as an acceptable result – this is applicable for the acute as well as the long-term results.'

Survival rates were highest in patients who maintained stable rMR ≤1+ for at least 12 months from implantation (Figure 1). Of the 212 patients who had rMR measurements by echocardiogram at discharge and at 12-month follow-up, patients with rMR ≤1+ at discharge and at 12 months had a significantly better all-cause mortality than those with rMR ≤1+ at discharge but rMR ≥2+ at 12 months (log-rank p=0.003).[6]

Thus, a sustained reduction in MR to ≤1+ at discharge and 12 months is associated with successful long-term outcome in mitral valve repair.[6]

'Patients with rMR ≤1+ at discharge, but rMR ≥2+ at 12-month follow-up revealed similar dismal survival rates and composite outcomes as patients who already showed rMR ≥2+ at discharge.'

Figure 1. The impact of rMR from discharge to 12-month follow-up.
All-cause mortality (A) and the composite outcome (all-cause mortality and rehospitalisation for heart failure; B). Adapted from Reichart D *et al*. 2020.



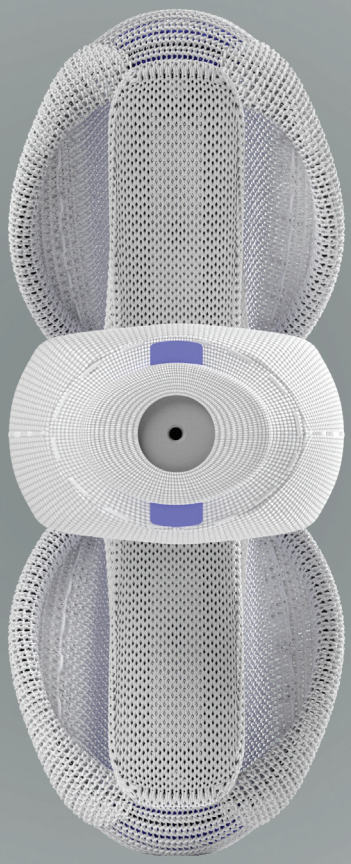
Lower MR Grades Are Within Your *Clasp*

PASCAL Repair System

More Opportunity, Lower MR Grades

Do you aspire to reach MR 0-1+ more often?

PASCAL repair system enhances your opportunity for success with a unique central spacer designed to block more jet and minimise mitral regurgitation.



Find out more at **Edwards.com/PASCAL**

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The CLASP Study 1-year outcome

Durable benefits of the PASCAL Repair System in mitral valve repair

Professor Scott Lim,
Advanced Heart Valve Center, University of Virginia, Charlottesville, USA | PI in the CLASP study

Professor of Medicine and Medical Director of the University of Virginia Advanced Cardiac Valve Center, Professor Scott Lim specialises in heart valve diseases. He is noted internationally for his expertise in novel transcatheter approaches to valve repair and replacement. Professor Lim is a PI in the CLASP study.

Early 30-day data from the CLASP study, summarised in the first edition of *TMTT Today* in July 2020, revealed a favourable safety profile and a highly significant reduction in MR with the PASCAL repair system in patients with clinically significant MR.[9] Newly presented 1-year data from the study show that the beneficial outcomes observed at 30 days are sustained at 6 months and 1 year.[10,11]

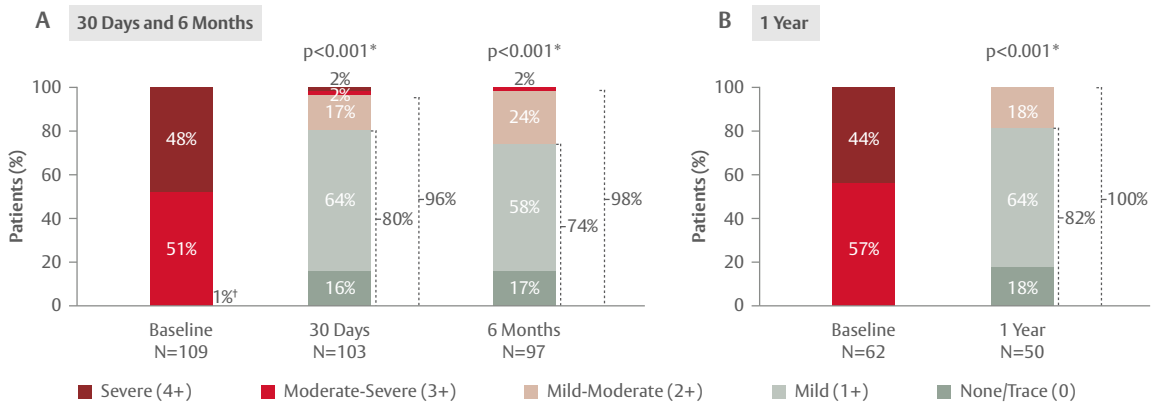
The CLASP study is a single-arm, multicentre, prospective study evaluating the safety, performance and clinical outcomes of the PASCAL repair system in adult patients with New York Heart Association (NYHA) functional class ≥II and MR ≥3+ despite optimal medical therapy. An independent ECHO core lab adjudicated the results from the study.

The PASCAL repair system was implanted successfully in 95% of the 109 patients taking part, with a mean of 1.4 devices implanted per patient and an average procedural time of 128 minutes.[10,11] At 1-year follow-up, a favourable safety profile was observed; the rate of composite major adverse events (MAE)‡ was 14.5%, with MAEs occurring in nine patients, four of whom had procedure-related events (Table 2).[10,11]

‡ Cardiovascular mortality, stroke, myocardial infarction, new need for renal replacement therapy, severe bleeding and re-intervention for study device.

'As the PASCAL device has independent clasps, interventional cardiologists can take time to make sure leaflet placement is optimised and adjusted on a patient-by-patient basis in order to maximise results.'

Figure 2. Severity of MR at (A) baseline, 30 days and 6 months, and (B) baseline and 1 year[10,11]



* p values calculated using Wilcoxon signed-rank test; paired analysis comparing baseline *vs* 30 days (n=102), baseline *vs* 6 months (n=96), or baseline *vs* 1 year (n=50). †Baseline MR measured as 3+ by transoesophageal echocardiogram. ©Elsevier 2020. Reproduced with permission.

82% **of patients have durable MR 0–1+ at 1 year.**

Long-term efficacy with the PASCAL repair system was impressive. At 1 year following implantation, survival rate was 92% and freedom from heart failure hospitalisation was 88%. The reduction in MR observed at 30 days was significant and sustained at 6 months and 1 year; at 1 year, 82% of patients had mild MR (≤1+) and all patients had mild-to-moderate MR (≤2+) (Figure 2).[10,11]

'100% of those enrolled were able to achieve and maintain a reduction in MR (≤2+) and 82% had mild or no MR after PASCAL.'

As observed in the 30-day dataset, the excellent performance of the PASCAL repair system at 1 year did not come at the cost of high gradients; mean transmitral valve gradient at 6 months and 1 year remained stable at 4.0 mmHg,[10,11] consistently below the accepted threshold of 5.0 mmHg.[15] Similarly, improvements in functional status, exercise capacity and quality of life were sustained; NYHA functional status (Figure 3), 6-minute walking distance (6MWD) and Kansas City Cardiomyopathy Questionnaire (KCCQ) score were consistently above baseline and remained stable at 6 months and 1 year.[10,11]

'There is significant improvement in ability to live life and (patients) have improved functional status by reducing MR.'

An association between long-term survival and MR ≤1+ at discharge and 1 year after mitral valve repair has been reported in an observational study.[6] Extrapolating from these findings, favourable long-term outcomes would be expected in the CLASP study as the proportion of patients achieving MR ≤1+ was consistently high at 30 days and 1 year after discharge (Figure 4).

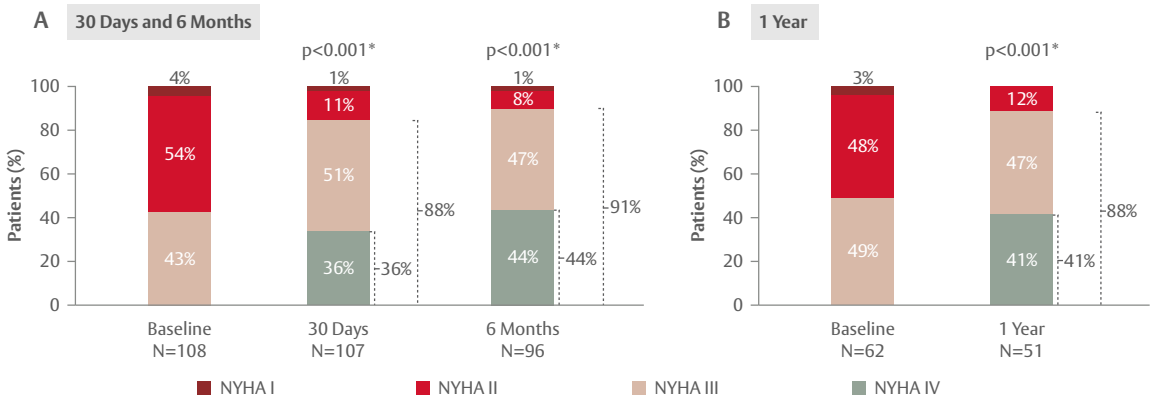
'PASCAL is a strikingly safe procedure and very effective at 1 year.'

Table 2. Safety profile at 30 days and 1 year[10,11]

Event adjudicated by Clinical Endpoint Committee	30 days N=109 % (n)	1 year N=62 % (n)
Cardiovascular mortality	0.9 (1)	6.5 (4)
Stroke	0.9 (1)	0.0 (0)
Myocardial infarction	0.0 (0)	1.6 (1)
New need for renal replacement therapy	0.0 (0)	0.0 (0)
Severe bleeding*	7.3 (8)	9.7 (6)
Re-intervention for study device-related complications	0.9 (1)	1.6 (1)
Composite major adverse cardiac event rate	8.3 (9)	14.5 (9)

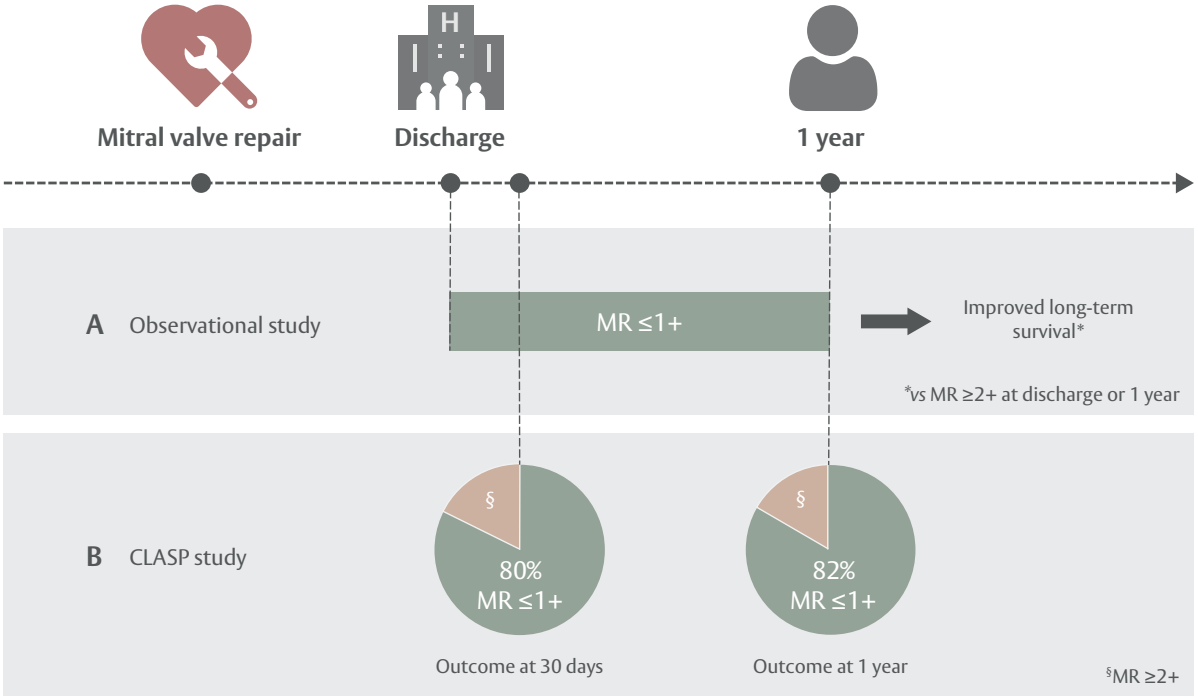
* Severe bleeding is major, extensive, life-threatening or fatal bleeding, as defined by the Mitral Valve Academic Research Consortium. Four patients had procedure-related events, including one patient with severe bleeding and cardiovascular mortality, one patient with re-intervention for study device-related complications and severe bleeding, and two patients with severe bleeding.

Figure 3. NYHA functional status at (A) baseline, 30 days and 6 months, and (B) baseline and 1 year[10,11]



* p values calculated using Wilcoxon signed-rank test; paired analysis comparing baseline *vs* 30 days (n=106), baseline *vs* 6 months (n=96), or baseline *vs* 1 year (n=51). ©Elsevier 2020. Reproduced with permission.

Figure 4. (A) Achieving MR ≤1+ at discharge and 1 year is linked to improved outcomes after mitral valve repair;[6] (B) Most patients achieved MR ≤1+ at 30 days and 1 year in the CLASP study[11]



Now Approved: PASCAL Ace Implant System

for Mitral and Tricuspid Leaflet Repair

The PASCAL Ace Implant System approval gives you another transcatheter device option for mitral and tricuspid regurgitation leaflet repair.[1]

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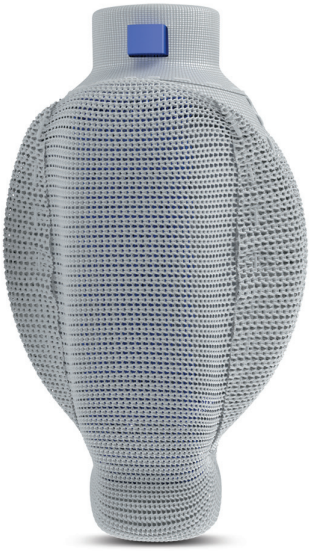
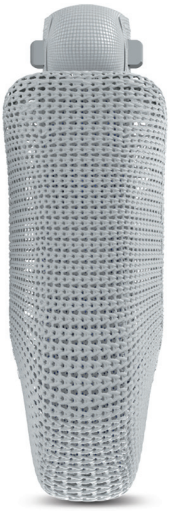
The PASCAL Ace Implant System

Our latest innovation to the PASCAL Implant System is designed with the same safety in mind, as well as a narrower profile to help you optimise your treatment of mitral and tricuspid regurgitation.[1,2]



PASCAL Implant*



PASCAL Ace Implant*

A new approach to leaflet repair[1,2]

Optimise your treatment approach, featuring:

- A smaller spacer that fills the regurgitant orifice and reduces leaflet stress
- Implant elongation designed to allow for more confident subvalvular navigation, particularly in challenging patient anatomies

In addition, the PASCAL Ace Implant System:

- Optimises leaflet capture during initial positioning or repositioning
- Allows direct manoeuvring in 3 planes with a flexible delivery system

Find out more at **Edwards.com/PASCAL**

*Not to scale.

References: 1. Edwards PASCAL Transcatheter Valve Repair System. Instructions for Use. Edwards Lifesciences LLC; 2020. **2.** Data on file. Edwards Lifesciences.

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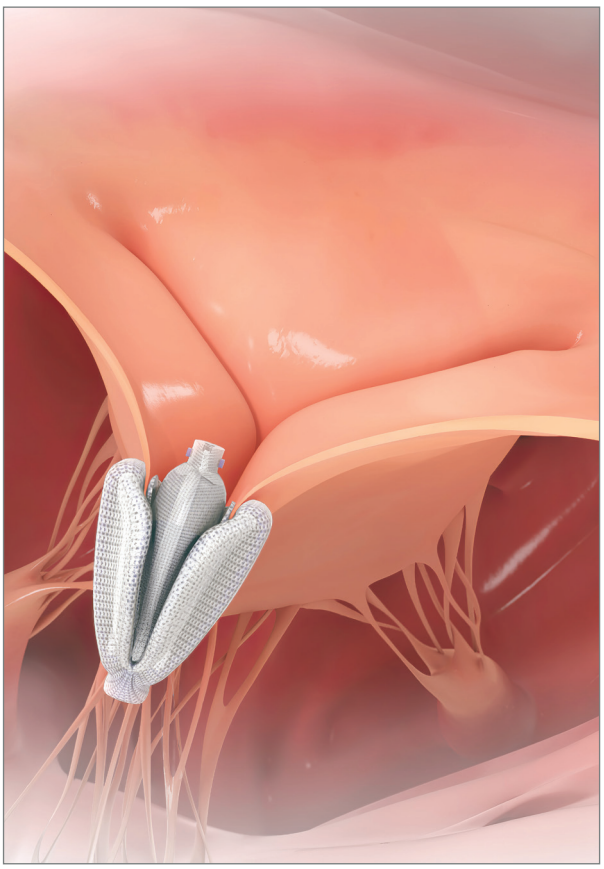
Tricuspid valve repair

and the Edwards PASCAL Transcatheter Valve Repair System

Tricuspid regurgitation has a high prevalence and, when severe, is associated with a high rate of mortality.[16,17] Although patients with TR often experience debilitating symptoms, they have limited treatment options; in the US, 1.6 million Americans are reported to have moderate-to-severe TR but only approximately 0.5% are treated surgically each year.[18,19]

The **Edwards PASCAL transcatheter valve repair system** is a new therapeutic option for patients with TR, which gained CE mark in May 2020,[20] and provides the opportunity to improve clinical outcomes in patients with TR or MR using the same device.[10,21] The PASCAL repair system offers a number of benefits to patients with TR, and physicians may benefit from the learning curve they have experienced with the PASCAL repair system in patients with MR as the implant and delivery system are the same in the two settings.[21,22]



PASCAL Repair System compassionate use experience

Early study highlights benefits of the PASCAL Repair System in tricuspid patients

Professor Dr med. Philipp Lurz,
Herzzentrum Leipzig, Universitätsklinik für Kardiologie, Leipzig, Germany

Professor Philipp Lurz is an interventional cardiologist, PI of the MiCLASP Registry, and an investigator in trials for multiple other therapies. He is the Deputy Head of Cardiology at Heart Center Leipzig of University Leipzig and the lead of the Program for Grown-up Congenital Heart Disease and for mitral/tricuspid interventions. His major area of research is related to structural heart disease and heart failure.

Transcatheter repair is a promising option for patients with severe TR who are considered high risk for surgery,[21,23] although certain features, including the presence of large tricuspid coaptation gaps, can predict procedural failure with some repair techniques.[24] Now, in a multicentre, observational, first-in-human study, the PASCAL repair system has been used successfully for leaflet repair in patients with severe TR.

This success demonstrates a number of potential advantages for patients, including independent grasping of leaflets, avoidance of excessive leaflet tension, and the ability to bridge large coaptation gaps.[21]

This compassionate use experience included patients with heart failure due to severe TR (≥3+) who were treated with the PASCAL repair system at six study sites. Of the 28 patients, 7 had TR 3+ (severe TR), 9 had TR 4+ (massive TR) and 12 had TR 5+ (torrential TR).[21] Patients had a mean age of 78 ± 6 years, were assessed as high surgical risk based on their European System for Cardiac Operative Risk Evaluation II score, and were in either NYHA functional class III (89%) or IV (11%).

In total, 40 devices were implanted, averaging 1.4 ± 0.6 devices per patient. Mean tricuspid annular diameter was 49.5 ± 6.0 mm and mean coaptation gap was 6.9 ± 3.0 mm.[21]

The data demonstrated high procedural success (86%) with the PASCAL repair system, defined as implantation of at least one device with post-procedural TR grade ≤2+ without mortality or conversion to surgery. No intra-procedural complications were observed among the 40 implants. At 30 days following the procedure, mortality was 7.1%; two patients experienced single-leaflet device attachment and were managed conservatively (Table 3).[21]

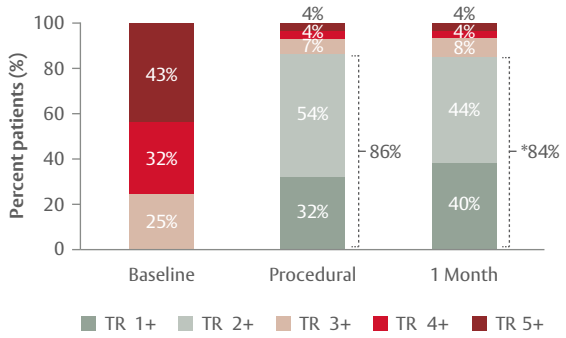
Table 3. Clinical outcomes at 30-day follow-up[21]

Outcome, n (%)	N=28
Mortality	2 (7.1)
Heart failure hospitalisation	1 (3.5)
Single-leaflet device attachment	2 (7.1)

'The right ventricle is a dynamic environment and the fact that this device is nitinol based – the closing mechanism is passive, so less stress on the leaflet – allows you to maintain some degree of dynamics.'

'Flexibility is great, and it has the ability to steer wherever you want to. PASCAL can be elongated and manoeuvred, which reduces the overall profile – this is helpful as it allows you to get out of the valve in case you are entangled with cords, without chance of injury.'

Figure 5. TR grade at baseline, post-procedure and 30-day follow-up[21]



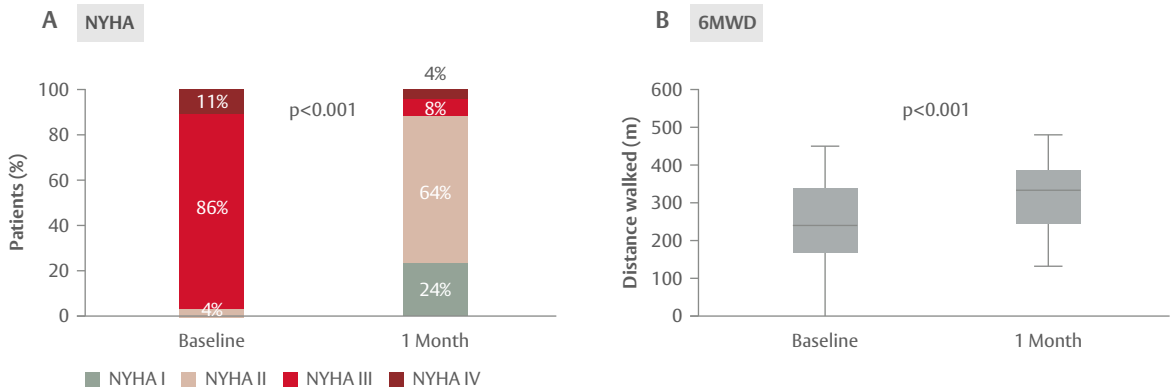
* Reported in the published literature as 85%.

Results with the PASCAL repair system show durable efficacy at short-term follow-up. Most patients demonstrated a sustained reduction of TR from baseline based on echocardiography both post-procedure and at 30-day follow-up (Figure 5). Whereas 100% of patients had severe TR (≥3+) at baseline, 85%* of patients had mild-to-moderate TR (≤2+) at 30 days. These outcomes were achieved with no worsening of right ventricular function, and there was even evidence of favourable right ventricular remodelling from baseline to 30 days (tricuspid annular diameter decreased from 47.4 ± 7.3 mm to 40.3 ± 7.1 mm, p<0.001). Patients also showed significant improvement in functional status at short-term follow-up. Most patients (88%) were in NYHA functional class I or II at 30 days, and there was a significant improvement in 6MWD from 240 m (interquartile range [IQR] 172–337 m) at baseline to 335 m (IQR 251–385 m) at 30 days (p<0.001) (Figure 6).[21]

'Coaptation gaps are larger (in TR vs MR) and it can be very challenging to approximate leaflets. This is something you can only do with independent grasping.'

The PASCAL repair system's efficacy in reducing TR compares favourably with that of other transcatheter tricuspid repair devices.[25,26] The system has several potential advantages for patients with severe TR (≥3+) and large coaptation gaps.[21] First, the central spacer of the PASCAL repair system reduces the approximation distance and fills the regurgitant orifice area while avoiding excessive tension on the tricuspid leaflets. Second, the PASCAL implant is wider than other competitor devices for tricuspid repair, which may result in better distribution of forces on the tricuspid leaflets. Third, independent operation of the clasps helps to maximise leaflet insertion, allowing them to bridge large coaptation gaps while grasping the leaflet safely. The PASCAL repair system can therefore also be used in patients who would be untreatable with conventional simultaneous leaflet grasping. Finally, during the cardiac cycle, the PASCAL repair system is able to move gently with the tricuspid leaflets due to its nitinol structure, without losing the closing force, and can accommodate for the high density of chordae in the tricuspid valve. These features likely contribute to the significant clinical improvement in patients with challenging tricuspid anatomy and severe TR observed in this compassionate use experience.[21]

Figure 6. Functional outcomes (A) NYHA and (B) 6MWD at baseline and 30-day follow-up[21]



Real-world experience: Successful case at 1-year follow-up

Early success of the PASCAL Repair System for the treatment of TR

Dr Ralph Stephan von Bardeleben,
Heart Valve Center, Universitätsmedizin Mainz, Germany

The Head of the Center of Structural Heart Disease Interventions and the Heart Valve Center in Mainz, Dr Ralph Stephan von Bardeleben is an interventional cardiologist with a specialty in percutaneous valve therapy. Dr von Bardeleben's department has been involved in a number of early in-human device implantations, including with PASCAL MR/TR, PASCAL Ace MR/TR, Evoque TR and Cardioband MR/TR. He was Investigator and Prinicipal Investigator to REPAIR, TRI REPAIR, MiCLASP, CLASP IID/IIF and others.

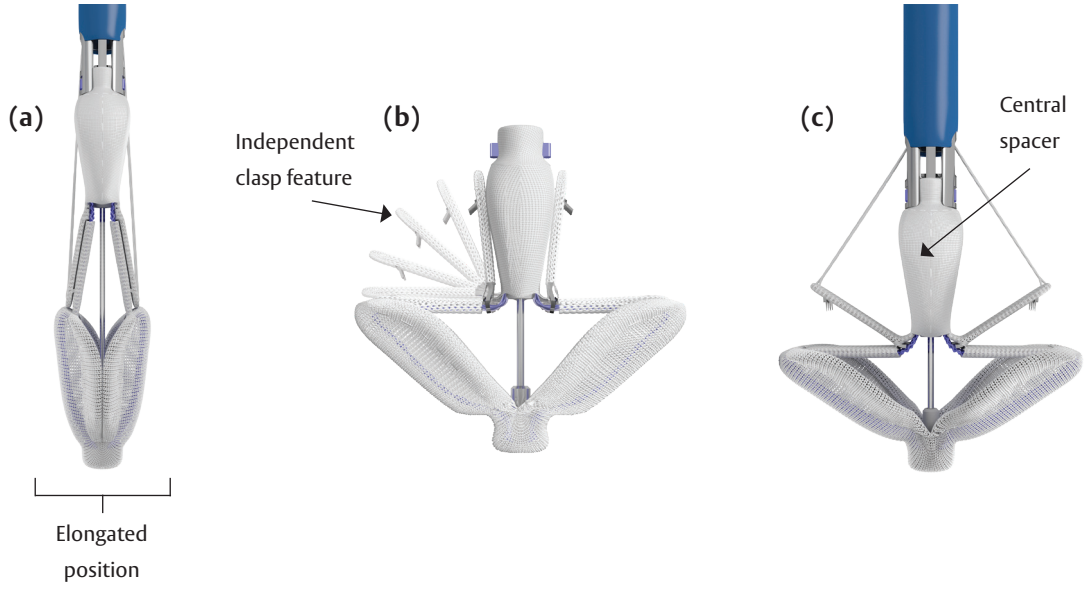
Unlike the mitral valve, tricuspid valves have dense, fragile chordae, thin, fragile and variable leaflets and a large annulus.[27] Early real-world experience has highlighted the unique features of the PASCAL repair system that facilitate its use in the repair of this complex and delicate structure (Figure 7).

- The slim profile of the elongated implant and the independent movement of catheters within the PASCAL delivery system allow for predictable implant positioning among the dense and fragile chordae of the tricuspid valve.
- Independent grasping capability and the woven nitinol structure allow for atraumatic leaflet capture, reducing stress on the leaflets.
- The unique central spacer is designed to bridge the typically large coaptation gap associated with TR.

Together, these features suggest the PASCAL repair system is well suited for TR repair, as exemplified in this real-world case study.

'The PASCAL system is capable of treating almost all anatomies in the tricuspid field.'

Figure 7: Key features of the PASCAL repair system



Use of the PASCAL Repair System in TR: A case study

This case study is taken from Dr von Bardeleben's presentation at EuroPCR 2020.[28]

The first European Union compassionate use case of the PASCAL repair system in TR was a male patient, aged 75 years, who presented with dyspnoea (NYHA IVb), pronounced peripheral oedema and repeat episodes of heart failure. The patient had received mitral valve repair three months prior and had a history of coronary artery disease without relevant stenosis, atrial fibrillation and stroke. Laboratory investigations and echocardiography revealed preserved diuresis and renal function (estimated glomerular filtration rate 72 mL/min; brain natriuretic peptide [BNP] 186 pg/mL), good left ventricular (LV) function (LV ejection fraction ~50%), and massive/torrential TR (grade 4–5) with rMR 1+ after mitral valve repair.

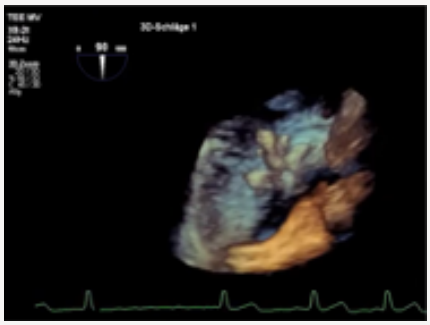
'The wide and gently contoured paddles engage and distribute forces evenly to leaflets to avoid leaflet slits and tears during the procedure.'

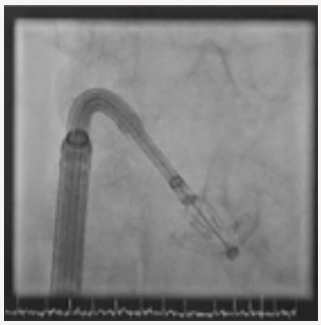
Two PASCAL implants were used for the 'clover' technique, in which the free edges of the tricuspid leaflets were brought together to produce a clover-shaped valve. Intra-procedural imaging was key to success during implantation; pre-echocardiography demonstrated the value of transoesophageal echocardiography and fluoroscopy to facilitate preparation and orientation of the PASCAL repair system (Figure 8), with clear visualisation of the clasps and wires. Transgastric and deep transoesophageal views helped to overcome imaging obstacles.

'Our first 7 PASCAL cases [in TR] have now reached 1-year follow up. We have 0% mortality at 30 days and 1 year. Patients remain in the same or lower class of regurgitation as at the end of the procedure.'

Figure 8. Intra-procedural imaging of PASCAL repair system implantation for TR

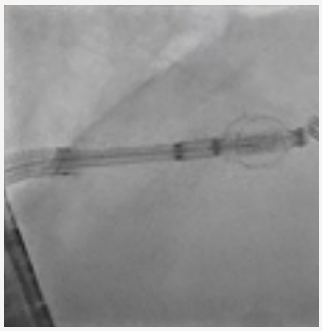
Pre Echo: TEE and Fluoroscopy





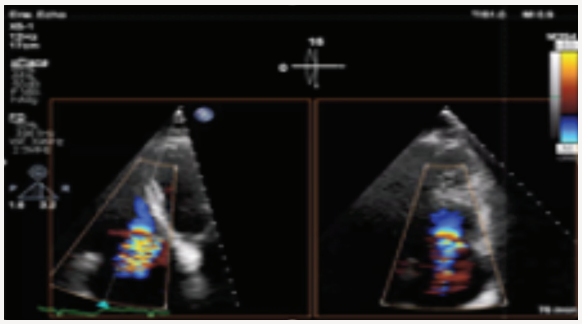
Intraprocedural Fluoroscopy

Device #1

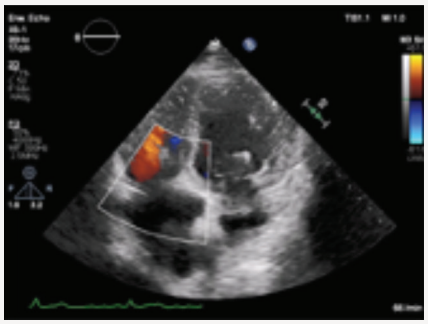


Device #2

Pre Echo: TTE



Post Echo: TTE 1-year follow up



TEE: transoesophageal echocardiography; TTE: transthoracic echocardiography

'In patients selected [for tricuspid repair with PASCAL], the reduction of TR leads to high improvement in fatigue, in NYHA class, and impressive improvement in 6MWD.'

At 1-year follow-up, the patient had no or mild TR (0–1+), showed evidence of remodelling of the formerly large right atrium, had normalised BNP values and good right ventricular ejection fraction. The case study demonstrates that independent grasping enables staged grasping of the leaflets to optimise outcomes.

Addressing tricuspid challenges with a nitinol implant

The PASCAL Repair System – how important is nitinol for transcatheter valve treatment?

Professor Dr med. Jörg Hausleiter,
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An interventional cardiologist expert in the field of valvular and coronary heart diseases, Professor Dr Jörg Hausleiter is Professor of Medicine and the Deputy Clinic Director at the Ludwig-Maximilians Universität in Munich, Germany. He is invested in bringing new percutaneous treatments to patients with coronary and valvular diseases..

Nitinol is a shape-memory alloy of nickel and titanium, which has unique properties – shape memory, superelasticity and biocompatibility – and has long been recognised as a useful material for use in medical devices.[29] These unique properties have led to the use of nitinol as an expandable frame in several tissue valves and valve repair systems.[9,30-32] In the PASCAL repair system, the nitinol paddles and nitinol woven central spacer enable optimised leaflet capture, avoiding stress on the native leaflets.[9]

Professor Hausleiter

Q: How important is nitinol in the PASCAL repair system and what benefits does it provide?

A: *It is a safety aspect that we have better force distribution on leaflets with lower risk of leaflet damage/tearing.*

Q: What specific advantages do you see in using nitinol in the PASCAL repair system for treatment success in treating TR?

A: *The leaflets of the tricuspid valve are significantly thinner than on the mitral side – risks might be higher on the tricuspid side – so this flexibility [of the PASCAL device] is especially useful on the tricuspid side to avoid leaflet damage.*

Q: What characteristics of the PASCAL repair system are enhanced by the presence of nitinol?

A: *Specific advantages in the PASCAL design – nitinol allows some flexibility of the PASCAL system meaning if you close the two large paddles of the PASCAL device, the tensioning occurs on the leaflets of the mitral or tricuspid valve. On the one side you want to achieve tension so you have remodelling of the valve annulus, but if the tensioning is too much, you have the risk of leaflet tears – this is more pronounced on the tricuspid valve. The nitinol aspect allows that some of the tensioning is directed to the nitinol, so it slightly opens and closes with the forces that are applied to the system. So, forces on the leaflets appear to be less than for other devices with stainless steel.*

The learning curve with the PASCAL Repair System in the tricuspid valve

Typically, as clinicians become familiar and gain experience with new devices, procedure times and outcomes improve. Real-world data indicate a short learning curve for clinicians when using the PASCAL repair system to treat patients with MR. Evidence from the first 1200 procedures shows that MR 0–1+ is achieved in 80% of patients by the time clinicians have performed 25 procedures. Even in cases with mixed aetiologies, where procedures are more complex, 76% MR 0–1+ rates are achieved after 25 cases. Also, procedure times reduce rapidly after the first five cases, and continue to drop between 5 and 25 cases, falling below 60 minutes without any compromise on safety.[22]

Experience gained through use of the PASCAL repair system in mitral valve repair, including navigation, repositioning and leaflet grasping, may be beneficial when starting to use the system for tricuspid valve repair.

While imaging is perceived to be the biggest challenge in tricuspid therapy, having exactly the same delivery system and the ability to translate experiences with the device in the mitral valve to the tricuspid valve is seen by users as beneficial. Here, our key experts offer their perspectives on the use of the PASCAL repair system in the tricuspid setting based on their earlier mitral experiences.

Professor Lurz

> *You need at least 10 cases for the initial learning curve in TR – learning how to improve imaging with manoeuvring and positioning, guiding and steering the catheter to reduce shadowing.*
>
> *Experience on how the device behaves [in MR], how to engage leaflets on the device and how to steer – all aspects are helpful [in using the PASCAL repair system in TR].*

Dr von Bardeleben

> *You should have experience of 25+ mitral valve interventions before you aim to go into the tricuspid field.*
>
> *It is important to know how to steer the PASCAL system into any direction and to make use of the specific advantages of the device – the spacer, independent grasping and the elevation feature.*
>
> *The acutely achieved results before complete PASCAL deployment from its delivery system seem to be very predictable.*

Conclusion

One-year data with the PASCAL repair system confirm earlier experience demonstrating its safety and durable efficacy in patients with clinically significant MR.[10] Now, early compassionate use and real-world data indicate similar benefits of the PASCAL repair system in patients with TR, including those with severe TR and large coaptation gaps.[21] Unique features of the PASCAL repair system, include the central spacer, which facilitates gentle capture of the delicate leaflets within the tricuspid valve, limiting leaflet stress, and allows for bridging large coaptation gaps.[21] The PASCAL repair system provides physicians with the convenience of a single device capable of successful mitral and tricuspid valve repair, with experience gained in the treatment of patients with MR potentially facilitating its use in treating patients with TR.

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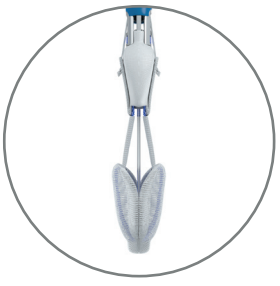

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