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Editorial

Transcatheter Closure of Postinfarct Ventricular Septal Defect: Promises and Uncertainties

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Postinfarct ventricular septal defect (PIVSD) is a rare yet dreadful mechanical complication following acute myocardial infarction (AMI). The incidence of PIVSD has decreased remarkably from 1% to 2% in the prereperfusion era to 0.1% to 0.3% in the primary percutaneous coronary intervention era.[1–3] In an analysis of almost 9 million AMI hospitalizations in the reperfusion era, the incidence of PIVSD following ST-elevation myocardial infarction has remained relatively stable, with an incidence rate of 0.18% in 2003 vs 0.26% in 2015.[4] The 30-day survival after PIVSD with medical therapy alone is only 6%.[1] Female sex, older age, chronic kidney disease, delayed presentation, and lack of reperfusion are potential risk factors for development of PIVSD.[5]

Surgical repair remains the standard of care for selected PIVSD patients.[6] Early surgical repair is associated with a significantly high mortality rate (>50%).[7] Delayed surgical repair (>2 weeks), allowing time for healing of the friable necrotic edges of the septal defect, is linked with lower mortality (30%-40%)[7,8]; however, these findings are likely confounded by survival and selection biases. Transcatheter closure was first described in 1988 by Lock et al[9]; since then, it has evolved as an alternative for patients who are not surgical candidates. Multiple small, retrospective studies have evaluated the feasibility and safety of transcatheter closure of PIVSD using different devices and reported high technical success rates (>80%) and short-term mortality rates ~32%.[10] Importantly, most of these studies were limited by selection bias and heterogeneity in the time of the procedure as well as the devices used. In a large multicenter series from the United Kingdom from 2010 to 2021 that included 362 patients with PIVSD (231 underwent surgical repair and 131 underwent initial transcatheter closure), in-hospital mortality was lower in the surgical repair group (44.2% vs 55.0%; $P = .048$), but there was no difference in mortality between groups at 5 years (53.7% vs 61.1%).[11]

In 2017, the United States Food and Drug Administration granted approval for use of the Amplatzer PIVSD closure device (Abbott) under the Humanitarian Device Exemption pathway with a prespecified condition to conduct a postapproval study. Prior to this approval, the procedure was performed only under Emergency and Compassionate use. In this issue of *JSCAI*, Iyer et al[12] report the initial US experience with the Amplatzer PIVSD closure device. A total of 131 patients who underwent closure of PIVSD between 2011 and 2021 at 64 centers were analyzed retrospectively. The patients were divided into 2 cohorts: cohort 1 (ie, Emergency and Compassionate use) included 99 patients between 2011 and 2016, and cohort 2 (ie, postapproval study) included 32 patients between 2017 and 2021. Most of the closures (~67%) were performed within 30 days after the AMI. In cohort 1, technical success was achieved in 76.8%, while 24-hour and 6-month survival rates were 84.3% and 37.2%, respectively. In cohort 2, 53.1% had successful closure (defined as absence of a residual shunt ≥3 mm). The average time for the procedure was long (169.9 ± 81.5 minutes), consistent with the UK experience,[11] highlighting the technical challenges of the procedure and/or insufficient early experience with the procedure given the rarity of the condition. The 6-month survival in cohort 2 was 46.4%. Only 11 patients had a follow-up echocardiogram at 6 months, of which 6 were deemed satisfactory for analysis. Four out of these 6 patients (66.7%) had successful closure on the follow-up echocardiogram.[12] Despite the encouraging acute and chronic success of the procedure noted in both cohorts, less than half of patients were alive at 6 months, highlighting the overall precarious presentation. Importantly, most deaths occurred within the first 30 days after the procedure, whereas only a few deaths were reported between 30 days and 6 months.

The study by Iyer et al[12] addresses a clinically relevant knowledge gap, but a few issues deserve careful consideration. First, this is a retrospective study with a limited sample size of highly selected patients (particularly cohort 2) enrolled from experienced centers, and its findings may be subject to selection bias, which could limit its generalizability. Consistent with other studies, only the patients who survived to undergo the procedure (almost a month after AMI) were enrolled, which introduces the risk of survivor bias. Second, the number of patients who were screened for the procedure but did not receive it was not captured. Moreover, the criteria to determine

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eligibility for the procedure (ie, poor surgical candidate) were not standardized across the sites. Third, the investigators defined procedural success as the absence of a residual shunt ≥3 mm, but the study did not capture the proportion of patients who achieved a complete shunt reduction. In the UK experience, two-thirds of the patients achieved complete resolution whereas one-third had partial shunting after the procedure.[12] Although partial reduction of the defect might allow hemodynamic stabilization, the impact of a small residual leak on the outcomes beyond discharge remains unknown. Only 6 patients had a satisfactory echocardiogram completed at 6 months, thus assessing the association between residual shunting and mortality could not be examined. Fourth, one-fifth of the patients received mechanical circulatory support (MCS) devices (predominately intraaortic balloon pump [~52%]), a practice that is not reflective of many centers. Finally, data collection was performed locally at the participating sites without central analysis. Notwithstanding these issues, the investigators should be applauded for their work, which represents the initial US experience with this device in a very high-risk population.

Although the study by Iyer et al[12] provides insights into the intricate nature of PIVSD and transcatheter management, there are some questions that remain unanswered. Despite some evidence supporting delayed transcatheter closure of PIVSD to permit tissue healing and improve anchoring of the closure device,[13] similar to the literature related to surgical repair,[7,8] the optimal timing for closure remains uncertain. Although MCS devices play a role in stabilization of hemodynamics, the optimal MCS device in the setting of PIVSD remains unclear. A multidisciplinary approach might be reasonable to optimize the interaction of MCS and the underlying PIVSD pathophysiology. Finally, identifying patients who are most likely to benefit from transcatheter closure remains critically important. For example, certain anatomical considerations, such as posterior PIVSD, are associated with unfavorable morphology and technical challenges with surgical repair. Future device iterations are also eagerly needed to expand the use of this therapy to other potential indications such as a bridge to surgical repair and residual shunt or patch dehiscence after surgical repair.

In conclusion, the investigators should be commended for presenting valuable insight into an emerging transcatheter option for one of the most lethal cardiac complications. Although the present work suggests the feasibility and safety of the Amplatzer PIVSD closure device, future studies are necessary to identify the optimal patient subset, time of repair, and the role of MCS devices for transcatheter PIVSD closure.

Declaration of competing interest

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