

population. The patients' characteristics reported in this previous study of the same group were similar to those in previous TAVI reports, including large series of "all comer" patients who had undergone TA-TAVI and the Placement of AoRTic TraNscatheter Valve (PARTNER) trial [3-5]. The mean STS score in these previous studies was systematically less than 15%, making the extremely high STS score reported by Pasic et al [1, 2] even more surprising.

In this regard, the calculation of the STS score merits particular attention. To avoid one of the most common errors leading to STS score overestimation, special care must be taken when the creatinine value is converted from SI to US units and then entered in the system: (1) the system works in mg/dL and not in $\mu\text{mol/L}$ (creatinine in $\mu\text{mol/L}/88.4 = \text{creatinine in mg/dL}$); and (2) the creatinine value in mg/dL should be inserted separated by a "." (point) instead of a "," (comma). Thus, in an 85-year-old woman 160 cm tall, weighing 60 kg, and diagnosed with severe symptomatic aortic stenosis with a history of hypertension, a normal creatinine (1.0 mg/dL), normal ejection fraction, "symptoms unlikely to be ischemia", and in New York Heart Association class III but in stable condition requiring an elective procedure, the STS score for mortality would have been 4.3%. However, using a creatinine value of 1,0 mg/dL (comma instead of point) or 100 $\mu\text{mol/L}$ (rather than 1.0 mg/dL) for the same patient-example would have raised the STS score up to 20.7%.

Perioperative risk evaluation of patients with symptomatic severe aortic stenosis using the EuroSCORE has been recently questioned due to overestimation of risk in many patients [6]. The STS score appears to be a more reliable risk model for high-risk patients evaluated for isolated aortic valve replacement [6]. However, inappropriate calculation of the STS score might lead to a significant overestimation of the patients' real risk, and this might introduce an important confounding factor with respect to the decision as to the type of intervention (standard aortic valve replacement vs TAVI) that should be offered. In addition, inappropriately high STS scores might artificially exaggerate the positive results obtained with surgical or transcatheter procedures. Although further research is needed to find the most accurate risk score for patients undergoing TAVI, the accurate use of the risk scores already in place is essential to properly determine the potential advantages of these procedures.

Rodrigo Bagur, MD

Josep Rodés-Cabau, MD

Quebec Heart & Lung Institute - Laval University

2725 Chemin Sainte-Foy - G1V 4G5

Quebec City, Quebec, Canada

e-mail: josep.rodés@criucpq.ulaval.ca

References

- Pasic M, Buz S, Dreyse S, et al. Transapical aortic valve implantation in 194 patients: problems, complications, and solutions. *Ann Thorac Surg* 2010;90:1463-70.
- Pasic M, Unbehaun A, Dreyse S, et al. Transapical aortic valve implantation in 175 consecutive patients: excellent outcome in very high-risk patients. *J Am Coll Cardiol* 2010;56:813-20.
- Rodés-Cabau J, Webb JG, Cheung A, et al. Transcatheter aortic valve implantation for the treatment of severe symptomatic aortic stenosis in patients at very high or prohibitive surgical risk. Acute and late outcomes of the multicenter Canadian experience. *J Am Coll Cardiol* 2010;55:1080-90.
- Leon MB, Smith CR, Mack M, et al. Transcatheter aortic-valve implantation for aortic stenosis in patients who cannot undergo surgery. *N Engl J Med* 2010;363:1597-607.
- Van Linden A, Kempfert J, Rastan AJ, et al. Risk of acute kidney injury after minimally invasive trans-apical aortic valve implantation in 270 patients. *Eur J Cardiothorac Surg* 2010 Dec 24. [Epub ahead of print].
- Dewey TM, Brown D, Ryan WH, Herbert MA, Prince SL, Mack MJ. Reliability of risk algorithms in predicting early and late operative outcomes in high-risk patients undergoing aortic valve replacement. *J Thorac Cardiovasc Surg* 2008;135:180-7.

Why Are ITA Free Flows Measured This Low?

To the Editor:

We congratulate Mannacio and colleagues for their outstanding achievement in conducting their randomized study on graft flow in pedicle versus skeletonized internal thoracic arteries (ITA). We were, however, surprised to read the low baseline free flows in both pedicle and skeletonized ITAs of 18.8 ± 13.9 mL/min and 13.8 ± 13.0 mL/min, respectively. Even after application of papaverine, flow increased only to 55.1 ± 24.5 mL/min in pedicled ITAs and 63.8 ± 31.3 mL/min in skeletonized ITAs [1].

Low free flow may not be significant when the ITA is anastomosed only to a single coronary artery. However, with increasing use of sequential and composite arterial grafting much higher flows up to 250 mL/min are needed to guarantee adequate coronary blood supply, and hence adequate flow in the ITA should be demonstrated ahead of its usage intraoperatively [2].

We have previously shown significant higher baseline free flows both in skeletonized and pedicled ITAs of 68.7 ± 54.5 mL/min and 51.3 ± 39.1 mL/min, respectively. After application of papaverine, these flows increased significantly in both groups; however, they were significantly higher in skeletonized ITAs (197.2 ± 66.6 mL/min vs 147.1 ± 70.5 mL/min) [3].

This difference in free flows in the ITAs between that obtained by the authors and our previous investigations could be explained by the dosage and the method of application of papaverine; however, authors used a higher dosage of topical papaverine (100 mg) than our 50 mg papaverine, which was given intraluminally [3]. Intraluminal application of papaverine results in superior dilatation and higher free flows. Although concerns about endothelial damage by its acidic pH have been raised previously, pH can be neutralized by diluting papaverine in heparinized blood.

Internal thoracic artery free flow is also dependent on mean arterial pressure, which was 70 mm Hg in our previous investigations. Mannacio and colleagues mentioned that all baseline measurements were obtained with a mean pressure of 80 mm Hg, which should have resulted in even higher free flows.

We have also previously demonstrated that ITA flow is dependent on the degree of native coronary artery stenosis, and, therefore, it would have been helpful if authors had provided this information. Intravascular flows in skeletonized left ITAs of "T"-Grafts, measured between 100 to 175 mL/min at 1 week and 160 to 250 mL/min at 6 months postoperatively, are dependent on the number of occluded native coronary arteries [2].

Another explanation could be a more traumatic harvesting technique resulting in ITA vasospasm, but this is unlikely as the authors have not experienced severe complications of ITA hypoperfusion during the postoperative period.

However, this is an excellent investigation that will further increase the credibility of skeletonized ITA. In our view, skeleton-

ized arterial grafts are a major step forward to sequential arterial anastomoses and to facilitate total arterial revascularization.

Selvaraj Shanmuganathan, MBBS, FRCS
Olaf Wendler, MD

Cardiovascular Services
King's College Hospital/King's Health Partners
Denmark Hill
London SE5 9RS, United Kingdom
e-mail: olaf.wendler@nhs.net

References

1. Mannacio V, Di Tommaso L, De Amicis V, Stassano P, Vosa C. Randomized flow capacity comparison of skeletonized and pedicled left internal mammary artery. *Ann Thorac Surg* 2011;91:24–30.
2. Markwirth T, Hennen B, Scheller B, Schaeffers HJ, Wendler O. Flow wire measurements after complete arterial coronary revascularization with T-grafts. *Ann Thorac Surg* 2001;71:788–93.
3. Wendler O, Tscholl D, Huang Q, Schaeffers HJ. Free flow capacity of skeletonized versus pedicled internal thoracic artery grafts in coronary artery bypass grafts. *Eur J Cardiothorac Surg* 1998;15:247–50.

Reply

To the Editor:

We thank Drs Shanmuganathan and Wendler [1] for their interest in our article [2], and the editor for giving us the opportunity to reply.

We know Dr Wendler and colleagues' study [3], and it was of great help in configuring our report. They directly measured the free flow of the internal mammary artery (IMA), allowing it to freely bleed into a container after distal division, and found higher free flow (both at the baseline and after application of intraluminal papaverine) than our values. However, it is evident that the measurement of the free flow of the IMAs graft relies on many different factors, such as: patients clinical characteristics, study design (prospective, randomized, retrospective), selection and exclusion criteria, number of patients operated on with each technique, timing of free flow measurement, use of papaverine, and so on [4–6].

Having said this, we are in agreement that the relatively low free flow, obtained immediately after harvesting the IMA, could be due to a vasospasm from vessel manipulation or due to a different dosage and method of application of papaverine. Intraluminal application of diluted papaverine compared with local application resulted in a superior flow rates of IMA [7]. However, we think that routine intraluminal application of papaverine should not be recommended to avoid further manipulations and damages, as also confirmed by other reports [7]. We resort to papaverine intraluminal use only in the few cases in which the free flow of the IMAs is scarce. In our study, intraluminal no-touch policy was strictly observed in all cases to avoid any misleading interference.

In regard to the issue of target vessel stenosis and its impact on IMA flow, it is evident that IMA graft flow is affected by the severity of the proximal stenosis and by the run-off of the target vessel.

Our study population had overall good run-off, assessed preoperatively by means of corrected thrombolysis in myocardial infarction (TIMI) frame count, and significant (>70%) stenosis of the left anterior descending, which was the target vessel in all cases. This could explain the lack of occurrence of early

postoperative hypoperfusion syndrome in both of our randomized groups.

Vito Mannacio, MD
Luigi Di Tommaso, MD
Vincenzo De Amicis, MD
Paolo Stassano, MD
Carlo Vosa, MD

Department of Cardiac Surgery
University of Naples Federico II
Via S Pansi 5
Naples 80131, Italy
e-mail: vitomannacio2@libero.it

References

1. Shanmuganathan S, Wendler O. Why are ITA free flows measured this low? (letter). *Ann Thorac Surg* 2011;92:1158–9.
2. Mannacio V, Di Tommaso L, De Amicis V, Stassano P, Vosa C. Randomized flow capacity comparison of skeletonized and pedicled left internal mammary artery. *Ann Thorac Surg* 2011;91:24–30.
3. Wendler O, Tscholl D, Huang Q, Schaeffers HJ. Free flow capacity of skeletonized versus pedicled internal thoracic artery grafts in coronary artery bypass grafts. *Eur J Cardiothorac Surg* 1998;15:247–50.
4. Boodhwani M, Lam BK, Nathan HJ, et al. Randomized, double-blind, within-patient comparison and improves sternal perfusion after coronary artery bypass surgery: a skeletonized internal thoracic artery harvesting reduces pain and dysesthesia. *Circulation* 2006;114:766–73.
5. Takami Y, Ina H. Effects of skeletonization on intraoperative flow and anastomosis diameter of internal thoracic arteries in coronary artery bypass grafting. *Ann Thorac Surg* 2002;73:1441–5.
6. Choi JB, Lee SJ. Skeletonized and pedicled internal thoracic artery graft: effect of free flow during bypass. *Ann Thorac Surg* 1996;61:909–13.
7. Dregelid E, Haldal K, Resch F, Stangeland L, Breivik K, Svendsen E. Dilation of the internal mammary artery by external and intraluminal papaverine application. *J Thorac Cardiovasc Surg* 1995;110:697–703.

Successful Management of Cervical Esophageal Perforation After Anterior Cervical Surgery

To the Editor:

Esophageal perforation after anterior cervical surgery is a really complicated and intractable problem for the team of spine surgeons and cooperative thoracic surgeons performing the procedure. Having read the article by Dr Rueth and his colleagues [1], I am fascinated by their management and the excellent outcome. The authors should be congratulated for their well-organized treatment algorithm. However, some issues should be discussed, and I wish to bring them to the authors and readers of *The Annals of Thoracic Surgery*:

1. The authors mentioned that their 6-cases report was the largest published case series [1]. However, we had reported our experience of this issue with 13 cases in 2004 [2]. In our report, the management and prevention key points had also been discussed from the spine surgeon's points of view. Moreover, Gaudinez and colleagues [3] reported 44 cases with esophageal perforation after anterior cervical surgery in the year 2000.
2. The authors used a total of 22 operations on these 6 patients and criticized the conservative treatment [1].