Emergency TAVI: expanding indication and concern of delayed treatment of aortic stenosis

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In 2002, Cribier and colleagues performed the first-in-human transcatheter aortic valve implantation (TAVI) in a 57-year-old critically ill patient presenting with cardiogenic shock due to severe aortic stenosis (AS) who had failed balloon valvuloplasty[1]. The intervention was successful with restoration of stable hemodynamics ushering in a new era in the management of patients with severe AS. Over the subsequent two decades, a series of carefully conducted randomized control trials demonstrated that TAVI resulted in similar or better clinical outcomes compared with surgical aortic valve replacement (SAVR). Owing to continuous device iterations and improved implantation technique, TAVI has matured the standard of care for the treatment of patients with severe, symptomatic AS and assumes a Class I indication in elderly patients (>65 years of age in ACC/AHA VHD guidelines; >75 years of age in ESC/EACTS guidelines) across the spectrum of surgical risk[2,3]. Of note, the evidence underlying current guideline recommendations was gathered in well-selected patients undergoing TAVI under elective conditions with strict exclusion of critically ill patients from the randomized clinical trials.

However, patients with severe AS do not infrequently present under non-elective conditions with acute decompensated heart failure or even cardiogenic shock, signifying a critical clinical status associated with poor short-term prognosis in the absence of durable aortic valve intervention. Although SAVR has been considered in these patients, the surgical approach in emergent and/or acute settings has been associated with an increased risk of perioperative mortality[4] and refusal by surgeons to routinely accept these patients. Percutaneous balloon aortic valvuloplasty has been proposed as another therapeutic option for patients with acute decompensated AS and has been used as a “bridge” to AVR.

However, the intervention is associated with similar procedural risks as TAVI, results in inferior acute hemodynamic improvement, does not provide a reproducible and durable outcome and is associated with poor long-term outcome[5].

Against this background, emergent/urgent TAVI has gained interest as a viable therapeutic option among patients with acute decompensated heart failure or cardiogenic shock. In a retrospective study including 711 TAVI patients, Frerker and colleagues compared clinical outcomes of elective versus emergency TAVI in patients with cardiogenic shock due to decompensated AS. Emergency TAVI was performed in 27 (3.5%) patients and was associated with increased 30-day and 1-year mortality as compared with elective TAVI (33.3% vs. 7.7% and 40.7% vs. 17.3%, respectively). Of note, a landmark analysis set at 30 days of follow-up showed no further difference in survival between emergent and elective TAVI interventions during longer-term follow-up[6]. The large-scale Society of Thoracic Surgeons and the American College of Cardiology Transcatheter Valve Therapy (STS/ACC TVT) registry in 40,042 patients undergoing TAVI investigated outcomes of patients undergoing urgent/emergency TAVI (9.9% of the entire population). Although device success was similar to elective TAVI (92.6% vs. 93.7%), mortality rates at 30-day and 1-year follow-up were increased (8.7% vs. 4.3% and 29.1% vs. 17.5%, respectively) among patients in the urgent/emergency TAVI group[7]. It should be noted that previous studies adopted non-uniform definitions for emergency TAVI with notable differences in patient populations and, therefore, should be interpreted cautiously. Indeed, the prevalence of urgent/emergency TAVI varies widely between studies (3.5%-24%)[6-8]. Notwithstanding, results have been consistent indicating technical

feasibility but increased risk of short-term mortality. (**Table**).

In this issue of *Eur Heart J Acute Cardiovasc Care*, Steffen and colleagues report data from a single-center retrospective study, which evaluated procedural and clinical outcomes in critically ill patients undergoing emergency TAVI[9]. The study population comprised 2,930 patients who underwent TAVI during a time frame of 7 years (between 2013 and 2019). Patients were deemed critically ill if intensive care therapy for the management of acute heart failure due to severe AS and emergency TAVI were required. The authors categorized critically ill patients into those with cardiogenic shock or those without cardiogenic shock according to the definition of the 2020 ESC position statement on cardiogenic shock and the CULPRIT-SHOCK trial[10,11]. A total of 179 (6.1%) patients were critically ill and underwent emergency TAVI; out of this population, 47 (1.6%) fulfilled the criteria for cardiogenic shock, and 132 (4.5%) patients did not have shock despite acute decompensation. At 90 days of follow-up after TAVI, all-cause mortality was higher among critically ill patients as compared with patients undergoing elective TAVI for both the shock group (HR 10.0 [95% CI 6.3-15.9]) and the group of patients without shock, respectively (HR 3.2 [95% CI 2.0-5.1]). Moreover, mortality was higher among critically ill patients with cardiogenic shock as compared to those without shock (42.6% vs. 15.9%). A landmark analysis revealed that the adverse impact associated with the critically ill clinical status was limited to the first 90 days after TAVI with no significant differences between groups during the time period between 90 days and 2 years of follow-up (mortality from 90-day to 2-year; 25.9% in shock group vs. 23.6% in no shock group vs. 18.7% in elective group; P = 0.29). In terms of symptom status, there were also no significant

differences in NYHA class among patients surviving the first 90 days after the procedure. In line with previous studies, the current data suggest that patients with severe aortic stenosis who are critically ill due to acute decompensation or cardiogenic shock have impaired short-term prognosis compared with patients undergoing elective TAVI but similar long-term outcomes among 90-day survivors.

The authors assessed the rate of technical success according to the Valve Academic Research Consortium-3 and observed technical failure more frequently in patients undergoing emergency TAVI compared to elective TAVI, mainly due to vascular complications. The emergent clinical setting may not allow for detailed pre-procedural imaging assessment in all cases, which has become a standard and important prerequisite for optimizing procedural success rendering patients without imaging work-up more susceptible for adverse procedural events. Given that technical failure importantly affects clinical outcomes, emergency TAVI should be performed by highly-experienced operators[12]. Additional findings of the study include the various medical conditions that aggravate or trigger deterioration of patients with severe AS towards a critically ill status, including notably acute coronary syndromes, arrhythmias, infection and bleeding. This observation should be kept in mind during the evaluation of patients with severe AS who commonly have several comorbidities and may quickly deteriorate during the work-up.

It should be noted that the present study only included patients undergoing TAVI, and therefore the findings do not apply to other treatment strategies. The number of patients who underwent SAVR or were not referred to AVR during the observation period was not

available due to the retrospective nature of study. Although AVR volumes have rapidly grown over the past 20 years with the advent of TAVI, a considerable proportion of patients with symptomatic, severe AS are not referred or do not receive AVR despite Class I guideline recommendations[13]. Inappropriately treated patients and/or those allocated to a watchful-waiting strategy in the setting of severe AS may lead to a complicated clinical course. Indeed, more than 60% of emergency admissions for acute decompensated heart failure due to severe AS have been observed in patients with known AS who were managed by a watchful waiting strategy[14]. These findings emphasize the need to identify symptomatic patients earlier, shorten the diagnostic decision pathway, avoid undertreatment of patients with severe symptomatic AS and provide timely access and referral to Heart Valve Centers.

In summary, emergency TAVI is feasible and life-saving in critically ill patients with acute decompensated heart failure and/or cardiogenic shock due to severe AS and is associated with favorable long-term survival and clinical symptom status among 90-day survivors. Efforts should aim to reduce the proportion of undertreated patients with AS and ensure timely diagnosis and therapeutic decision-making to address avoidable adverse events of a treatable lesion with a poor prognosis if left untreated.

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1 **Table.** Summary of observational studies comparing urgent/emergency versus elective

Study Author (year)	Number of emergency TAVI (% of entire population)	Definition of emergency TAVI	Age	STS-PROM	Follow-up	All-cause mortality
Landes et al. (2016)	27 (6.6%)	Acute decompensated heart failure secondary to severe AS; decompensation persisted despite medical therapy and did not allow ambulation; TAVI was performed in the same hospital stay; AND the index admission occurred before the TAVI assessment process began or was completed.	80 ± 9	9.7 ± 6.1	30-day	3.7% vs. 4.3% vs. 3.8%; P = 0.8 (urgent vs. semi-elective vs. elective)
Freker et al. (2016)	27 (3.5%)	Systolic blood pressure of less than 90 mmHg for more than 30 minutes or needed infusion of catecholamines to maintain a systolic pressure above 90 mmHg; clinical signs of pulmonary	78 ± 9	60.4 ± 6.1 (Logistic EuroSCORE)	30-day	33.3% vs. 7.1%; P <0.0001 (emergency vs. elective)

		congestion; AND impaired end-organ perfusion.			1-year	40.7% vs. 17.3%; P = 0.0009 (emergency vs. elective)
STS/ACC TVT Kolte et al. (2018)	3,952 (9.9%; Urgent 9.7% and emergency 0.2%)	Urgent: procedure required during same hospitalization in order to minimize chance of further clinical deterioration. Emergency: Intervention in which there should be no delay.	84 (78, 88)	11.8 (7.6, 17.9)	30-day	8.7% vs. 4.3%; P <0.001 (emergency/urgent vs. elective)
					1-year	29.1% vs. 17.5%; P =0.001 (emergency/urgent vs. elective)
Elbadawi et al. (2018)	10,114 (24%)	TAVI requiring during same hospitalization.	81 ± 9	NA	In-hospital	5.6% vs. 4.4%; P <0.001 (urgent vs. nonurgent)
OCEAN-TAVI Enta et. Al (2020)	87 (5.4%)	Patients who required unplanned hospitalisation and TAVI during the same hospitalization.	84 ± 7	13.7 (8.2, 21.0)	30-day	9.2% vs. 1.3%; P <0.0001 (emergent vs. elective)
					1-year	29.3% vs. 10.4%; P <0.0001 (emergent vs. elective)
STS/ACC TVT Masha et al. (2020)	2,200 (4.1%)	Inotrope use within 24 h before TAVI; pre-procedural cardiac arrest; pre-procedural use of mechanical circulatory support; OR cardiopulmonary bypass.	83 (77, 87)	9.8 (6.0 16.5)	30-day	$HR_{adjusted}$ 3.73 (3.11-3.48)
					1-year	$HR_{adjusted}$ 1.83 (1.61-2.07)

AS = aortic stenosis; HR = hazard ratio; STS-PROM = Society of Thoracic Surgeons Predicted Risk of Mortality; TAVI = transcatheter aortic valve implantation.

TAVI.