

Is transradial access beneficial in cardiogenic shock patients?

“...our large study presenting access site choice and outcomes from a 7-year national perspective, suggests that adoption of the transradial access site is safe in patients undergoing percutaneous coronary intervention for cardiogenic shock and may be associated with improved mortality outcomes in a selected group of such patients and as such should be considered as the primary access site by experienced radial operators in such patients.”

Keywords: access site • cardiogenic shock • femoral • PCI • radial

Despite advances in percutaneous coronary intervention (PCI) and mechanical support over the past few decades, cardiogenic shock remains the leading cause of mortality in patients hospitalized with acute myocardial infarction [1] with 30-day mortality rates of over 40% reported [2]. Major bleeding complications following PCI in patients with cardiogenic shock have been reported in up to one third of patients [3]. This may relate to abnormalities in platelet physiology and coagulation/fibrinolysis pathways, as well as access site-related complications both from the intra-aortic balloon pump and the femoral access site through which the PCI is undertaken.

Major bleeding is one of the most common procedural-related complications occurring following PCI with a reported prevalence of 15% in our recent meta-analysis of 42 studies including half a million patients and is independently associated with a three-fold increase in mortality [4]. Major bleeding complications following PCI have a similar risk of mortality as observed with periprocedural myocardial infarction [5] and contribute up to 12.1% of all in-hospital mortalities following PCI in North America [6] with major bleeding complications accounting for 14% of 30-day ‘noncardiac’ mortalities in the SHOCK trial [7].

A significant proportion of major bleeding complications encountered during PCI occur through the femoral access site [8] and adoption of the radial access site has been shown to decrease access site-related

bleeding complications [9] and mortality outcomes [10,11] in selected populations. The transradial access site (TRA) has become the default access site for PCI across many North American and European interventional centers [9,12], driven through increasing recognition of the prognostic impact of peri-procedural bleeding complications, education programs and the miniaturization and development of radial-specific equipment enabling complex PCI cases that would historically have been performed through the transfemoral access site (TFA) to be undertaken radially [13–15]. While increasingly complex PCI procedures have routinely been undertaken through the TRA, patients presenting in cardiogenic shock are often treated via the femoral arterial approach even in experienced radial centers and commentators have suggested that cardiogenic shock remains the final frontier that has given even experienced radial operators pause [16]. Arterial vasoconstriction resulting from the presence of shock and the pharmacotherapy used to treat it, the potential need for larger bore access and the frequent requirement for left ventricular support devices remain as perceived barriers in the utilization of the TRA in patients with shock. Patients with cardiogenic shock have been excluded from randomized controlled trials (RCTs) that have studied the influence of access site choice on clinical and procedural outcomes in patients undergoing PCI and until recently, no data have been published regarding whether it was



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feasible and safe to undertake PCI procedures in patients with cardiogenic shock through the TRA.

The first such data focusing on the feasibility and outcomes associated with TRA use in patients with cardiogenic shock undergoing PCI has been derived from two recent small retrospective studies from experienced transradial PCI units that have suggested that TRA is both feasible and may be associated with favorable outcomes in this high risk cohort [17,18]. In a single-center study of 120 patients who underwent PCI for cardiogenic shock in an experienced transradial center [17], in which over 60% of the procedures were undertaken through the TRA, both in-hospital mortality and major adverse cardiovascular events (MACE) outcomes were significantly lower in the TRA group compared with the TFA group. However, patients in the TFA cohort in this study had greater hemodynamic compromise and were more likely to have mechanical ventilation, which likely contributed to the more favorable outcomes reported in the TRA group. Similarly in the two-center retrospective analysis of 197 patients with cardiogenic shock who underwent PCI for ST-elevation myocardial infarction (STEMI) [18] in which TRA was utilized in 55% of cases, no differences in 30-day mortality outcomes between the TFA and TRA cohorts were reported, but a reduction in non-CABG-related major bleeding complications in the TRA group were observed. However, on longer term follow-up, the authors reported that 1-year survival was significantly better in the TRA cohort compared with the TFA cohort (hazard ratio [HR]: 0.65; 95% CI: 0.42–0.98; $p = 0.041$), even after adjustment for baseline covariates.

While these two small observational studies suggest that TRA is feasible for a significant proportion of cases undergoing PCI with cardiogenic shock, and is safe and perhaps associated with more favorable outcomes, the results are derived in dedicated radial centers with operators having significant experience with the TRA. It is unclear whether the TRA would be feasible in such a proportion of cases outside of such a few specialist centers, or whether the favorable outcomes reported in these small single-centered registry studies could be replicated on a large scale involving multiple units and operators. Furthermore, while the growth of TRA has been widely documented nationally in many European, North American and Asian countries as the default access site [19], it is unclear whether TRA adoption has grown to a similar extent in complex cardiogenic shock cases.

We have recently reported the first study of access site choice and associated outcomes in all cardiogenic shock PCI procedures performed and recorded in the UK's comprehensive national PCI registry. The

national database allowed us to investigate a cohort of over 7000 patients with cardiogenic shock undergoing PCI over a 7-year period [20]. We show that the growth of TRA utilization in cardiogenic shock mirrors that observed in contemporary PCI, albeit at a slower pace with the radial artery used as an access site in 9.5% of all cases of cardiogenic shock in 2006, rising to 34.2% of all cases in 2012. This growth in TRA utilization in cardiogenic shock has occurred mainly in experienced TRA centers, with the greatest proportion of cases undertaken in those centers with the greatest experience in transradial PCI (47% of cases undertaken through TRA in centers whose radial utilization is >75%, while only 8% of cases undertaken in centers whose radial utilization is <25%). We also demonstrate that crude 30-day outcomes were observed to be less favorable in the TFA cohort compared with the TRA cohort although this is likely to represent the adverse risk profile in the TFA cohort, with those patients with greatest hemodynamic compromise more likely to have the TFA access site used, and with independent predictors of TFA utilization including inotropic agent use (odds ratio [OR]: 1.59; 95% CI: 1.27–1.98; $p < 0.0001$), presence of ventilation (OR: 2.51; 95% CI: 2.08–3.04; $p < 0.0001$) and use of an intra-aortic balloon pump (OR: 1.88; 95% CI: 1.60–2.22; $p < 0.0001$). Interestingly, once differences in baseline characteristics were adjusted for through multivariate analysis and propensity score matching, TRA was consistently associated with a 30–40% reduction in mortality. This appeared to be related to center experience in TRA use, with no mortality benefit observed in centers with TRA utilization rates <25% (HR: 0.68; 95% CI: 0.45–1.03; $p = 0.06$) and the greatest benefit of TRA observed in those centers with rates of TRA use >75% (HR: 0.50; 95% CI: 0.35–0.73; $p < 0.0001$). Finally TRA utilization was independently associated with a 63% reduction in major bleeding complications (HR: 0.37; 95% CI: 0.18–0.73; $p = 0.004$).

The TRA has been shown to be feasible in patients with cardiogenic shock as an access site for PCI in both specialist transradial centers and from a national perspective, where its growth has mirrored the growth in TRA reported elsewhere in lower risk cohorts. TRA has been shown to be associated with favorable outcomes in a selected group of patients with cardiogenic shock undergoing PCI, with documented reductions in the risk of mortality, MACE and bleeding complications reported.

However, it must be borne in mind that the relationship between mortality/MACE outcomes and TRA utilization that we and others have reported does not infer causality. All studies that have reported on access site choice in the setting of PCI in cardiogenic shock have

documented that TFA is used in more clinically unstable patients that may in part contribute to the increased rates of mortality observed with TFA. Although both we and others have attempted to adjust for such factors through the use of various statistical methodologies, unmeasured confounders may contribute to selection bias that cannot be completely controlled for using such techniques.

Should the TRA be adopted as the default access site for all PCI procedures undertaken in patients with cardiogenic shock by all operators? Our analysis suggests that even in the most experienced transradial centers with PCI undertaken in >75% of cases through the radial artery, a significant proportion of cardiogenic shock PCI procedures are still undertaken through the femoral approach (~50%). Patients with cardiogenic shock represent the most challenging and hemodynamically unstable patients who undergo PCI and inexperienced transradial operators should not underestimate complexity of undertaking PCI through the TRA. There is a significant learning curve for utilization of the TRA, which has been reported to extend to several hundred cases, even with radial specific equipment and the recent consensus document on the radial approach in percutaneous cardiovascular interventions: position paper by the European Association of Percutaneous Cardiovascular Interventions has provided a framework through which a stepwise approach to learning is proposed according to clinical

characteristics, presentation and lesion characteristics in which cardiogenic shock does not even feature [13]. Operators at the start of their learning curve should consider the TFA as the default access site until their familiarity and experience with TRA increase.

Nevertheless, in the hands of experienced operators/centers, the TRA represents a viable access site for undertaking PCI in this high-risk cohort and is associated with significant reductions in bleeding complications. Furthermore, our large study presenting access site choice and outcomes from a 7-year national perspective, suggests that adoption of the TRA is safe in patients undergoing PCI for cardiogenic shock and may be associated with improved mortality outcomes in a selected group of such patients and as such should be considered as the primary access site by experienced radial operators in such patients.

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