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Sapien 3 Ultra balloon-expandable transcatheter aortic valve: in-hospital and 30-day results from the multicentre S3U registry

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Abstract

Aims. To evaluate 30-day safety and efficacy outcomes of transcatheter aortic valve implantation (TAVI) performed with the SAPIEN 3 Ultra (Edwards Lifesciences, Irvine, CA) system.

Methods and results. The S3U Registry is a physician-led, post-approval, multicenter, observational registry of transfemoral TAVI with the SAPIEN 3 Ultra. New features include an improved sealing skirt, a 14F expandable sheath and a new delivery catheter. Overall, 139 consecutive patients at 9 participating centers were enrolled. Mean age was 81.4±8.3 years, average STS score 3.8±2.4%. The vast majority (97.2%) underwent TAVI with local anesthesia (28.8%) or conscious sedation (68.3%). Balloon pre-dilatation was performed in 30 patients (21.6%), post-dilatation in 3 (2.2%). In-hospital, there were no cases of death, stroke, conversion to open-heart surgery. Major vascular complications occurred in 3 patients (2.2%), as well as major or life-threatening bleedings (2.2%). There were 2 moderate (1.4%) and no moderate/severe paravalvular leaks. Median length of stay after TAVI was 3 days (IQR 3-5 days). At 30-day there were no deaths, MI, or strokes and the incidence of new permanent pace-maker was 4.4%.

Conclusions. This first multicenter international experience of transfemoral TAVI with the SAPIEN 3 Ultra transcatheter heart valve shows excellent in-hospital and 30-day clinical outcomes.

Classifications: Aortic stenosis; Femoral; TAVI; Miscellaneous

CONDENSED ABSTRACT (100 words)

The S3U prospective, investigator-driven, multicenter, international registry evaluated post-procedural and 30-day outcomes of transcatheter aortic valve implantation (TAVI) with the new SAPIEN 3 Ultra (Edwards Lifesciences, Irvine, CA) balloon-expandable valve. Overall, 139 transfemoral TAVI were included. Mean age was 81.4±8.3 years, STS score 3.8±2.4%. At 30-day, there were no deaths or strokes. Major vascular complications and major or life-threatening bleedings occurred in 3 patients (2.2%) each. There were no moderate/severe paravalvular leaks. The incidence of new permanent pace-maker was 4.4%. The S3U registry with on-label use of the SAPIEN 3 Ultra shows excellent in-hospital and 30-day clinical outcomes.

ABBREVIATIONS LIST

EuroSCORE=European System for Cardiac Operative Risk Evaluation

IPE=initial product evaluation

PPM=permanent pace-maker

PVL=paravalvular leak

TAVI=transcatheter aortic valve implantation

SAVR=surgical aortic valve replacement

S3U=SAPIEN 3 Ultra

STS PROM=Society of Thoracic Surgery predictor of mortality

VARC-2=Valve Academic Research Consortium 2

Introduction

Transcatheter aortic valve implantation (TAVI) represents an alternative to surgical aortic valve replacement (SAVR) for elderly patients with severe aortic stenosis (AS). Randomized clinical trials have demonstrated superiority of TAVI over medical therapy in patients at prohibitive surgical risk, and equivalence or superiority over SAVR for all other surgical risk categories(1-7). The field of TAVI is rapidly evolving, with major refinements in technology, procedural techniques, patient selection and biomedical engineering. With the development of improved devices, new approaches and new implantation strategies, TAVI has become much simpler and safer. The first transcatheter heart valve device implanted in man in 2002 was a balloon-expandable device(8). Since then, 3 further device iterations have been released and approved for clinical use by Edwards Lifesciences (Irvine, California): the SAPIEN,(9) the SAPIEN XT(10) and the SAPIEN 3(11). Changes included innovations in the valve, the delivery system and the introducer sheath. The recently released SAPIEN 3 Ultra is the latest development whose features include an improved sealing skirt and a lower profile, simplified delivery catheter and has gained approval for commercial use in Europe and the USA. To date, there are no reports documenting clinical experience with the SAPIEN 3 Ultra.

We herein report the 30-day outcomes of the S3U Registry, a physician-led, post-approval multicenter, real world observational registry of transfemoral TAVI with the SAPIEN 3 Ultra device.

Methods

Study design and patient population

The SAPIEN 3 Ultra received CE market approval on November 16th 2018. Since after, an Initial Product Evaluation (IPE) phase was launched, with a limited product release in selected centers

across Europe. The IPE was terminated on December 2nd 2018. Concurrently, we designed a physician-led, international, multicenter, prospective registry aimed at collecting clinical, echocardiographic, procedural and outcome data of the first consecutive transfemoral SAPIEN 3 Ultra procedures performed within the IPE phase and up to February 27th 2019. In total, 9 centers participated in the study. Indication for TAVI was determined by a Heart Team based and the selection of SAPIEN 3 Ultra was based on labeled indications and then left to the final decision of the operators. The manufacturer of the SAPIEN 3 Ultra, Edwards LifeSciences, had no role in data collection, analysis, manuscript drafting and did not provide any financial support for the study.

The SAPIEN 3 ULTRA device (figure 1)

The SAPIEN 3 Ultra retained the SAPIEN 3 cobalt-chromium alloy frame, with low delivery profile and high radial strength. The SAPIEN 3 Ultra characteristics and differences compared to SAPIEN 3 are reported in figure 1. Briefly, the most important changes are related to the outer skirt made by a textured polyethylene terephthalate and 40% higher than that of SAPIEN 3 for a better final sealing. The SAPIEN 3 Ultra is available in 3 sizes 20, 23 and 26 mm, whereas the 29 mm valve is the SAPIEN 3 mounted on the Ultra delivery system. The delivery system was also modified with on-balloon valve crimping to streamline the procedure, eliminating the need for valve alignment and flex catheter retraction steps. The crossing profile is lower thanks to smooth tip-to-valve transition and to a shorter tapered distal tip. Finally, the Axela sheath replaced the e-Sheath with new features. It is a 14F expandable sheath for all valve sizes, including the 29mm SAPIEN 3. It has a hydrophilic coating for smooth insertion, tracking and removal. The specific design allows transient expansion and active contraction and by mean of a seamless design it maintains optimal haemostasis throughout the procedure.

Definitions and outcomes

All patients had symptomatic severe native AS defined by standard criteria. Peripheral artery disease (PAD) included a history of intermittent claudication, previous peripheral vascular treatment or documented peripheral arterial stenosis greater than 50%. Chronic obstructive pulmonary disease was identified by forced expiratory volume in 1 second<1 liter or long-term use of bronchodilators, steroids or oxygen for lung disease. Chronic kidney disease (CKD) was identified by a glomerular filtration rate (GFR) <60 ml/min calculated by the Cockroft-Gault formula. The logistic EuroSCORE (European System for Cardiac Operative Risk Evaluation), the EuroSCORE II and the Society of Thoracic Surgery predictor of mortality (STS PROM) score were reported as part of a multiparametric evaluation(12,13). TAVI procedures were performed as per standard practice of each center. Similarly, there was not a standardization of post-procedural anti-thrombotic therapy. The primary objective of the study was to evaluate post procedural and 30-day safety and efficacy outcomes. All endpoints were defined according to the VARC-2 (Valve Academic Research Consortium 2) criteria(14). Main outcomes of interest were: device success, all-cause death, cardiac death, stroke, vascular complications, bleeding, new permanent pacemaker insertion and acute kidney injury. Implant success was defined as only one valve implanted in the proper anatomical location, device success according to VARC-2 criteria. All events and values collected are site-reported. The 30-day outcome was obtained through an outpatient clinic visit or telephone contact.

Statistical analysis

Descriptive statistics are reported. Continuous variables were expressed as mean±standard deviation (SD), or median and interquartile range (IQR) when appropriate, and categorical variables as counts and percentages. All analyses were performed with the SAS 9.3 system (SAS Institute, Cary, NC). Prospective TAVI databases were approved by local ethics committees at each participating center, and patients signed written informed consent for enrolment in the registry where required. The

study protocol is in accordance with the declaration of Helsinki. For the UK data were collected as part of a mandatory UK national cardiac audit and all patient identifiable fields were removed before analysis. The study complies with section 251 of the National Health Service Act 2006. Ethical approval was not required under research governance arrangements for analyses.

Results

During the study period, 139 consecutive patients underwent transfemoral TAVI with the SAPIEN 3 Ultra at participating centers and were enrolled in the registry. Baseline characteristics are reported in table 1 and table 2. Mean age was 81.4±8.3 years, 54.5% were female and average STS score was 3.8±2.4%. The vast majority (97.2%) underwent TAVI with local anesthesia (28.8%) or by conscious sedation (68.3%) (table 3). The new SAPIEN 3 Ultra valves 20, 23 or 26 mm were used in 118 patients (84.9%), the SAPIEN 3 29 mm with the Axela sheath and the Ultra delivery system in 21 (15.1%). In 1 patient the 23 mm valve get stuck in the sheath and could not be further advanced, requiring a sheath exchange and replacement of the valve with a new one. The procedure ended successfully but there was a flow-limiting dissection of the iliac that had to be fixed with a peripheral stent from the contralateral femoral artery. Re-analysis of the angio-CT scan confirmed a minimal diameter of 5.5 mm without relevant calcifications or tortuosity at the site of sheath kinking. Most of the valves were implanted without balloon pre-dilatation (78.4%). Post-dilatation was performed in 3 cases (2.2%). Mean procedural duration, from entrance to exit from the catheterization laboratory, was 121±47 minutes. Implant success was 100%, device success according to the VARC-2 definition was 97.8%: there were 2 cases (1.4%) with moderate PVL, and 1 cases (1.4%) with mean final gradient >20 mmHg and patient-prosthesis mismatch (AVA<0.65 cm2/m2) with a 20 mm device. In-hospital, there were no cases of death, stroke, conversion to open-heart surgery. The rate of new permanent pace-maker implantation to discharge was 2.2%.

Major vascular complications occurred in 3 patients (2.2%), and major or life-threatening bleedings in 3 patients (2.2%). Valve hemodynamics and incidence of PVL are shown in figure 2. Mean trans-valvular gradients were 19±6 mmHg for the 20 mm device, 12±4 mmHg for the 23mm, 11±4 mmHg for the 26 mm, and 10±4 mmHg for the 29 mm. In 1 patient a focal leaflet thickening suggestive for thrombosis was detected at post-procedural echocardiography, without affecting transvalvular gradients. The thickening resolved after 24 hours of full anticoagulation and the patient was discharged with a mean gradient=10 mmHg. The median length of stay after TAVI was 3 days (IQR 3-5 days), total hospitalization was 4 days (IQR 2-7 days). At 30-day (table 3 and figure 3), there were no deaths, MI, or strokes. Anti-thrombotics at discharge were dual antiplatelet in 58%, single antiplatelet in 7%, oral anticoagulation in 35% (20% direct anticoagulants, in 10% combined with a single antiplatelet). Three additional patients required a new permanent pace-maker after discharge, with an overall 30-day incidence of 4.4%, and 3 patients were re-admitted because of CHF: 2 paroxysmal AF with high heart rate, 1 obese and severely hypertensive patient who inappropriately reduced diuretics. In all patients re-admitted echocardiography showed a well-functioning prosthesis.

The present patient population was compared with a control population composed by 139 consecutive patients treated with the SAPIEN 3 in the period immediately preceding the introduction of the Ultra system. The results are reported in Supplementary Tables 1 and 2. Briefly, patients treated with the Ultra were more frequently female with an overall lower surgical risk (e.g. STS PROM 3.8±2.4% vs. 6.1±5.0%). There were no significant differences regarding in-hospital and 30-day outcomes.

Discussion

The current analysis reports for the first time on procedural and clinical outcomes in a consecutive series of patients undergoing transfemoral TAVI with the Sapien 3 Ultra in the prospective, international, multicenter S3U registry. The main findings are the followings: 1) Device success was observed in 98% of the cases; 2) In-hospital, there were no cases of death, stroke or conversion to open-heart surgery. The PM rate, major vascular complication and severe bleeding were below 3%, and PVL below 2% (none> moderate); 3) Valve hemodynamics seem comparable to the SAPIEN 3; 4) These results were maintained at 30-day with the final incidence of new PM of 4.4%. In addition, the rate of post dilatation was low, compared with modern series, at 2.2%, perhaps indicating the better sealing characteristics of the improved PET skirt.

The technical changes of the SAPIEN 3 Ultra compared to SAPIEN 3 were aimed at streamlining the procedure, make it safer, expand the rate of patients treatable with transfemoral access and mostly to reduce the incidence of PVL. Our initial experience, with strict on-label use of SAPIEN 3 Ultra, confirms these expectations both in terms of early procedural and clinical results. To note, general anesthesia was not needed in 97.2%, balloon pre-dilatation was performed in a minority of patients, and the median hospital length of stay after TAVI was 3 days. Most importantly, we report an exceptionally low incidence of all major complications both in-hospital and at 30 days that parallel those reported by Waksman and colleagues with the use of SAPIEN 3 in low-risk patients(15). However, we enrolled older patients (on average +8 years) and, differently from the low-risk TAVR study, we included patients across all risk categories. There was, however, 1 case with a small kinking of the sheath that was not visible at angiography but precluded valve advancement, finally causing a minor vascular complication. Whether this could be attributed to the play of chance or to a somewhat minor resistance to compression of the Axela sheath cannot be inferred from our data. After completion of this study, other similar cases have been reported worldwide. In addition, a few cases of unexplained balloon-rupture during valve implant have been reported which have resulted in significant difficulty retrieving the valve into the catheter and

withdrawing the system from the patient. In some cases, that was associated with vascular injury, bleeding, or need for surgical intervention, prompting the manufacturer to issue a Field Safety Notice and, later on, the US Food and Drug Administration (FDA) to issue a class I recall of the Sapien 3 Ultra delivery system (16). Following these events, the company is now supporting the use of SAPIEN 3 Ultra with the Edwards Commander delivery system through the 14 French expandable eSheath.

In contrast with previous studies which have observed a higher rate of pacemaker requirement with SAPIEN 3 (4,11,17) compared to the SAPIEN-XT trials(2,10), the rate of permanent pace-maker in our study was low at 4.4% to 30 days. The reasons for this observation are speculative and may have occurred by chance or explained by the small cohort size. Our patient population presented low rate of RBBB or conduction disturbances at baseline. However, it is possible that the low rate of predilatation, afforded by the lower crossing profile of the device and the low rate of post dilatation, due to the improved sealing skirt reducing PVL, may have been contributory factors.

Limitations

This study presents some limitations that should be acknowledged. This is a relatively small series of SAPIEN 3 Ultra -treated patients performed by very experienced operators working in high-volume centers. Second, outcomes were self-reported by participating centers in the absence of a clinical event committee and there was no core lab evaluation of echocardiographic results. While hard clinical endpoints such as mortality, stroke and major bleedings can be considered highly reliable, echocardiography and hemodynamics could suffer from inter-centers differences in evaluation and reporting. Overall, external validity of these results should be evaluated in larger studies. Importantly, however, our results were obtained in the learning phase of the new device for all operators, confirming the safety and the great efficacy of the SAPIEN 3 Ultra even under these circumstances. The comparison with previous generation devices (figure 3) is provided only for

descriptive purpose and has no scientific validity. In fact, we cannot assume that improved outcomes are due only to the device because the time period is different and it is well established that outcomes are improving due to increased experience. Finally, in the present study all cases were performed with the Axela sheath and the Ultra delivery system. After identification of potential issues with both devices, in most centers the Sapien 3 Ultra valve is now implanted using the Sapien 3 delivery kit consisting of the eSheath and the Commander delivery system. Although it is reasonable to assume consistent results with the latter combination, further testing is needed to confirm this hypothesis.

Conclusion

This first multicenter experience of patients treated by transfemoral TAVI with strict on-label use of the new SAPIEN 3 Ultra transcatheter heart valve shows excellent in-hospital and 30-day clinical outcomes confirming that refinements in technology and biomedical engineering may simplify and improve overall TAVI results.

Impact on daily practice:

Transcatheter aortic valve implantation (TAVI) represents an alternative to surgical aortic valve replacement (SAVR) for elderly patients with severe aortic stenosis (AS) irrespective of surgical risk. TAVI devices are constantly refined to address shortcomings of previous-generations.

This investigator-driven multicenter international study is the first to evaluate in-hospital and 30-day clinical outcomes associated with the latest-generation balloon-expandable transcatheter heart valve of the SAPIEN family, the SAPIEN 3 Ultra, demonstrating effective reduction of short-term complications and excellent clinical results.

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Conflicts of interests

F. Saia reports receiving consulting fees from Abbott Vascular, Eli Lilly, Astra Zeneca, St.Jude Medical, and speaker's fees from Abbott Vascular, Eli Lilly, Astra Zeneca, St.Jude Medical, Terumo, Biosensors, Edwards, Boston Scientific. G. Tarantini reports speaker's fees from Abbott Vascular, Edwards, Boston Scientific, Medtronic. SN Doshi has received consulting fees from Medtronic, Edwards LifeSciences and Boston Scientific. M Laine reports consulting fees from Boston Scientific, Medtronic and Edwards LifeSciences

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Figure legends

FIGURE 1. The SAPIEN 3 Ultra device. The SAPIEN 3 Ultra presents a number of important innovations in comparison with the SAPIEN 3 device, that involve the valve, the delivery system, and the introducer sheath. A. The valve retains the SAPIEN 3 frame and bovine pericardial leaflets, whereas the outer skirt (asterisk) is made of textured PET, different from the fabric seal of the SAPIEN 3 and around 40% higher. B. The Ultra delivery system. Highlighted, the new balloon re-designed to allow on-balloon valve crimping, obviating the need of valve alignment and pusher retraction before valve release. The distal end presents a smoother tip-to-valve transition and a shorter tapered distal tip. C. The Axela sheath: 14F expandable sheath compatible with all valve sizes, engineered to allow transient expansion and active contraction (square box), with hydrophilic coating and a seamless design.

FIGURE 2. Hemodynamics and paravalvular regurgitation (PVL). A. Aortic valve area (AVA) before and after transcatheter aortic valve implantation at echocardiography. B. PVL grade before hospital discharge.

FIGURE 3. 30-day clinical outcomes. Thirty-day results of the Sapien 3 Ultra - S3U registry in comparison with the main trials and registries of the Sapien transcatheter heart valve family.

Tables

Table 1. Baseline characteristics

	(n=139)
Demographics	
Age, *yrs*	81.4 ± 8.3
Female gender, n (%)	77 (55.4)
Body mass index, kg/m^2	27.3 ± 4,6
Risk Factors	
Diabetes, n (%)	31 (22.3)
Hypertension, n (%)	125 (89.9)
Dyslipidemia, n (%)	82 (59.0)
Smoking	14 (10.1)
Clinical history	
Previous myocardial infarction, n (%)	25 (18.0)
Previous PCI, n (%)	46 (33.1)
Previous CABG, n (%)	9 (6.5)
Previous AVR, n (%)	0 (0.0)
Previous stroke, n (%)	11 (7.9)
Permanent pacemaker, n (%)	10 (7.2)
Comorbidities	
CKD, n (%)	87 (62.6)
Dialysis, n (%)	2 (1.4)
COPD, n (%)	20 (14.4)
PAD, n (%)	13 (9.5)
CVD, n (%)	11 (7.9)
Atrial fibrillation, n (%)	35 (25.2)
Neurologic dysfunction, n (%)	6 (4.3)
Clinical presentation	
Dyspnea, n (%)	138 (99.3)
NYHA I- II	56 (40.3)
NYHA III-IV	82 (59.0)
Stable angina, n (%)	15 (10.8)
Syncope, n (%)	14 (10.1)
Pulmonary hypertension*, n (%)	9 (6.5)

Surgical risk	
STS PROM, *%*	3.8 ± 2.4
Logistic EuroSCORE, *%*	14.0 ± 11.5
EuroSCORE II, %	4.6 ± 4.7
Severe liver disease, n (%)	5 (3.6)
Hostile thorax, n (%)	1 (0.7)
Porcelain aorta, n (%)	11 (7.9)
ECG	
LBBB	8 (5.8)
RBBB	10 (7.2)
1st degree AVB	12 (8.6%)

AVB= atrio-ventricular block; AVR= aortic valve replacement; CVD= cerebrovascular disease; PAD= peripheral artery disease; PCI= percutaneous coronary intervention; CABG= coronary artery bypass graft; CKD= chronic kidney disease (GFR<60ml/min); COPD=chronic obstructive pulmonary disease; EuroSCORE=European System for Cardiac Operative Risk Evaluation; LBBB= left bundle branch block; RBBB=right bundle branch block; STS PROM= Society of Thoracic Surgery predictor of mortality

*Systolic pulmonary arterial pressure > 60 mmHg

Table 2. Echocardiography

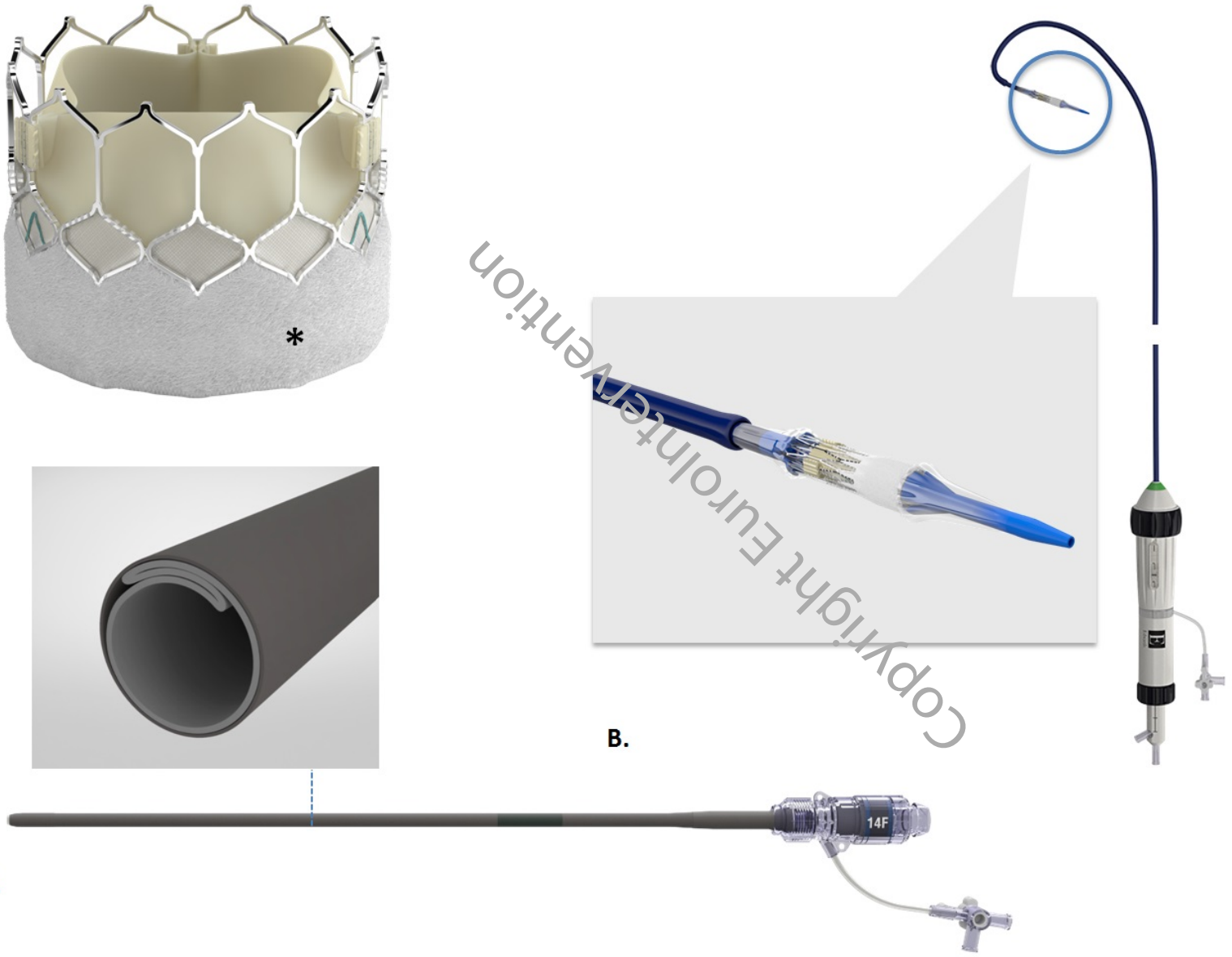
	Baseline (n=139)	Discharge (n=139)
Echocardiography		
AVA, *cm²*	0.6 ± 0.2	1.6 ± 0.4
AVAi, cm^2/m^2	0.4 ± 0.1	1.0 ± 0.3
Mean transvalvular gradient, *mmHg*	46.3 ± 13.8	11.6 ± 4.3
Max transvalvular gradient, *mmHg*	75.4 ± 21.4	21.3 ± 6.8
LVEF, *%*	57.9 ± 10.6	58.1 ± 10.3
LVEF<30% n (%)	3 (2.2)	2 (1.4)
Mitral regurgitation, n (%)		(n=122)
None	21 (15.1)	41 (29.5)
Mild	71 (51.1)	60 (43.2)
Moderate	31 (22.3)	15 (10.8)
Moderate-to-severe	4 (2.9)	3 (2.2)
Severe	4 (2.9)	3 (2.2)
Aortic regurgitation, n (%)		
None	49 (35.3)	123 (88.5)
Mild	63 (45.3)	14 (10.1)
Moderate	17 (12.2)	2 (1.4)
Moderate-to-severe	1 (0.7)	0 (0.0)
Severe	3 (2.2)	0 (0.0)

AVA= aortic valve area; AVAi= AVA indexed; LVEF=left ventricular ejection fraction.

Table 3. Procedural, in-hospital and 30-day outcomes

	Patients (n=139)
Anestesia/sedation status	
Standalone local anestesia, n (%)	40 (28.8)
Conscious sedation, n (%)	95 (68.3)
General anesthesia, n (%)	4 (2.9)
Valve size, n (%)	
20mm, n (%)	5 (3.6)
23mm, n (%)	60 (43.2)
26mm, n (%)	53 (38.1)
29mm, n (%)	21 (15.1)
Pre-dilatation	30 (21.6)
Device success, n (%)	136 (97.8)
Valve malposition, n (%)	0 (0.0)
Need for second valve, n (%)	0 (0.0)
Conversion to open surgery, n (%)	0 (0.0)
Cardiac tamponade, n (%)	0 (0.0)
Coronary occlusion, n (%)	0 (0.0)
Annulus rupture, n (%)	0 (0.0)
In-hospital	
All-cause death, n (%)	0 (0.0)
Acute myocardial infarction, n (%)	0 (0.0)
Stroke, n (%)	0 (0.0)
Vascular complications	
Major vascular complications, *n (%)*	3 (2.2)
Minor vascular complications, *n (%)*	15 (10.8)
Bleeding, n (%)	
Life-threatening or disabling bleeding	1 (0.7)
Major bleeding	2 (1.4)
Minor bleeding	6 (4.3)

Acute kidney injury, n (%)	
Class 1	4 (2.9)
Class 2	0 (0.0)
Class 3	5 (3.6)
New permanent pacemaker, n (%)	3 (2.2)
New atrial fibrillation, n (%)	5 (3.6)
30-day outcome	
All-cause death, n (%)	0 (0.0)
Cardiovascular death, n (%)	0 (0.0)
Stroke, n (%)	0 (0.0)
Re-hospitalization for CHF, n (%)	3 (2.2)
New permanent pacemaker, n (%)	3 (2.2)



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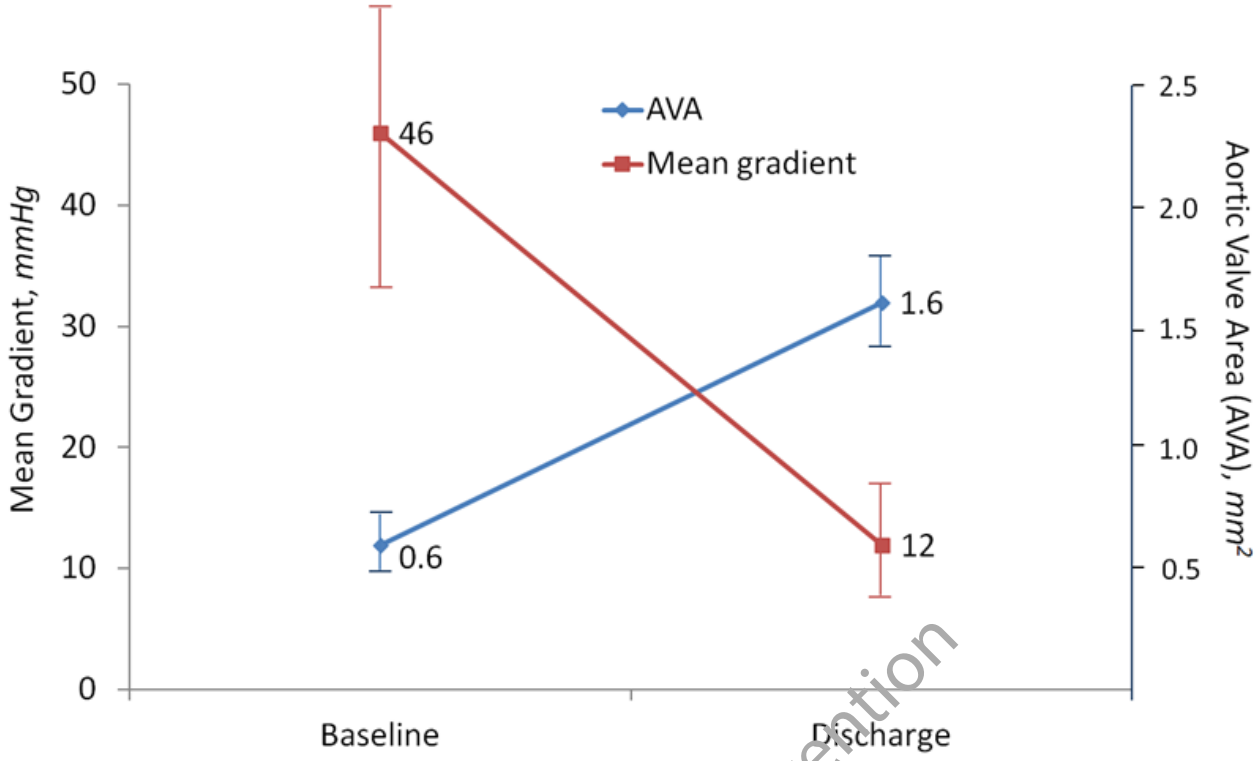

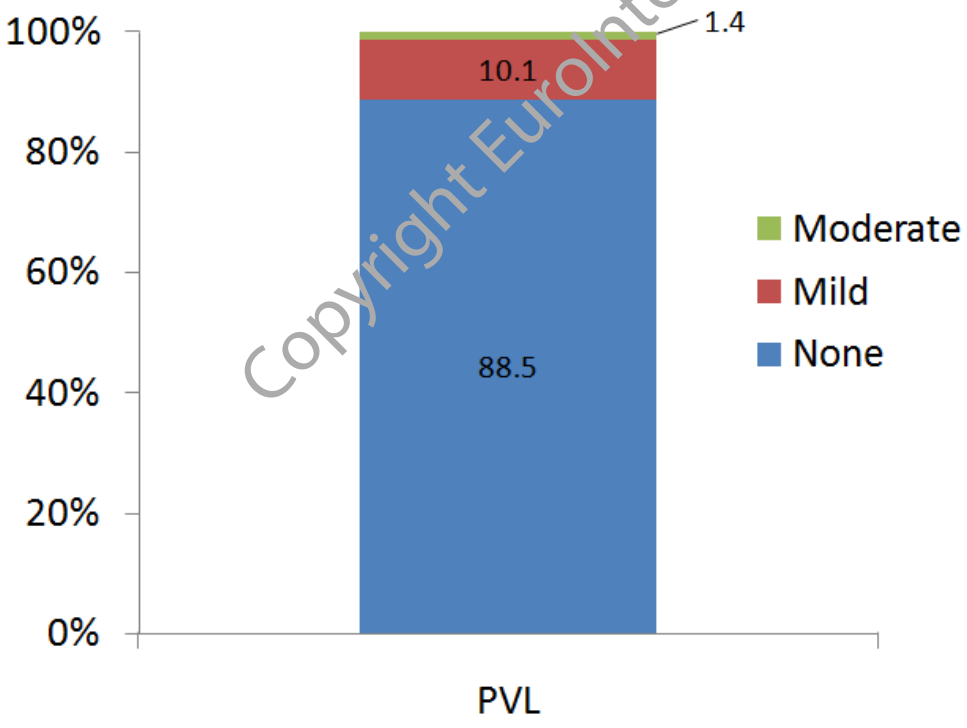

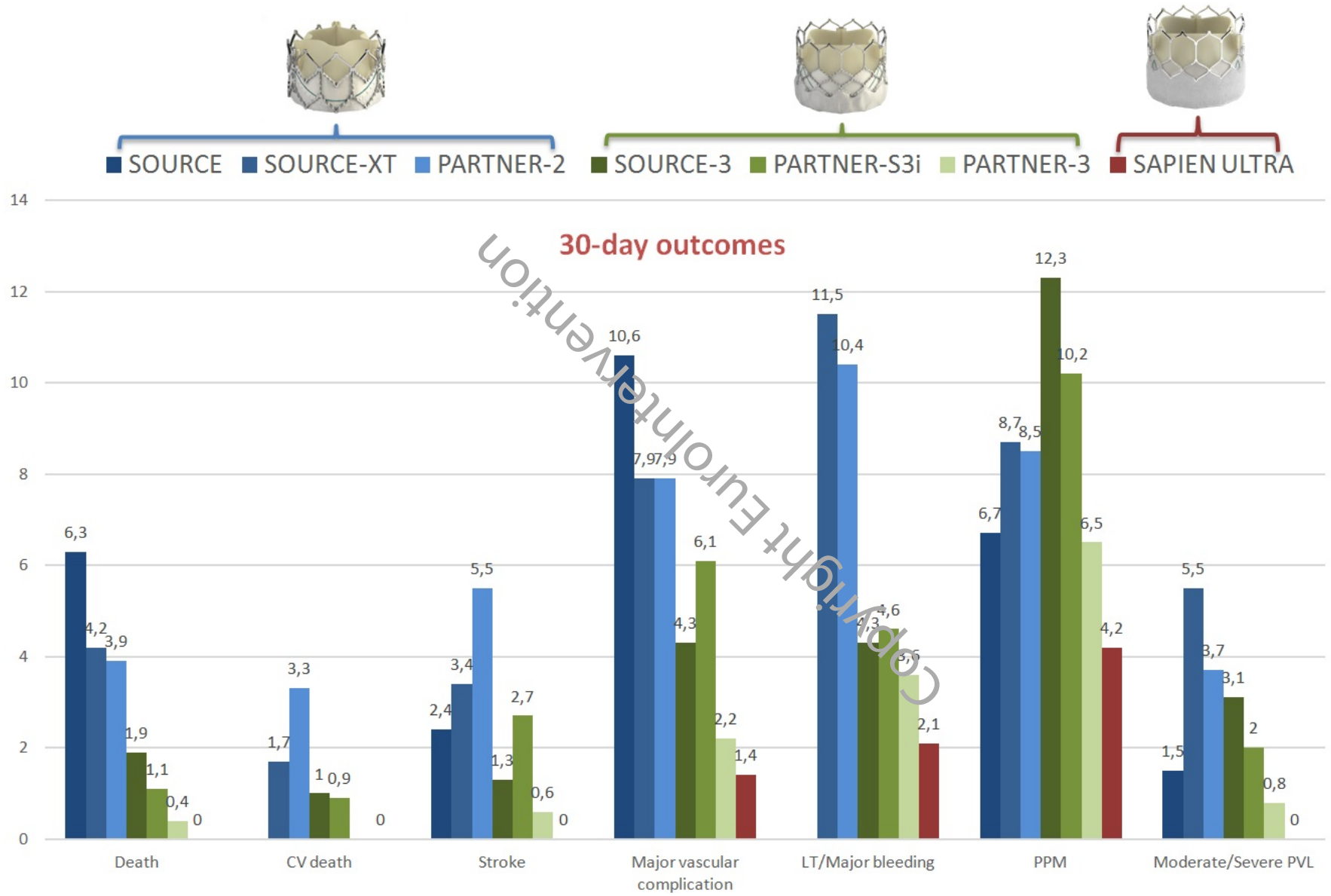

Supplemental Tables

Table 1. Baseline characteristics

	SAPIEN 3 ULTRA (n=139)	SAPIEN 3 (n=139)	P value
Demographics			
Age, *yrs*	81.4 ± 8.3	82.1 ± 6.6	0.40
Female gender, n (%)	77 (55.4)	58 (41.3%)	0.02
Clinical history			
Previous myocardial infarction, n (%)	24 (17.3)	33 (23.7)	0.18
Previous PCI, n (%)	46 (33.1)	46 (33.1)	1
Previous CABG, n (%)	9 (6.5)	19 (13.7)	0.05
Previous AVR, n (%)	0 (0.0)	0 (0)	1
Previous stroke, n (%)	11 (7.9)	15 (10.8)	0.41
Permanent pacemaker, n (%)	10 (7.2)	13 (9.4%)	0.51
Comorbidities			
CKD, n (%)	87 (62.6)	114 (82.0)	<0.001
Dialysis, n (%)	2 (1.4)	1 (0.7)	0.56
COPD, n (%)	20 (14.4)	40 (28.8)	0.004
PAD, n (%)	13 (9.5)	13 (9.5)	1
Atrial fibrillation, n (%)	35 (25.2)	56 (40.3)	0.007
Neurologic dysfunction, n (%)	6 (4.3)	3 (2.2)	0.32
Pulmonary hypertension*, n (%)	9 (6.5)	7 (7.7)	0.99
Surgical risk			
STS PROM, *%*	3.8 ± 2.4	6.1 ± 5.0	<0.001
Logistic EuroSCORE, *%*	14.0 ± 11.5	17.6 ± 13.0	0.015
EuroSCORE II, %	4.6 ± 4.7	6.4 ± 5.3	0.004
Severe liver disease, n (%)	5 (3.6)	2 (1.44)	0.25
Hostile thorax, n (%)	1 (0.7)	0 (0)	0.32
Porcelain aorta, n (%)	11 (7.9)	6 (4.3)	0.21
Echocardiography			
AVA, *cm^2*	0.63 ± 0.16	0.74 ± 0.18	<0.0001
Mean transvalvular gradient, *mmHg*	46.3 ± 13.8	40.6 ± 13.6	0.0007
LVEF, *%*	57.9 ± 10.6	56.3 ± 13.5	0.26
LVEF<30% n (%)	3 (2.2)	10 (7.4)	0.05
Valve size, n (%)			0.07