Cohort Study

ANNALS OF MEDICINE & SURGERY

OPEN

A prospective, international, bicentric study to evaluate PremiCron suture material for cardiac valve surgery – PREMIVALVE a cohort study

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Introduction: The most common age-related heart valve diseases include aortic valve stenosis and mitral valve insufficiency. The suture material is not the focus of most studies. The aim of the study was to assess the performance of PremiCron suture material for cardiac valve reconstruction and/or replacement under clinical routine. Performance was evaluated using the incidence of major adverse cardiac and cerebrovascular events (MACCE) combined with endocarditis.

Materials and methods: The study was designed as an international, prospective, bicentric, observational, single-arm study to evaluate the PremiCron suture material in cardiac valve surgery and compare the outcome with literature data regarding postoperative complications. The primary endpoint was a composite of MACCE acquired in the hospital, combined with endocarditis occurring up to 6 months postoperatively. The secondary parameters were intraoperative handling of the suture, incidence of MACCE and other relevant complications and quality of life up to 6 months after surgery. Patients were examined at discharge, 30 days, and 6 months postoperatively.

Results: A total of 198 patients were enrolled in two centers in Europe. The cumulative primary endpoint event rate was 5.0%, lower than the reference value of 8.2% from the literature. Comparison of the incidence of individual MACCE until discharge and endocarditis rate 6 months postoperatively also showed that our data were within the range of the published rates. Quality of life significantly increased from preoperatively to 6 months after surgery. Ease of handling of the suture material was rated as very good.

Conclusion: The PremiCron suture material is safe and very eligible for cardiac valve replacement and/or cardiac valve reconstruction in a broad patient population with a cardiac valve disorder treated under daily clinical practice.

Keywords: endocarditis, MACCE, nonabsorbable coated polyester suture, valve reconstruction, valve replacement

Introduction

Aortic valve stenosis is the third most common cardiovascular disease in Germany after arterial hypertension and coronary artery disease and aortic valve stenosis surgery is the second most common cardiac surgery after coronary artery bypass (https://www.aerztezeitung.de/medizin/krankheiten/herzkreislauf/article/333109/haeufigste-ursache-herzklappen-erkrankungen-inzwischen-altersbedingte-veraenderungen.html).

HIGHLIGHTS

- First cohort study systematically analyzing PremiCron suture for cardiac valve surgery.
- Clinical data generation in clinical routine setting (real world data).
- Pledgeted and nonpledgeted polyester sutures are safe and efficient for cardiac surgery.

A total of 161 917 heart surgeries were performed in Germany in 2020 out of which 35 469 corresponding to 21.9% were heart valve interventions (https://www.dgthg.de/sites/default/files/GermanHeartSurgeryReport2020.pdf). These were either done conventionally (sternotomy) or minimally invasive (https://www.dgthg.de/de/dgthg_leistungsstatistik).

The most common age-related heart valve diseases include aortic valve stenosis and mitral valve insufficiency. In 2020 the number of conventional aortic valve replacement surgeries exceeded 8186 procedures followed by over 6000 mitral valve interventions. When an aortic valve replacement was required, a biologic heart valve was implanted in 87.9% of cases. In mitral valve surgery, the patient's own mitral valve was reconstructed in 64.1% of cases (https://www.dgthg.de/de/dgthg_leistungsstatistik). Significantly less often are defects of the tricuspid valve (0.4%). Sometimes these are treated together with a mitral valve defect (http://herzzentrum.immanuel.de/herzzentrum-branden

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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Annals of Medicine & Surgery (2023) 85:835–841

Received 1 December 2022; Accepted 15 March 2023

Published online 4 April 2023

http://dx.doi.org/10.1097/MS9.0000000000000442

burg-bei-berlin-leistungen/therapiemoeglichkeiten/herzklappeneingriffe/chirurgische-klappeneingriffe/).

According to the Spanish Society of Cardiovascular and Endovascular Surgery, a total of 27 017 adult heart surgeries were performed in Spain in 2020. This number is 19.1% lower than in 2019 and probably related to decreased surgical activity in the context of the coronavirus disease-2019 pandemic outbreak. Of these procedures, 6766 (25.0%) were valvular interventions. The most common age-related valve disease was also aortic stenosis and mitral regurgitation. In 2020, 3532 isolated aortic valve replacements and 1539 isolated mitral valve procedures were conducted in Spain. Out of the 1539 isolated mitral valve procedures, 589 (38.3%) were mitral valve repairs. Isolated tricuspid valve surgery was also rare. Most of the tricuspid valve procedures were associated with mitral valve repairs, and only 118 isolated tricuspid valve procedures were reported.

Regarding heart valve prostheses, a mechanical valve was used in 29% of the cases, and a biological one in 50% of cases. Seventeen percent of cases received an annuloplasty ring and 4% of patients were operated on using a valve conduit[1].

All valves are stitched with a polyester sleeve. To anchor the valve, the retaining threads are presented with felt reinforcement. These are used to guide and anchor the heart valve in the correct position.

Echocardiography plays a crucial role in the assessment of the postoperative course, since it evaluates the valve function and morphology. The first follow-up is about 3–6 months after surgery.

Sutures made of polyester as well as pledgets made of polytetrafluoroethylene have been in clinical use since the 1960s[2]. The use of double armed, nonabsorbable, braided, coated sutures (polyester) – such as PremiCron – is recommended to anchor prostheses with pledgets in valve replacement surgery and for the reconstructive surgery of the mitral or tricuspid valve without pledgets. Polyester sutures have been mentioned in the literature and their high tensile strength, minimal tissue reactivity, and long-term resistance have been pointed out, but the clinical outcome of suture material is not the focus of most suture-related studies[3–6].

The aim of this prospective, international, bicentric, observational, single-arm study is to assess the performance of PremiCron suture material for cardiac valve reconstruction and/or replacement under clinical routine and compare the outcome with the literature data regarding postoperative complications. If the results from the present study are equal to or better than the published data, the PremiCron suture material, can be regarded as a safe and good alternative to existing suture materials for heart valve surgery.

Materials and Methods

The present PREMIVALVE study is reported in line with the STROCSS Guideline, which is a standard for published cohort studies[7].

Registration and ethics approval

In accordance with the Declaration of Helsinki, this cohort study was registered in www.clinicaltrials.gov before the first patient was enrolled. The final study protocol was approved by the Ethics Committees responsible for the participating clinics. The ethics approval was needed to meet national requirements. A clinical study protocol was created and approved by all participating clinics *a priori*, but not published in a peer-reviewed journal.

All the enrolled patients gave their written informed consent before their inclusion in the study.

Study design

The study was designed as an international, prospective, bicentric, observational, single-arm cohort study to evaluate PremiCron suture in cardiac valve surgery. Enrollment took place between January 2020 and August 2021 in two community hospitals located in Germany and Spain. The last included patient received his/her 6 months postoperative visit on 13 January 2022. The patients were examined on the day of discharge, and 30 days and 6 months after surgery. Data collection and clarification were completed in February 2022. An analysis was performed in April 2022 and a final clinical study report was completed in June 2022.

Population and intervention

A total of 198 patients were planned to be enrolled in this study, including a dropout rate of 5%. The number of patients to be recruited per center was not fixed. Approximately 99 patients were expected to be included in each center. The recruitment was stopped after the total sample size had been reached. The patients were treated according to the local standard and PremiCron suture material with and without pledgets (PremiPatch), manufactured by B. Braun Surgical SA, was used for cardiac valve reconstruction and/or replacement. The participating surgeons selected the size of the United States Pharmacopoe thread used. The suture material was applied by senior physicians, consultants, and residents who had been trained in, and were familiar with, the use of the suture material. A control group was not treated in parallel and a patient randomization did not take place. For comparison purposes of the primary clinical outcome, the publications of Stoliński and colleagues and Phanindranath and colleagues served as historic controls. Stoliński *et al*.[8] compared the clinical outcome of minimally invasive versus standard valve replacement. The complication rates reported for standard valve replacement were chosen for the present trial. Phanindranath and colleagues analyzed the risk factors and pathogenesis in the development of prosthetic valve endocarditis. According to the authors, the incidence of prosthetic valve endocarditis is highest during the first 6–12 months after surgery[9]. Therefore, we used the reported rate for this outcome parameter in our study for comparison at 6 months, after conducting a 6-month postsurgery examination in both participating clinics.

Patients were recruited from the patient population treated at the participating hospitals as part of daily clinical routine according to the clinic's standard. Echocardiography was standardly performed in both clinics preoperatively and 3–6 months postoperatively to assess the valve function and morphology. No additional follow-up visits were performed for this cohort study. Regular monitoring visits were performed at all hospitals to ensure the quality and validity of the data.

Inclusion and exclusion criteria

Inclusion criteria:

(1) Patients undergoing an elective, primary open or minimal invasive surgery for a single or multiple cardiac valve reconstruction and/or replacement.
(2) Age greater than or equal to 18 years.
(3) Written informed consent for participating in the study.

All enrolled patients gave their written informed consent before their inclusion in the study, for the scientific analysis of their pseudonymized data set in accordance with the Data Protection Law.

Exclusion criteria:

(1) Patients undergoing an elective, primary cardiac valve reconstruction, and/or replacement combined with a coronary arterial bypass graft surgery.
(2) Emergency surgery.
(3) Infective endocarditis.
(4) Previous cardiac surgical procedures.
(5) Known immunodeficiency or immunosuppression.
(6) Participation or planned participation in another cardiovascular study before the study follow-up is completed.
(7) Inability to give informed consent due to a mental condition, mental retardation, or language barrier.
(8) Pregnancy.

Primary and secondary variables

The incidence of a composite endpoint containing in hospital major adverse cardiac and cerebral events (MACCE) combined with another cardiac adverse event (endocarditis) occurring until 6 months postoperatively was the primary variable.

The secondary objective of the study included the evaluation of various safety, effectiveness, and performance parameters.

Safety:

(1) Incidence of the individual components in hospital MACCE until the day of discharge [death, stroke, myocardial infarction (MI)] and the endocarditis of the reconstructed/replaced cardiac valve.
(2) Incidence of death, stroke, MI, endocarditis of the reconstructed/replaced cardiac valve until 30 days and 6 months postoperatively.
(3) Incidence of atrial fibrillation, renal failure, pneumonia, mediastinitis, bleeding, superficial, and deep chest wound infections until discharge, 30 days and 6 months postoperatively.
(4) Other adverse events (valve related reoperation, hemothorax, paravalvular leakage, pacemaker insertion, embolism, valve insufficiency, gastrointestinal bleeding, surgery not valve related) until 6 months postoperatively.

Effectiveness:

(1) Length of ICU and postoperative hospital stay.
(2) Intraoperative handling of the suture material using a questionnaire containing different dimensions and a five-point assessment level (Likert scale) including pledget assessment.
(3) Improvement in the quality of life score (EQ-5D-5L) until 6 months after surgery.
(4) Employment status.

The assessment of the intraoperative handling of the suture material was performed using a five-point Likert scale (1 worst – 5 best). The following dimensions were evaluated: knot security, elasticity, feel, tissue drag, and knot pull strength.

The quality of life (QoL) was rated by the patients using the EQ-5D-5L questionnaire preoperatively, 30 days postoperatively and 6 months after surgery. The EQ-5D-5L was used in the German and Spanish language and the sponsor took up a license at the EuroQol Group. EQ-5D is a standardized measure of health status developed by the EuroQol Group to provide a simple, generic measure of health for clinical and economic appraisal. The EQ-5D is designed for self-completion by respondents and takes only a few minutes to complete. Instructions for respondents are included in the questionnaire. The EQ-5D-5L consists of two pages – the descriptive system and the EQ visual analog scale (EQ-VAS).The descriptive system comprises five dimensions (mobility, self-care, usual activities, pain/discomfort, anxiety/depression). Each dimension has five levels: no problems, slight, moderate, severe or extreme problems. The EQ-VAS records the respondents' self-rated health on a 20-cm vertical, VAS with the endpoints labeled 'the best health you can imagine, points = 100' and 'the worst health you can imagine, points = 0'.

Statistical Analysis

Sample size estimation

According to the literature data, the combined incidence of subsequent MACCEs: MI (1.9%), stroke (1.4%), mortality until discharge (1.4%)[8], plus endocarditis of the replaced/reconstructed valve until 6 months (3.5%)[9] add up to 8.2% together.

This rate P (test) = 8.2% is also expected when the PremiCron suture is used. For the noninferiority margin, the rate of $M = 15\%$ or more is considered as unacceptable.

A one-group χ^2-test with a 0.025 one-sided significance level will have an 80.0% power to detect the difference between the null hypothesis proportion, p0, of 0.150 and the alternative proportion, pA, of 0.082 when the sample size is 188 patients.

A 5% dropout rate is considered to be appropriate for the 6 months follow-up, so 198 patients have to be recruited for the study.

If the data of this observational study confirms the noninferiority as defined above, the PremiCron suture material can be regarded as safe and effective.

Statistical analysis methods

A one-group χ^2-test with a 0.025 one-sided significance level was used to test the noninferiority according to the above hypothesis (primary endpoint). Additionally, the 95% CIs for individual adverse event rates were calculated in order to compare the study results with the literature.

In secondary multivariate analyses, age, sex, and BMI were used as covariates to adjust for. Additionally, the centre-ID and the indication were used as random effects.

All data were analyzed by means of tables, figures, listings, and statistical tests if appropriate. The final programming was performed after closure of the database by using an appropriate statistical software package.

The statistical analyses were performed according to the following principles:

(1) Variables with metric or ordinal scale will be summarized with: number of observations used (N), median, mean, SD.
(2) Categorical variables were summarized with: Number of observations (N), relative frequencies (P, %).

The following standard procedures were used for comparisons:

(1) χ^2-test for binary data.
(2) *U*-test according to Wilcoxon–Mann–Whitney or to Kreskas–Wallis for nonparametric data.
(3) *t*-Test or one-way analysis of variance for metric data, if a normal distribution may be assumed.

Statistical tests were performed two-tailed with the prespecified significance level of alpha 5% or the respective one-tailed with the prespecified significance level of alpha 2.5%.

The test regarding the primary variable was considered confirmatory, all other tests were explanatory. The *P* values of the explanatory tests may be interpreted as measures of difference in the current sample rather than a significant difference in the basic population.

Results

The study population consisted of 107 patients enrolled in Germany and 91 patients recruited in Spain. No patient was lost to follow-up or withdrawn, Fig. 1.

Demography

Enrolled in the study were 126 (64%) males and 73 (36%) females. The patients averaged 66.32 ± 10.67 years of age (range: 20–86 years). The New York Heart Association (NYHA) classification was as follows: NYHA I (4%), NYHA II (61%), NYHA III (33%), and NYHA IV (2%). A detailed collection of preoperative data is presented in Table 1.

Intraoperative details

The thorax was either opened by a complete sternotomy (53%) or a partial sternotomy (3. ICR or 4. ICR). In two cases there was a conversion from minimally invasive to a complete sternotomy. A total of 239 surgical interventions were performed in 198 patients. More replacements were done compared to reconstructions ($N = 170$ vs. 69, respectively). The majority of replacements were performed at the aortic valve ($N = 136/170$; 80%), followed by the mitral valve ($N = 33/170$; 19.5%), and only one replacement was performed at the tricuspid valve (0.5%). In contrast, reconstructions were more often conducted at the mitral valve ($N = 43/69$; 62%). One-third of the reconstructions were done at the tricuspid valve ($N = 21/69$; 30%) and the minority of the reconstructions was observed at the aortic valve ($N = 5/69$; 7%). The replaced valves were positioned 65% supra-annular and 35% intra-annular. In case of an aortic valve, the positioning was mainly supra-annular ($N = 102/136$, 75%), whereas mitral valves were placed intra-annular 78% ($N = 26/33$).

Table 1

Demographics and pre-existing conditions in the study population.

Variable	N	Median	Mean	SD	PctN
Age	198	68	66.32	10.67	
BMI	198	27.37	28.07	4.73	
LVEF, %	194	55	58.06	10.26	
Heart rhythm					
Sinus rhythm	151				76.26
Atrial fibrillation	47				23.74
NYHA classification					
NYHA I	8				4.04
NYHA II	121				61.11
NYHA III	65				32.83
NYHA IV	4				2.02
Arterial hypertension	136				68.69
Hyperlipidemia	99				50
Diabetes					
Oral medication	25				12.63
Insulin dependent	4				2.02
COPD	22				11.11
Stroke	10				5.05
Chronic renal insufficiency with dialysis	3				1.52
Aortic aneurysm	5				2.53
Coronary heart disease	7				3.54
Peripheral arterial disease	3				1.52
Valve pathology					
Aortic stenosis	115				58.08
Mitral stenosis	25				12.63
Aortic insufficiency					
Mild grade I	74				37.37
Moderate grade II	25				12.63
Severe grade III–IV	30				15.15
Mitral insufficiency	83				41.92
Mild grade I	15				7.58
Moderate grade II	59				29.8
Severe grade III–IV					
Tricuspid	82				41.41
Insufficiency	12				6.06
Mild grade I	16				8.08
Moderate grade II					
Severe grade III–IV					

COPD, chronic obstructive pulmonary disease; LVEF, left ventricular ejection fraction; NYHA, New York Heart Association; PctN, percentage from total number.

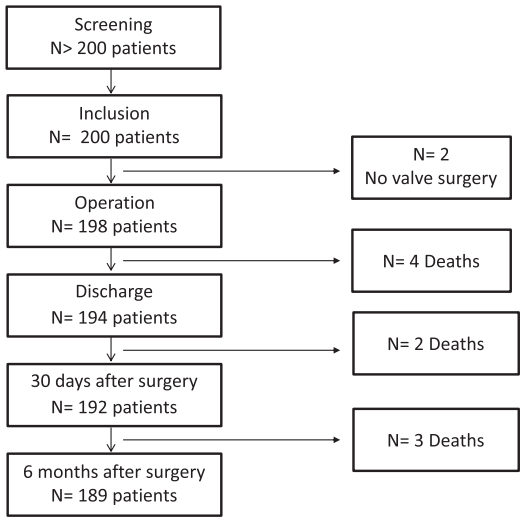

Figure 1. Disposition of patients over the study period.

Outcomes

Primary endpoint:

Until discharge, nine MACCEs occurred: four deaths, two MI, s and three strokes. In addition, one endocarditis was observed until 6 months postoperatively leading to an event rate of 5.0%, 95% CI (2.65–9.16%; $P < 0.0001$).

Secondary safety parameter:

Until 30 days after surgery, two additional patients died and one additional stroke was observed. Between 30 days and 6 months postoperatively, three additional patients died.

Until the end of the study, a total of nine deaths, two MIs, four strokes, and one endocarditis were recorded, indicating a total MACCE + endocarditis rate of 7.5% at 6 months after surgery (Table 2).

Two patients died of cardiogenic shock, two from multiorgan failure, three died due to severe respiratory insufficiency as a result of pneumonia with coronavirus disease-2019, one patient died after suffering a massive stroke and one died due to pancreatic cancer.

We also analyzed and assessed the incidence of other common complications that occur after cardiac valve replacement and/or valve reconstruction. With 33% , atrial fibrillation was the most often seen complication, followed by pleural effusion either on the left or right side (10%). The incidence of other events like respiratory insufficiency, atrioventricular block (4%), renal failure, pneumonia, delirium, postoperative bleeding, pericardial effusion, hemothorax, peripheral edema, heart failure, urinary retention, wound dehiscence of the operational wound, pneumothorax, wound infection of the chest, and paravalvular leaks (0.5%) were low (0.55–4%).

Performance analysis

Length of ICU and hospital stay: patients stayed in the clinic for an average of 9.91 ± 8.76 days. The mean duration of the ICU stay was 4.08 ± 8.49 days (minimum 1–maximum 108 days).

Handling of the suture material: all dimensions from the Likert scale were predominantly evaluated with four to five points (88–99%), indicating that the handling of the suture material is excellent and suitable for cardiac valve replacement and/or valve reconstruction (Fig. 2).

Suture material with pledgets (PremiPatch) was used in 156 patients (79%) and only one pledget size and configuration was applied (6 × 3 mm, firm, oval). The mean number of applied pledgets per patient was 15. In 58% of the surgeries in which pledgets were applied, the cardiac surgeon mentioned agreeing or strongly agreeing that the oval shape avoided the overlapping of the pledgets. Regarding the reduction of foreign material by using oval shaped pledgets, there was no clear agreement among the participating surgeons.

No adverse event or complication was reported in causal relationship with the applied suture material with pledgets.

QoL; EQ-5D-5L assessment: preoperatively, the patients assessed their health with 69.47 points ± 22.82. At 30 days postoperatively, an increase to 70.77 ± 16.39 was observed and the assessment at 6 months after surgery was of 79.02 ± 15.62 points. A *t*-test indicated that the QoL significantly improved 6 months after surgery compared to the screening status ($P < 0.0001$).

Status of employment: the total population consisted of ~64% retirees. A total of 34 patients were able to work full-time 6 months after surgery. Seven patients reported part-time work 6 months postoperatively. A total of 21 patients were unable to work. Mean duration from surgery to resumption of activity was 102.98 ± 52.22 days.

Discussion

The increase in age, as well as the various concomitant diseases of cardiac surgery patients associated with old age, present heart surgeons with new challenges. In addition to patient safety, the focus of heart surgery is on improving life expectancy and QoL. Despite the increase in age, the survival rate remains constant at 97%. Regardless of age, men are more affected than women, with two-thirds of cardiac surgery patients being men (https://www.dgthg.de/sites/default/files/GermanHeartSurgeryReport2020.pdf).

After coronary bypass surgery, heart valve surgery is one of the most common cardiac surgery procedures. The surgical procedures are performed either minimally invasive or through a complete median sternotomy. A comparison between partial sternotomy versus complete sternotomy for aortic heart valve

Table 2

MACCE and endocarditis rate depending on the time.

Complication	Parameter	In hospital	One month	Six months	Twelve months
Atrial fibrillation	*N*	55/198	59/198	61/198	
Atrial fibrillation	Rate	27.78% (21.99%, 34.41%)	29.80% (23.85%, 36.52%)	30.81% (24.78%, 37.56%)	
Endocarditis	*N*			1/198	
Endocarditis	Rate			0.51% (0.00%, 3.09%)	
Mortality	*N*	4/198	6/198	7/198	9/198
Mortality	Rate	2.02% (0.61%, 5.26%)	3.03% (1.25%, 6.60%)	3.54% (1.58%, 7.26%)	4.55% (2.29%, 8.53%)
Myocardial infarction	*N*	2/198			
Myocardial infarction	Rate	1.01% (0.04%, 3.85%)			
Pneumonia	*N*	3/198	4/198	6/198	
Pneumonia	Rate	1.52% (0.31%, 4.57%)	2.02% (0.61%, 5.26%)	3.03% (1.25%, 6.60%)	
Postoperative bleeding	*N*	5/198			
Postoperative bleeding	Rate	2.53% (0.92%, 5.94%)			
Renal failure	*N*	7/198	8/198		
Renal failure	Rate	3.54% (1.58%, 7.26%)	4.04% (1.93%, 7.90%)		
SSI A1	*N*		1/198		
SSI A1	Rate		0.51% (0.00%, 3.09%)		
Stroke	*N*	3/198	4/198		
Stroke	Rate	1.52% (0.31%, 4.57%)	2.02% (0.61%, 5.26%)		

SSI A1, surgical site infection superficial.

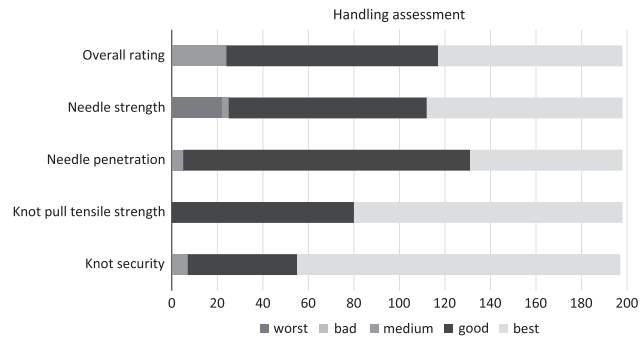

Figure 2. Intraoperative handling assessment of PremiCron suture for cardiac valve replacement/reconstruction.

replacement showed comparable mortality, while patients in the partial sternotomy group were mobilized faster and able to leave the hospital more quickly[10,11]. The surgical techniques used are safe. The patient´s QoL improves, many lead a normal life and practice their profession.

After surgery, patients remain in the ICU for about 2–3 days and the length of hospital stay ranges from 1 to 3 weeks. Known early complications of heart valve surgery include bleeding, wound infection, pericarditis, endocarditis, arrhythmias, and heart failure. Late complications include blood clotting disorders, infection of the prosthetic heart lining (prosthetic endocarditis), inflammation of the heart muscle due to valve installation, need for reoperation, damage to the valve function, and heart failure (https://www.tk.de/techniker/service/gesundheit-und- medizin/behandlungen-und-medizin/herz-kreislauf-erkrankungen/was-versteht-man-unter-einer-herzklappenoperation-2015486).

An aortic valve operation presents a 3% mortality rate, for the mitral valve, the rate is higher, namely 5–9%. Patients undergoing valve replacement have the choice between receiving a mechanical (artificial) or a biological prosthesis.

The outcome of suture material is of minor interest in most of the studies performed for cardiac valve surgery. After conducting an extensive literature search using the following three search terms: “cardiac surgery”, “suture”, and “randomized controlled trial”, we found 32 related papers. The assessment of these publications showed that either the suture technique (continuous vs. interrupted) or pledget versus nonpledget sutures were mainly compared. There is currently no publication available evaluating a specific suture type or different types of suture material in parallel. By checking the names of the used suture materials in the available literature, one fact is obvious, namely that either polypropylene or polyester sutures are applied for cardiac valve surgery, but their performance was not the main objective of the performed studies. Therefore, it is difficult to compare our outcome/findings with other suture materials, but the application of either one of the sutures consisting of polyester or polypropylene seems to be the standard suture material for cardiac valve interventions.

Incidence and severity of postoperative complications are key elements in determining the risk–benefit ratio of any surgical procedures. Therefore, as a primary outcome of this study, a safety parameter was chosen including the combination of MACCE (death, stroke, myocardial infection) until discharge and endocarditis rate 6 months postoperatively. We found a cumulative primary outcome rate of 5.05% compared to 8.2% resulting from the data generated in the literature[8,9]. A *t*-test indicated that our MACCE rate + endocarditis rate was significantly lower. A comparison of the incidence of individual MACCE until discharge and endocarditis rate 6 months postoperatively also showed that our data were within the range of the published rates.

We also analyzed the incidence of other common complications that occur after cardiac valve surgery. New atrial fibrillation (33%), pleural effusion (10%), wound infection of chest wound (1.8%), paravalvular leaks (0.5%), hemothorax (0.5%), and pneumonia (3%) were comparable with the rates published in the literature: atrial fibrillation (25%), pleural effusion (9%), wound infection of the chest (1.9%), paravalvular leaks (0.9%), hemothorax (1.0%), and pneumonia (1.4%).

It is well known that men are more affected by heart valve diseases than women. Also, in the PremiValve study, two-third of the included patients were males. The age of the patients, including pre-existing conditions, is also comparable to the literature data. According to the literature, 40% of valve patients have high blood pressure; in our study, a high blood pressure condition was reported in 69% of cases. Since high blood pressure is a risk factor for certain cardiac surgical outcome parameters, the PremiValve includes numerous high-risk patients. Overall, 26% of the patients had atrial fibrillation preoperatively, this value also corresponds to the information from the literature.

In the PremiValve study, an aortic valve stenosis was almost exclusively treated by a heart valve replacement, while a mitral valve insufficiency was treated by reconstruction. The treatment of a tricuspidal valve played a subordinate role in the PremiValve study. The operations were performed either minimally invasive (mainly aortic valve surgery) or by means of a median sternotomy for the treatment of mitral and tricuspid valves. There were not any significant differences in either the surgical approach or the distribution of procedures between the current study population and the patients in the compared literature.

The intraoperative results show that in the PremiValve study, a typical cardiac surgical population was treated under routine conditions. Both the demographic and intraoperative data are consistent with the findings from the literature. Both the average length of ICU stay (4.0 days) and the duration of postoperative hospital stay (9.9 days) correspond to the information from the literature. After the operation in the PremiValve study, working people resumed their professional activity after about 14 weeks, which is also comparable to the literature data.

QoL significantly increased from preoperatively to 6 months postoperatively. Significant improvement was observed in all dimensions/categories of the EQ. 5D5L questionnaire, suggesting that the surgery was a very effective measure to increase QoL and sustain the employment status of the patient.

A cumulus of clinical and surgical factors, one of these being the used suture material, postoperatively contributed to the very good results in the first 30 days and at 6 months.

Echocardiography was standardly performed in both clinics at 3–6 months postoperatively to assess the valve function and morphology and thus remotely the effect of the polyester suture material. Except for one patient who developed early endocarditis, all other enrolled patients presented excellent echocardiographic results.

The suturing of the heart valves or the heart valve reconstruction was carried out with the PremiCron polyester suture

material . Assessment of the handling of the thread was done in five categories using a five-point Likert scale (1 worse–5 best). Participating surgeons rated all categories with four to five points, indicating a very good handling performance of PremiCron during cardiac valve replacement and/or reconstruction.

Twenty-nine surgeons of various functions located in two different European hospitals performed the cardiac valve reconstruction and replacements in a representative study population under daily clinical routine; indicating a high transferability and generalization of our clinical results.

Nonetheless, our study has some limitations, such as the use of a historical control group and a short-time postoperative follow-up. A further limitation is the small cohort size.

Conclusion

Our findings indicate that PremiCron is safe and efficient for cardiac valve interventions to either fix the valve during replacement or to reconstruct the valve anatomy. Therefore, PremiCron can be regarded as a viable alternative to other suture materials in use for cardiac valve surgery.

Ethics approval

The study was approved by the ethics committees responsible for the participating clinics. A positive ethics approval was obtained by the following Institutional Review Boards. Ethics Committee, University of Tübingen, Germany, Project Number: 496/2019BO2, and the Comité Ético de Investigación Clinica, Hospital de la Santa Creu i Sant Pau, Barcelona, Spain, Project Number: 19/355(PS).

Consent

The authors declare that a written informed consent was obtained from all participating patients according to the Data Protection Law.

Sources of funding

The study was initiated, sponsored and funded by B. Braun Surgical SA, Barcelona, Spain. Aesculap AG was responsible for project management, monitoring, data management, statistics and study registration.

Author contribution

P.B. designed the study together with Adrian Ursulescu. Data collection and data approval were performed by A.U., M.R., and M.T. V.B. (contributor) was responsible for statistics and data analysis. M.R. wrote the manuscript together with Petra Baumann. The manuscript was reviewed and approved by A.U. and M.T.

Conflicts of interest disclosure

P.B. is employed by Aesculap AG. M.R., A.U., and M.T. declare no conflict of interest.

Research registration number

1. Name of the registry: ClinicalTrials.gov
2. Unique identifying number or registration ID: NCT04096859 3.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): PremiCron Suture for Cardiac Valve Repair-Full Text View-ClinicalTrials.gov

Guarantor

Petra Baumann and Magdalena Rufa are the guarantors for this cohort study.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Acknowledgments

The authors would like to thank Viktor Breul for the statistical analysis, Irene Fita for doing the monitoring visits in the Spanish clinic and to all participating cardiac surgeons for performing the surgeries. In addition, the authors would like to thank all patients for their participation in this cohort study.

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