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Aborted sternotomy in the modern era of transcatheter aortic valve replacement

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SOUHRN

Úvod: U některých pacientů se symptomatickou aortální stenózou se provádí sternotomie, která se někdy nedokončí, pokud se během výkonu nečekaně zjistí přítomnost těžké kalcifikace aorty. Cílem této studie je popsat naše zkušenosti a analyzovat příčiny postižení, jeho léčbu i výsledky našich pacientů.
Metody: Naše studie byla retrospektivní. V době od ledna 2010 do prosince 2017 jsme provedli kardiochirurgický výkon u 10 565 jedinců; z tohoto počtu nebyla sternotomie dokončena u 27 pacientů (0,3 %), z nichž sedm mělo těžkou aortální stenózu. Důvodem pro nedokončení výkonu byla během výkonu nečekaně zjištěná těžká kalcifikace vzestupné aorty, která znemožnila cross-clamping aorty. Po nedokončené sternotomii byla na základě rozhodnutí kardiologického týmu u dvou pacientů zahájena konzervativní léčba a u pěti pacientů byla provedena katetrizační náhrada aortální chlopně. Průměrná a střední délka sledování byla 33 ± 20, resp. 39 (0–54) měsíců.
Výsledky: Průměrná a střední doba mezi nedokončenou sternotomií a další intervencí byla 2,6 ± 1,4, resp. 2 (1–5) měsíce; v tomto období nedošlo k žádnému úmrtí. Během dlouhodobého sledování zemřeli celkem čtyři ze sedmi pacientů (57,14 %); jednalo se o oba pacienty (100 %) s indikací ke konzervativní léčbě a o dva z pěti pacientů (40 %) s indikací ke katetrizační náhradě aortální chlopně.
Výsledky: Nedokončená sternotomie byla spojena s vyšší nemocniční i dlouhodobou mortalitou. Přes poměrně vyšší dlouhodobou mortalitu měla katetrizační náhrada aortální chlopně příznivější vliv na přežití ve srovnání s pacienty s indikací pouze ke konzervativní léčbě. Preventivní strategii u těchto vysoce rizikových pacientů by mohlo představovat provedení předoperačního vyšetření hrudníku výpočetní tomografií.

Keywords:
Aborted sternotomy
Porcelain aorta
Transcatheter aortic valve replacement

ABSTRACT

Introduction: Some patients with symptomatic aortic stenosis undergo sternotomy and have the operation aborted because of intraoperative discovery of unexpected severe calcification of the aorta. The aim of this study is to present our experience and analyze the causes, the management, and the outcomes of these patients.
Methods: This is a retrospective study. Between January 2010 and December 2017 10565 patients underwent cardiac surgery, 27 patients (0.3%) had aborted sternotomy, of whom seven patients with severe aortic stenosis. The reason was unexpected intraoperative discovery of severe calcified ascending aorta that precluded placing of an aortic cross-clamp. Following the aborted sternotomy, based on the heart team's decision, 2 patients were referred for conservative treatment, 5 patients underwent transcatheter aortic valve replacement. The mean and median follow-up times were 33 ± 20 and 39 (0–54) months respectively.
Results: Mean and median time between the aborted sternotomy and the next intervention were 2.6 ± 1.4 and 2 (1–5) months respectively with no mortality within this period.
The total long-term mortality was 4/7 patients (57.14%). Both patients (100%) who were referred for conservative treatment, as well as two of the five patients (40%) that had undergone TAVR, died during follow-up.
Conclusions: Aborted sternotomy had higher hospital and long-term mortality. Transcatheter aortic valve replacement, despite the relative high long-term mortality, had a better effect on the survival compared to the patients who were offered only conservative treatment. A preventive strategy in these high risk patients might be based on routine preoperative chest computer tomography imaging.

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Introduction

Surgical aortic valve replacement (SAVR) remains the choice for symptomatic aortic stenosis (AS), and some patients undergo sternotomy and have the operation aborted because of intraoperative discovery of unexpected severe calcification of the aorta. The calcified aorta is difficult to manage and studies have reported significant risks of stroke and mortality in these patients.[1]

Transcatheter aortic valve replacement (TAVR) and transcatheter valve technology represent a new alternative for intermediate and high risk patients.[2] Some authors have suggested that TAVR may be the preferred therapy and offers clampless treatment options for patients with AS and an extensive calcification of the ascending aorta or porcelain aorta.[3,4]

The aim of this study is to present our institutional experience and analyze the causes, the management, and the outcomes of the unexpected need to abort sternotomy in patients with symptomatic AS accepted for SAVR in the modern era of TAVR.

Patients and methods

Patients

This is a retrospective descriptive study. From January 2010, since when there is a national registry in cardiac surgery, until December 2017 10565 cardiac operations were performed in our institute. Twenty-seven patients (0.3%) had aborted sternotomy, of whom seven patients with severe AS. Three patients were indicated for SAVR and four patients were indicated for SAVR + coronary artery bypass grafting (CABG). The reason for the aborted sternotomy in these patients was unexpected intraoperative discovery of severe calcified ascending aorta that precluded placing of an aortic cross-clamp. For the rest of the patients the reason for aborted sternotomy was unexpected intraoperative discovery of severe calcified coronary arteries non-amenable for bypass grafting. Following the aborted sternotomy, based on the heart team's decision, 2 patients were referred for conservative treatment, 4 patients underwent TAVR and 1 patient combined TAVR + percutaneous coronary intervention (PCI). The mean and median follow-up times were 33 ± 20 and 39 (0–54) months respectively. The study was formally approved by the institutional review board and the patient informed consent was obtained to present it.

Statistical analysis

All variables were expressed as mean +/– standard deviation, median, and qualitative variables as numbers and percentages.

Results

The pre-procedural characteristics of the patients are presented in Table 1. Two patients were referred for conservative treatment (indicated for SAVR + CABG), four patients underwent transapical transcatheter aortic valve replacement (TA-TAVR) due to unsuitable anatomy for transfemoral transcatheter aortic valve replacement (TF--TAVR) and finally 1 patient had TF-TAVR. One of the patients had combined TA-TAVI + PCI.

Mean and median time between the aborted sternotomy and the next intervention were 2.6 ± 1.4 and 2 (1–5) months respectively with no mortality within this period.

One patient who was referred for conservative treatment died during hospitalization as a result of acute heart failure, and 3 patients died during follow-up. The total long-term mortality was 4/7 patients (57.14%). Both pa-

Table 1 – Pre-procedural characteristics of the patients

Variable	All, n = 7	Conservative treatment, n = 2	TAVR treatment, n = 5
Age, years (mean ± SD)	74 ± 4.77	78 ± 6	72.8 ± 2.93
Male – female	4/3	0/2	4/1
EuroSCORE II (mean ± SD)	6.5 ± 4.82	6.4 ± 0.68	6.54 ± 5.69
STS score (mean ± SD)	2.74 ± 2.03	3.84 ± 0.99	2.30 ± 2.19
Hypertension	6	2	4
Hyperlipidemia	6	2	4
Diabetes mellitus	2	1	1
Peripheral vascular disease	4	2	2
Stroke	4	2	2
COPD	1	0	1
Atrial fibrillation	1 permanent AF	0	1 permanent AF
Myocardial infarction in the past	0	0	0
Percutaneous intervention in the past	0	0	0
Aortic valve disease – severe AS	7	2	5
Coronary artery disease	4	2	2

AF – atrial fibrillation; AS – aortic stenosis, COPD – chronic obstructive pulmonary disease; SD – standard deviation; TAVR – transcatheter aortic valve replacement.

Table 2 – Hospital and long-term mortality

Variable	Number of patients	Procedure
Hospital mortality	Conservative treatment 1/2 pt	
	TAVR 0/5 pt	
Long-term mortality	Conservative treatment 2/2 pt	
	TAVR 2/3	1 pt after TA-TAVR, 1 pt after TF-TAVR

pt – patient; TA-TAVR – transapical transcatheter aortic valve replacement; TF-TAVR – transfemoral transcatheter aortic valve replacement.

tients (100%) who were referred for conservative treatment, as well as two from the five patients (40%) that had undergone TAVR, died during follow-up.

The hospital and long-term mortality are shown in Table 2.

The mean and median follow-up times from aborted sternotomy to death were 40.75 ± 25.4 and 47.5 (0–68) months respectively

The long-term mortality according to the initially indicated operation and the treatment after the aborted sternotomy is shown in Table 3.

Discussion

Some patients with symptomatic AS undergo sternotomy and have the operation aborted because of intraoperative discovery of unexpected severe calcification of the aorta and the aorta that precluded aortic cross-clamping. Transcatheter interventions offer non-surgical treatment options in these patients.

The conventional approach for treatment of severe aortic stenosis is SAVR, but the procedure can be technically challenging when the aorta is severely calcified with an increased risk of stroke and mortality up to 14%.[5] Hypothermic circulatory arrest and transcatheter aortic valve replacement offer clampless treatment options in these patients. Salem et al.[6] reported that initial replacement of incidental calcified ascending aorta using moderate hypothermic circulatory arrest was not associated with increased risk of neurologic events and mortality. Similar results are reported also by Kaneko et al.[7] in patients under 80 years old. Older patients in their series had increased mortality and the authors recommended TAVR.

In our study 7 patients were indicated for SAVR due to severe aortic stenosis. After the decision of the heart team 5 of them were referred for TAVR and 2 patients were offered conservative treatment. In our opinion, conventional AVR with moderate hypothermic arrest in this group of complex patients increases mortality risk, so we chose to perform TAVR which is a less invasive procedure, with 100% success rate. The choice of delivery for TAVR was based on iliofemoral vessel anatomy. The transfemoral approach was preferred when the anatomy was suitable, otherwise alternative approaches were used like the transapical approach. Moreover, a multicenter registry also suggested that sutureless valves, which reduces the on-pump time and probably simplifies the procedure, may be an effective tool in the special scenario of the porcelain aorta. Nevertheless, the unavoidable manipulation of the ascending aorta is associated with the same risks as the conventional surgery in cases of porcelain aorta.[8]

Similar strategy like ours is reported by Castrodeza et al.[9] and Idress et al.[10] with hospital death of 9.7%, six-month mortality of 22.6% and 4 late deaths in the TAVR group (12 patients) respectively. No hospital mortality and 2 late deaths in the TAVR group were reported in our study.

The main reason for aborted sternotomy in our study, as also reported by other authors,[9] was severely calcified ascending aorta. This entity was associated to a higher rate of hospital and long-term mortality, especially in the older patients. Other factors, except the aborted sternotomy, such as patients-related factors, procedure-related factors or comorbidities may play a role in the increased mortality.

Comparing the hospital and long-term mortality between the conservative and the TAVR treatment groups, despite the low number of patients in both, it was lower in the percutaneous treatment group.

It may be concluded that TAVR in the group of patients with severe aortic stenosis, despite the relative high long-term mortality, had better effect on the survival compared to the patients who were offered only conservative treatment.

A preventive strategy in these high risk patients might be based on imaging evaluation, and preoperative chest computer tomography imaging has a central role.[11–13] In the recent years we have changed our practice and all patients above 70 years old have a routine preoperative chest computed tomography for evaluation of the aorta

This study has few limitations. It is a retrospective, single center study. All the data were collected from the national registry and the archives of our clinic, and some data may not be accurate. Moreover, due to the limited number of patients, the study may not have enough sta-

Table 3 – Long-term mortality according to the initially indicated operation and the treatment after the aborted sternotomy

Indicated operation	Number of patients	Treatment	Mortality
AVR	3	0 pts conservative, 2 pts TA-TAVR, 1 pt TF-TAVR	2/3
CABG + AVR	4	2 pts conservative, 1 ptTA-TAVR, 1 pt TA-TAVR + PCI	2/2 0/2

AVR – aortic valve replacement; CABG – coronary artery bypass grafting; PCI – percutaneous coronary intervention; pt – patient; TA-TAVR – transapical transcatheter aortic valve replacement; TF-TAVR – transfemoral transcatheter aortic valve replacement.

tistical power to show the differences in the mortality between the two groups of patients.

In conclusion, in this retrospective study, some patients with symptomatic AS following the aborted sternotomy after the decision of the heart team were offered only conservative treatment. However, as we live in the modern era of transcatheter technology techniques, no patient should be denied TAVR, which is the preferred method for inoperable or high risk patients in the modern era.[2,14] A preventive strategy to avoid the aborted sternotomy might based on routine preoperative imaging of all high risk patients.

Conflict of interest
The authors declare no conflict of interest.

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