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the SUGAR trial. *Eur Heart J* 2021. Published online November 4. doi:10.1093/eurheartj/ehab790. Accessed on 31/08/2021.
8. Carrié D, Berland J, Verheye S, Hauptmann KE, Vrolix M, Musto C, Berti S, Dibié A, Maupas E, Antoniucci D, Schofer J. Five-year clinical outcome of multicenter randomized trial comparing amphilimus - with paclitaxel-eluting stents in de novo native coronary artery lesions. *Int J Cardiol* 2020;301:50–55.
9. Romaguera R, Gómez-Hospital JA, Gomez-Lara J, Brugaletta S, Pinar E, Jiménez-Quevedo P, Gracida M, Roura G, Ferreiro JL, Teruel L, Montanya E, Fernandez-Ortiz A, Alfonso F, Valgimigli M, Sabate M, Cequier A. A randomized comparison of reservoir-based polymer-free amphilimus-eluting stents versus everolimus-eluting stents with durable polymer in patients with diabetes mellitus: the RESERVOIR clinical trial. *JACC Cardiovasc Interv* 2016;9:42–50.

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Divergent Effects of COVID-19 Pandemic on Reported Adverse Events for Percutaneous Aortic Valve Prostheses and Non−Allograft Tissue Valves

Cardiologists have adapted their practices significantly to address COVID-19 concerns. We sought to determine how the COVID-19 pandemic impacted heart valve replacement procedures, specifically examining the weekly reported rates of adverse events attributed to percutaneous aortic valve prostheses and non−allograft tissue heart valves. Using data from the Food and Drug Administration (FDA) Manufacturer and User Facility Device Experience (MAUDE) database, we compared weekly adverse event reports during the year immediately preceding the pandemic (March 2019 to March 2020) to those during the first year of the pandemic (March 2020 to March 2021). We find a 107.4% increase in reported deaths and a 45.1% increase in reported malfunctions attributed to percutaneous aortic valve prostheses during the pandemic compared with before the pandemic. In contrast, we find a 27.4% decrease in reported injuries attributed to non−allograft tissue heart valves during the pandemic compared with before the pandemic. The dramatic increase in reported deaths and malfunctions attributed to percutaneous aortic valve prostheses, concurrent with the significant decrease in reported injuries attributed to non−allograft tissue heart valves, may reflect shifts in care patterns and clinical decisions during the COVID-19 pandemic.

We have recently reported that the COVID-19 pandemic was associated with a significant 46% decrease in weekly reported deaths attributed to implantable cardioverter defibrillators (ICDs), and a significant 27% decrease in weekly reported injuries attributed to coronary drug-eluting stents.[1] Building on this previous work, this report assesses the impact of the COVID-19 pandemic on weekly reports of adverse events attributed to 2 heart valve replacement techniques: percutaneous aortic valve prostheses and non−allograft tissue heart valves. We used the FDA MAUDE database, which lists reports from manufacturers, distributors, clinicians, and other voluntary reporters and is publicly accessible.[2] We filtered the MAUDE data by device and adverse event type, examining "malfunction," "injury," and "death" reports with the filter "Aortic Valve, Prosthesis, Percutaneously Delivered" for percutaneous aortic valve prostheses, and the filter "Heart-Valve, Non Allograft Tissue" for non−allograft tissue heart valves. Since the World Health Organization officially declared COVID-19 a pandemic on March 11, 2020,[3] we chose to record the number of reports given each week over 3 years: March 2018 to March 2019, March 2019 to March 20, and March 2020 to March 2021. For clarity, March 2020 to March 2021 will be herein called "pandemic data" or 2020 to 2021, March 2019 to March 2020 will be called "pre-pandemic data" or 2019 to 2020, and March 2018 to March 2019 will be called 2018 to 2019. We performed paired *t* tests for the differences between weekly reported adverse event types for each event type.

In comparing the data from 2019 to 2020 to the data from 2020 to 2021, we found that there were, on average, 7.3 more weekly reports of percutaneous aortic valve prosthesis-attributed deaths during the pandemic than there were pre-pandemic, an increase of 107.4% ($p < 0.0005$) (Figure 1). To determine whether this trend was isolated, we also compared the weekly reports of percutaneous aortic valve prosthesis-attributed deaths for 2018 to 2019 to the data for 2019 to 2020. In this case, we found a decrease in the average number of weekly reported percutaneous aortic valve prosthesis-attributed deaths

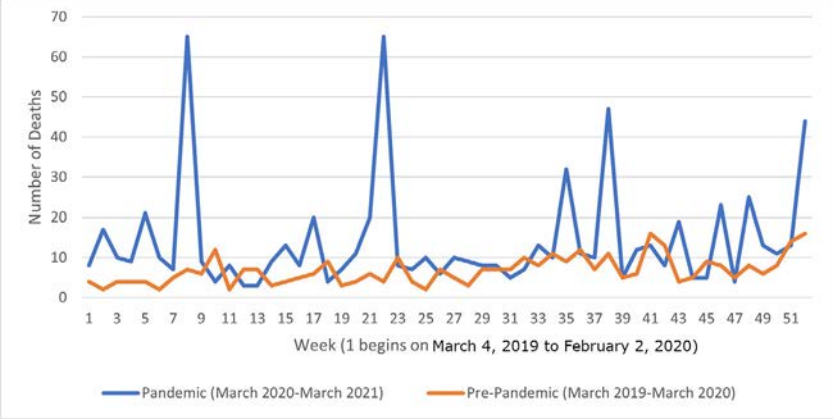

Figure 1. Weekly number of reported deaths attributed to percutaneous aortic valve prostheses in the FDA MAUDE database.

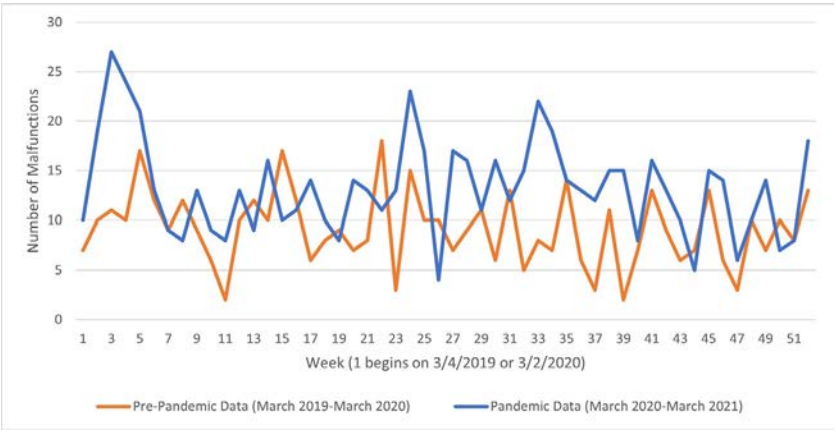

Figure 2. Weekly number of reported malfunctions attributed to percutaneous aortic valve prostheses in the FDA MAUDE database.

by ~1.6 weekly reports between 2018 and 2019 and 2019 to 2020; however, the difference did not achieve the same level of significance (mean difference [2019 minus 2018] ≈ 1.6 reports, p ≈ 0.02).

Concerning malfunctions attributed to percutaneous aortic valve prostheses, we found a significant increase in weekly reports of percutaneous aortic valve prosthesis-attributed malfunctions during the pandemic. Specifically, we found there were, on average, 4.1 more weekly reports of percutaneous aortic valve prosthesis-attributed malfunctions during the pandemic than there were pre-pandemic, an increase of 45.1% (p <0.0001) (Figure 2). In comparing 2018 to 2019 data to 2019 to 2020 data, we found no significant change in the weekly reports of percutaneous aortic valve prosthesis-attributed malfunctions (mean difference [2019 minus 2018] ≈ −0.3 reports, p ≈ 0.73). We additionally examined the number of weekly reports for percutaneous aortic valve prosthesis-attributed injuries; there was an increase in weekly reports of percutaneous aortic valve prosthesis-attributed injuries during the pandemic (mean difference [pandemic minus year preceding pandemic] ≈ 15.0 reports, p ≈ 0.003), although the difference did not achieve the same level of significance as that for deaths or malfunctions.

To investigate possible pandemic impacts on other methods for valve replacement, we chose to examine non−allograft tissue heart valves. We found that there were, on average, 9.0 fewer weekly reported injuries attributed to non−allograft tissue heart valves during the pandemic than there were pre-pandemic, a decrease of 27.4% (p = 0.0003) (Figure 3). The comparison between 2018 to 2019 data and 2019 to 2020 data showed an increase by 5.4 reports weekly, but this difference did not achieve the same level of significance (p = 0.0067). We also examined non−allograft tissue heart valve-attributed malfunctions and deaths, but we found no significant differences (non−allograft tissue heart valve malfunctions: mean difference [pandemic minus pre-pandemic] ≈ 1.1 reports, p ≈ 0.03; non−allograft tissue heart valve deaths: mean difference [pandemic minus pre-pandemic] ≈ −0.8 reports, p ≈ 0.02).

Using data from the FDA MAUDE database, we found that the weekly adverse event reports for 2 heart valve replacement procedures significantly diverged during the pandemic, with reports of percutaneous aortic valve prosthesis-attributed malfunctions and deaths dramatically rising, whereas reports of non−allograft tissue heart valve injuries dropped. In our previous work on ICDs and stents,[1] we speculated that underreporting might be a possible explanation for decreases in adverse event reports for ICDs and

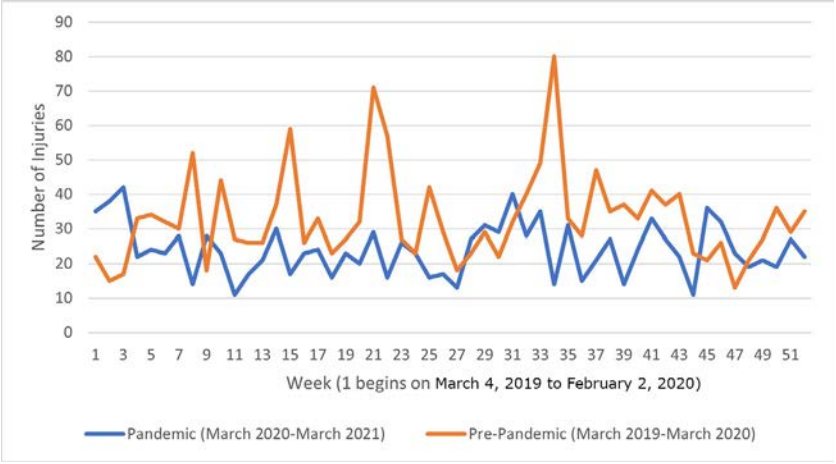

Figure 3. Weekly number of reported injuries attributed to non−allograft tissue heart valves in the FDA MAUDE database.

stents during the pandemic. However, underreporting would not explain the increase in adverse event reports for percutaneous aortic valve prostheses in the current study. Rather, these results may be explained by shifts in care patterns during the pandemic, specifically a shift from surgical aortic valve replacement (sAVR) to transcatheter aortic valve replacement (TAVR). TAVR is associated with shorter hospital stays than sAVR, so that TAVR patients are subjected to a lower risk of contracting COVID-19 during their hospital stay.[4] Moreover, TAVR typically requires no ventilation or critical care capacity, in contrast to sAVR. These factors may have prompted physicians to choose TAVR instead of sAVR for patients with severe aortic stenosis during the COVID-19 pandemic.[5] However, whereas some clinical data support the use of TAVR in low-risk patient groups, the data are not complete, and questions remain regarding TAVR valve durability, paravalvular leak, and the need for permanent pacing after TAVR.[6] A shift to TAVR during the pandemic could therefore have led to an increase in reported adverse events for percutaneous aortic valve prostheses with a concomitant decrease in reported adverse events for non−allograft tissue heart valves.

Pandemic-related treatment delays may be an additional factor causing an increase in adverse event reports for percutaneous aortic valve prostheses. Delays in intervention for severe aortic stenosis lead to poorer outcomes; the risk of TAVR increases as the disease advances, making the procedure more challenging if patients wait longer.[6] In a recent study of 71 patients with severe aortic stenosis during the COVID-19 pandemic, patients with deferred TAVR were more commonly hospitalized for worsening heart failure than patients with expedited TAVR.[7] Overall, delayed treatment may have combined with shifts from sAVR to TAVR, resulting in increased adverse events for percutaneous aortic valve prostheses, and decreased adverse events for non−allograft tissue heart valves during the pandemic. Future research must evaluate the long-term impact of pandemic-related changes in clinical decision-making for heart valve replacement.

Disclosures

The authors have no conflicts of interest to declare.

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1. Zhou ES, Bhatia SK. Decrease in reported rates of cardiovascular device-related adverse events during the coronavirus disease 2019 pandemic. *Am J Cardiol* 2021;163:140–142.
2. Food and Drug Administration, MAUDE - Manufacturer and User Facility Device Experience. Available at: https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfMAUDE/Search.cfm?smc=1. Accessed on September 27, 2021.
3. Cucinotta D, Vanelli M. WHO declares COVID-19 a pandemic. *Acta Biomed* 2020;91:157–160.
4. Ahamed J. Severe aortic stenosis patient risk during the COVID-19 pandemic. *Open Heart* 2020;7:e001355.
5. Basman C, Kliger CA, Pirelli L, Scheinerman SJ. Management of elective aortic valve replacement over the long term in the era of COVID-19. *Eur J Cardiothorac Surg* 2020;57:1029–1031.
6. Khialani B, MacCarthy P. Transcatheter management of severe aortic stenosis during the COVID-19 pandemic. *Heart* 2020;106:1183–1190.
7. Ryffel C, Lanz J, Corpataux N, Reusser N, Stortecky S, Windecker S, Pilgrim T. Mortality, stroke, and hospitalization associated with deferred vs expedited aortic valve replacement in patients referred for symptomatic severe aortic stenosis during the COVID-19 pandemic. *JAMA Netw Open* 2020;3:e2020402.

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Acute Kidney Recovery Following Transcatheter Aortic Valve Implantation: A Matter of Definition?

Acute kidney injury (AKI) represents a common complication after aortic valve implantation whose predictors and negative impact on long-term outcomes are well established. Recently, the concept of acute kidney recovery (AKR) after transcatheter aortic valve implantation (TAVI) was proposed. Such a phenomenon is based on the theoretical improvement of renal function following the increase of cardiac output after aortic valve implantation leading to increased renal perfusion and reduced glomerular venous congestion.[1,2] However, to date, there is no univocal definition, and the available data on clinical predictors and outcomes at the follow-up are conflicting.[3] Extravalvular cardiac damage (EVCD) has been described in patients with severe aortic stenosis, showing a significant impact on outcomes after TAVI and particularly on renal function, leading to higher rates of AKI. However, the impact of such a condition on the long-term clinical outcomes is limited to patients showing advanced stages of cardiac damage.[1]

We conducted a retrospective, observational analysis, aiming to compare the 2 most accredited AKR definitions, analyzing their clinical predictors and the long-term clinical outcomes after TAVI. Between March 2010 and August 2020, 786 patients underwent TAVI for symptomatic severe aortic stenosis at the University Hospital of Verona, Verona, Italy. Patients with the inability to receive preventive hydration, according to the baseline risk of AKI, on dialysis, or with glomerular filtration rate (GFR) <10 ml/min before admission were excluded. The resulting study population included 706 patients.

The definitions of AKR used in the study were the following: (1) AKR_1 was defined as an increase of GFR of 25% at discharge compared with baseline GFR, as proposed in a previous large analysis by the Northern New England Cardiovascular Disease Study Group[4]; (2) AKR2 mirroring AKI definition, either as an increase of GFR of 25% compared with baseline or a decrease in serum creatinine of at least 0.3 mg/100 ml, both measured at 24 and 72 hours after the procedure.[5] The primary end point of the present analysis was to compare the incidence of AKR_1 and AKR_2 according to the degree of EVCD. The secondary end point was to assess the impact of AKR on all-cause cardiac death and a composite end point of cardiac death, rehospitalization for congestive heart failure and/or stroke at a 24-month follow-up, according to the different AKR definitions.

Mean age was 82.3 ± 5.9 years, and 55.2% (390 of 706) were female; median European System for Cardiac Operative Risk Evaluation was 15.5. (9.5 to 25.9) At baseline, 127 patients (18.0%) were classified as stage 0/1 (no cardiac damage/left ventricular damage), 466 (66.0%) as stage 2 (left atrial or mitral valve damage), 79 (11.2%) as