Changes in treatment of aortic valve diseases for acute and elective indications during the COVID-19 pandemic: A retrospective single-center analysis from 2019 to 2020

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Abstract

Background. Coronavirus disease 2019 (COVID-19) pandemic had an impact on the quality of healthcare services and led to many changes in the treatment of cardiac pathologies.

Objectives. To assess the differences in the clinical manifestations, management and outcomes of patients with aortic valve diseases (AVDs) treated invasively before and during the pandemic.

Materials and methods. This retrospective single-center study involved patients with AVDs treated by means of balloon aortic valvuloplasty (BAV), transcatheter aortic valve implantation (TAVI) or surgical aortic valve replacement (SAVR) in 2019 and 2020. They were divided into groups with respect to the year of intervention (2019 compared to 2020) and the priority of admission (urgent compared to elective). Preoperative characteristics, early outcomes and probability of annual survival were compared between the groups.

Results. The number of patients admitted urgently increased from 37 in 2019 to 54 in 2020, with a higher prevalence of men in 2020 (83.3% compared to 56.8%, respectively). Elective cases, on the other hand, declined from 279 in 2019 to 256 in 2020. Among the latter, more subjects had manifestations of heart failure ($p < 0.001$), coronary artery disease (CAD; $p = 0.002$), hypertension ($p = 0.006$), as well as had a history of a stroke ($p = 0.002$). In the meantime, more TAVI and fewer SAVR procedures were performed in 2020 (86 compared to 127 and 192 compared to 125, respectively; $p < 0.001$). In 2020, TAVI individuals had risk of death (according to the EuroSCORE scale) than in 2019 ($p < 0.001$). The probability of annual survival was comparable ($p = 0.769$) among AVD patients treated before and during the coronavirus pandemic (91.3% compared to 88.3%, respectively).

Conclusions. Although during the COVID-19 pandemic more nonelective and higher-risk AVD individuals received interventional treatment, the outcomes were comparable to the pre-pandemic era (2019). Our findings support highly valuable, less invasive therapeutic methods for treating aortic pathologies during the pandemic.

Key words: outcomes, coronavirus, aortic valve replacement, transcatheter aortic valve implantation, aortic valve disease

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Background

Coronavirus disease 2019 (COVID-19) pandemic has affected healthcare systems globally. Consequently, the number of admissions to general hospitals[1,2] and cardiology departments in particular decreased markedly.[3,4] Hence, a reduction in the number of cardiology services and procedures, especially elective cases, has been observed.[3,5,6] A marked decline in the majority of cardiac procedures performed at National Health Service (NHS) hospitals (in the UK) was obvious after the pandemic outbreak.[6] A similar trend was also observed in Poland.[7,8]

In the meantime, special attention was paid to minimizing hospitalization times of patients and shifting to minimally invasive procedures, although these were not always considered the method of choice.[9] This trend was observed in many prevalent cardiac diseases such as aortic valve diseases (AVDs), aortic stenosis (AS) and coronary artery disease (CAD) that can be potentially treated by either interventional cardiologists or cardiac surgeons. Patients with AS can be treated surgically with cardiopulmonary bypass (CPB) and surgical aortic valve replacement (SAVR), or by transcatheter aortic valve implantation (TAVI).[10]

Objectives

This study aimed to assess how the COVID-19 pandemic affected the clinical profiles, priority of treatments, form of applied therapeutic methods, and outcomes of patients with AVD, treated at a cardiac surgical center experienced in both SAVR and TAVI procedures.

Materials and methods

Patients

This retrospective study evaluated consecutive patients treated for significant AVD between January 1, 2019, and December 31, 2020, at the Department of Cardiac Surgery and Transplantology in Poznań, Poland. The groups were divided based on the year (2019 – before the coronavirus pandemic outbreak, compared to 2020 – after the outbreak) of admission, the method of treatment (SAVR compared to TAVI) performed, and the priority of the intervention (elective compared to nonelective – urgent/emergent). Medical charts were retrospectively reviewed and baseline data (Table 1,2) were collected and analyzed.

Therapeutic method

Patients were treated with SAVR (218 in 2019 and 168 in 2020) using a complete or upper partial median sternotomy and CPB with cardioplegic arrest. Some patients required additional procedures (see Table 1). Catheter-based methods included TAVI carried out through percutaneous puncture or surgical exposure of the femoral arteries (91 in 2019 and 134 in 2020) and balloon aortic valvuloplasty (BAV; 7 in 2019 and 8 in 2020).

Post-procedural data

Early morbidity and mortality as well as annual survival probability were taken into consideration. Early or in-hospital outcome analysis during the first 30 days after the procedures irrespective of place (hospital, rehabilitation center or home) was performed.

Data analysis

The normality of continuous variables was checked using the Shapiro–Wilk test. Data that met the criteria of normal distribution were shown as means with standard deviations (SDs). Non-normal data were presented using medians with interquartile ranges (IQRs: Q1–Q3). The Levene's test was used to assess the equality of variances between normally distributed data from 2019 and 2020. Student's t-tests were used to compare unpaired continuous variables. The other variables were compared using a nonparametric Mann–Whitney U test and a χ^2 test with or without Yates's correction. Statistical significance

Table 1. Additional invasive procedures among emergency and elective patients

Procedures	Emergency patients					Elective patients				
	2019	Percentage	2020	Percentage	χ^2 test	2019	Percentage	2020	Percentage	χ^2 test
Total number of urgent SAVR procedures	26	100%	43	100%	–	192	100%	125	100%	–
Graft of the aorta	3	11.54%	9	20.93%	p = 0.503	38	19.79%	14	11.20%	p = 0.044
CABG	7	26.92%	8	18.60%	p = 0.417	33	17.19%	17	13.60%	p = 0.392
MVR with/or TVR	2	7.69%	4	9.30%	p = 0.833	8	4.17%	8	6.40%	p = 0.375
Wrapping of the ascending aorta	2	7.69%	1	2.33%	p = 0.653	14	7.29%	8	6.40%	p = 0.760
SAVR isolated	7	26.92%	15	34.88%	p = 0.492	109	56.77%	72	57.60%	p = 0.884

SAVR – surgical aortic valve replacement; CABG – coronary artery bypass grafting; MVR – mitral valve replacement; TVR – tricuspid valve repair.

Table 2. General characteristics and comorbidities of emergency and elective patients in 2019 and 2020

Factors	Emergency patients			Elective patients		
	2019	2020	p-value	2019	2020	p-value
Number of patients	37	54	–	279	256	–
Age, median (IQR)	69 (27–87)	64 (19–82)	p = 0.074	71 (23–92)	71 (20–92)	p = 0.019
Gender W/M	16/21 43.2%/56.8%	9/45 16.7%/83.3%	p = 0.005	125/154 44.8%/55.2%	118/138 46.0%/54.0%	p = 0.765
BMI, mean ±SD	27.85 ±4.79	27.20 ±4.51	p = 0.545	28.25 ±4.65	28.45 ±4.91	p = 0.889
Time of hospitalization, median (IQR)	16.5 (13–28)	15 (10–22)	p = 0.173	SAVR: 14 (11–16) TAVI: 9 (7–10)	SAVR: 12 (10–14) TAVI: 7 (5–10)	SAVR: p = 0.002 TAVI: p = 0.006
Cardiovascular diseases						
Cardiovascular diseases	2019	2020	p-value	2019	2020	p-value
Heart failure	15	23	p = 0.900	104	143	p < 0.001
Myocardial infarction	0	4	–	1	1	p = 0.951
Post-myocardial infarction	2	8	p = 0.159	12	17	p = 0.232
Coronary artery disease	11	18	p = 0.717	60	86	p = 0.002
Aortic aneurysm	4	11	p = 0.227	42	25	p = 0.065
Hypertension	21	35	p = 0.438	176	190	p = 0.006
Atherosclerosis	3	7	p = 0.467	26	28	p = 0.535
Infective endocarditis	7	14	p = 0.436	6	3	p = 0.379
Hyperlipidemia	8	7	p = 0.274	68	56	p = 0.494
Stroke	0	4	–	2	13	p = 0.002
Post-stroke	1	7	p = 0.090	8	12	p = 0.268
Pacemaker	5	2	p = 0.085	9	14	p = 0.201
Other						
Other diseases	2019	2020	p-value	2019	2020	p-value
Diabetes mellitus	10	19	p = 0.412	59	72	p = 0.061
Chronic kidney disease	8	6	p = 0.172	16	19	p = 0.431
Hypothyroidism	8	1	p = 0.002	17	15	p = 0.909
Anemia	3	2	p = 0.365	6	5	p = 0.872
Thrombosis	0	1	–	1	1	p = 0.951
Pulmonary embolism	0	2	–	1	2	p = 0.513
Pulmonary diseases	1	8	p = 0.057	21	22	p = 0.650
Cancer	1	3	p = 0.094	13	7	p = 0.241
EuroSCORE, median (IQR)	1.66 (0.5–44.48)	3.66 (0.5–20.67)	p = 0.086	1.24 (0.61–14.41)	1.96 (0.5–84.83)	p < 0.001

W/M – women/men; IQR – interquartile range; BMI – body mass index; SD – standard deviation; SAVR – surgical aortic valve replacement; TAVI – transcatheter aortic valve implantation.

was defined as $p < 0.05$. The probability of survival was calculated using the Kaplan–Meier method and the differences between the groups were analyzed using a log-rank test. The analysis was performed with Statistica v. 13.3 (TIBCO Software Inc., Palo Alto, USA).

Results

The number of individuals with severe AVD treated invasively remained virtually unchanged between 2019 (n = 316) and 2020 (n = 310). A significant increase in the number of nonelective cases was observed (from 37 in 2019 to 54 in 2020).

Clinical characteristics and procedural details

Nonelective patients

The only difference in the preprocedural clinical presentation (2019 compared to 2020) was the age of the patients (Table 2). The most visible change in nonelective procedures was a marked increase (by 65%) in SAVR cases (26/43) which corresponded with an increase of roughly 10% overall (Fig. 1). The rate of concomitant procedures in the SAVR subset of patients was comparable between years (2019 compared to 2020). More detailed data are outlined in Table 1.

Elective patients

Similar to nonelective patients, there was a difference (2019 compared to 2020) in the age of elective patients (Table 2). In this group, a significant shift from SAVR being the dominant procedure in 2019 to a slight predominance of TAVI in 2020 occurred (Fig. 1). Moreover, some comorbidities such as CAD, arterial hypertension and history of stroke were significantly more common in 2020 (Table 2).

Post-procedural course and one-year probability of survival

Atrial fibrillation was the only early post-procedural adverse event that was found to be more prevalent in 2019 than in 2020 among AVD individuals admitted electively to our department. In the urgent/emergent group of patients, the rates of all in-hospital complications were comparable between the compared years.

A total of 22 patients died during the early post-procedural period. However, the overall mortality in patients undergoing procedures on the aortic valve was almost twice as high in 2020 (4.5%; 14/310) as compared to 2019 (2.5%; 8/316; p = 0.178). In the elective subgroups, in-hospital mortality was 2.2% (n = 6) in 2019 and 3.5% (n = 9) in 2020, whereas among urgently/emergently treated patients, it was 5.4% (n = 2) in 2019 and 5.6% (n = 5) in 2020.

The survival rate for all patients treated invasively for AS was comparable between 2019 and 2020 groups (p = 0.769). Three-month, 6-month and 1-year survival probabilities for patients in 2019 compared to 2020 were calculated using the Kaplan–Meier method and were found to be 95.2% (295 patients at risk) compared to 93.6% (265 patients at risk), 93.4% (273) compared to 90.5% (255), and 91.3% (266) compared to 88.3% (248), respectively. Statistically significant differences were observed among TAVI- and SAVR-treated patients during the consecutive years. In 2020, the annual survival rate was higher among TAVI patients and lower in SAVR patients compared to the survival rates in 2019 (Fig. 2).

Discussion

One of the most important findings of this study was a significant increase in the number of urgently/emergently admitted AVD individuals accompanied by a marked decline in elective admissions. Our observations were not consistent with previously published studies that indicated a reduction in the number of invasive interventions for cardiovascular diseases, irrespective of priority (elective/nonelective), by roughly 50% in the UK.[4–8] A reason for this discrepancy and the increase in the number of nonelective patients in our observational study was the conversion of a second cardiac surgery center in the area, with a similar volume of cases during previous years, into a facility dedicated to the treatment of COVID-19 patients in 2020.

Among elective patients, a significant decrease in the number of SAVR operations and an increase in TAVI procedures were observed. This tendency has been seen for many years.[11] In 2020, the numbers of SAVR and TAVI procedures were almost equal. The shift to less invasive procedures was associated with a decline in the length of hospitalization[12] and may be linked to reduced exposure to medical personnel.[13,14] For these reasons, the TAVI procedure could prove to be more effective during the pandemic.

In elective patients who received SAVR, men remained the prevalent group. Women underwent slightly more TAVI procedures and this tendency was seen in the following years. Besides the typical risk factors for AVD development such as arterial hypertension, hyperlipidemia and smoking (in many countries more prevalent in middle-aged men), women tended to underreport the manifestations of the disease[15] and/or avoid healthcare staff.[16] Moreover, some patients may have developed or aggravated their conditions because of a diagnosis of COVID-19 seen in their medical histories.[17–20]

No statistical differences in the baseline clinical status of patients were found between the compared years in the urgent/emergent group. However, one cannot exclude that this was probably due to the relatively low number of such patients (37 and 54 cases). In the urgent/emergent patients, 6 of them during 2020 only required the replacement

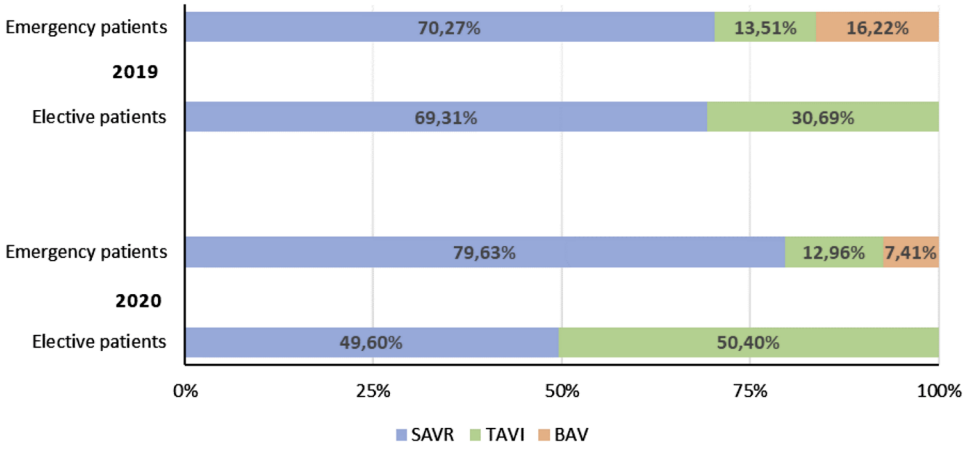

Fig. 1. The structure of procedures among elective and emergency patients in 2019 and 2020

SAVR – surgical aortic valve replacement; TAVI – transcatheter aortic valve implantation; BAV – balloon aortic valvuloplasty.

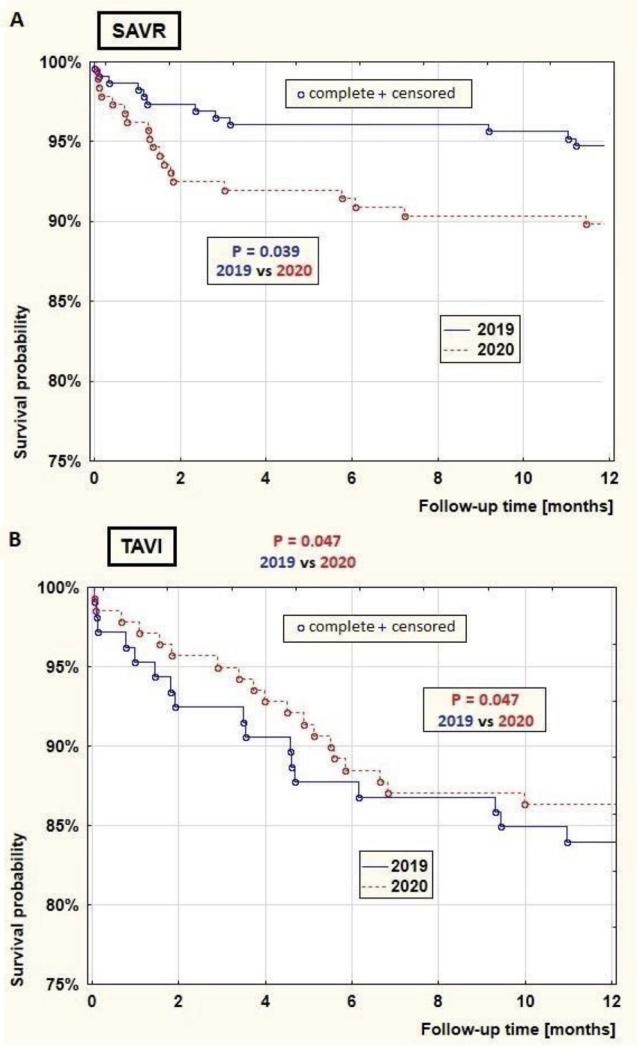

Fig. 2. Annual survival probability in transcatheter aortic valve implantation (TAVI) and surgical aortic valve replacement (SAVR) patients in 2019 and 2020

of a previously implanted aortic valve prosthesis (there were no such cases in 2019). These replacements were mainly due to secondary infective endocarditis and paravalvular leaks.

In our study, some interesting findings regarding the mortality rate were noted, e.g., improved survival after TAVI compared to a worse survival after SAVR procedures. Some research has indicated that the mortality rate of elderly patients after TAVI was similar to that of younger patients.[21] Other publications have shown the survival in elderly patients after TAVI to be similar to the survival in an age-matched general population.[22,23] In our study, we revealed that the experience of our team resulted in a very good survival rate.

Limitations

We are aware of some limitations of our study. First of all, it was a retrospective analysis and the nonelective subgroups were relatively small. Despite the aforementioned facts, some findings were of clinical significance.

Conclusions

Despite the fact that during COVID-19 pandemic more nonelective and high-risk AVD individuals received the interventional treatment, the outcomes were comparable to the pre-pandemic era (2019). Our findings support the value of less invasive therapeutic methods for aortic pathologies during the pandemic.

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