comparisons between two stentless valves, which showed no difference in postoperative aortic valve area, maximum velocity across the valve and mortality.

Pelletier *et al.* [8] performed a cohort study comparing 878 CE porcine and 715 Ionescu-Shiley, CE and Mitroflow bovine valves in AVR, MVR or MR from 1976–88. It showed similar late survival rates and clinical improvement. However, the freedom from all valve-related complications was significantly better in porcine valves.

Eichinger *et al.* [9] conducted an RCT comparing 68 MM porcine valve and 70 CE Perimount bovine valves in AVR in the years 2000 to 2002. There was no difference in patient–prosthesis mismatch. The bovine valve had lower mean pressure gradient at rest and during exercise 10 months after operation.

Walther *et al.* [10] carried out an RCT on 100 patients from 2000–2003 comparing MM porcine and Perimount bovine valves. Transvalvular blood flow velocity and mean pressure were assessed. Both valves showed acceptable haemodynamic function with significant LV mass regression with overall better haemodynamic profile in bovine valves.

Czer *et al.* [11] conducted a cohort study on 656 patients comparing Hancock standard and CE porcine valves with St Jude Medical bileaflet bovine valves in AVR, MVR or MR positions from 1976–1984. Both porcine and bovine valves had a similar mortality rate. Porcine valves had higher structural failure rates with higher reoperation rates. Bovine valves showed better functional status postoperatively.

Dalmau *et al.* [12] performed an RCT in Spain comparing 43 MM porcine valves with 43 Edward Perimount Magna bovine valves in AVR position. Mean pressure gradient, EOA and LV mass regression were examined. Bovine valves showed better haemodynamic function with lower patient–prosthesis mismatch prevalence at 1-year follow-up.

Borger *et al.* [13] performed a cohort study comparing 57 Medtronic Hancock II porcine valves with 57 CE Perimount Magna bovine valves in AVR and/or concomitant procedures in 2004 to 2005. Bovine valves showed better peak and mean transvalvular gradients with lower patient–prosthesis mismatch.

Wagner *et al.* [14] compared 50 CE Perimount bovine valves, 70 Perimount Magna bovine valves, 44 MM porcine valves and 28 Soprano bovine valves through a cohort study in Germany. They demonstrated that generally bovine valves had better haemodynamic performance compared with porcine valves.

Suri *et al.* [15] conducted an RCT from 2004 to 2006 examining 76 Edwards Perimount bovine and 76 MM Porcine valves. Despite small differences in haemodynamic performance, both valves had similar LV regression after 1 year follow-up.

An RCT performed by Dalmau *et al.* [16] from 2004 to 2006 comparing 54 Edwards Perimount Magna bovine and 54 MM showed superior haemodynamic function in bovine valves leading to LV regression. Patients with bovine valves also had better overall survival rate at 5 years.

## CLINICAL BOTTOM LINE

In conclusion, the bovine valve is superior in its complication and haemodynamic profile. Both bovine and porcine valves have comparable results with regard to the mortality, postoperative functional status and valve durability. Significant variability between the valve manufacturers, study designs, study period and patient population in the above studies imposes limitations to the comparison of both valves.

**Conflict of interest:** none declared.

## REFERENCES

[1] Dunning J, Prendergast B, Mackway-Jones K. Towards evidence-based medicine in cardiothoracic surgery: best BETS. Interact CardioVasc Thorac Surg 2003;2:405–9.
[2] Reichenspurner H, Weinhold Ch, Nollert G, Kaulbach HG, Vetter HO, Boehm DH *et al.* Comparison of porcine biological valves with pericardial valves—a 12-year clinical experience with 1123 bio-prostheses. Thorac Cardiovasc Surg 1995;43:19–26.
[3] Gao G, Wu Y, Grunkemeier GL, Furnary AP, Starr A. Durability of pericardial versus porcine aortic valves. J Am Coll Cardiol 2004;44:384–8.
[4] Chambers JB, Rajani R, Parkin D, Rimington HM, Blauth CI, Venn GE *et al.* Bovine pericardial versus porcine stented replacement aortic valves: early results of a randomized comparison of the Perimount and the Mosaic valves. J Thorac Cardiovasc Surg 2008;136:1142–8.
[5] Jamieson WRE, Germann E, Aupart MR, Neville PH, Marchand MA, Fradet GJ. 15-Year comparison of supra-annular porcine and perimount aortic bioprostheses. Asian Cardiovasc Thorac Ann 2006;14:200–5.
[6] Chaudhry MA, Raco L, Muriithi EW, Bernacca GM, Tolland MM, Wheatley DJ. Porcine versus pericardial bioprostheses: eleven-year follow up of a prospective randomized trial. J Heart Valve Dis 2000;9:429–38.
[7] Casabona R, De Paulis R, Zattera GF, Di Summa M, Bottone W, Stacchino C *et al.* Stentless porcine and pericardial valve in aortic position. Ann Thorac Surg 1992;54:681–5.
[8] Pelletier LC, Carrier M, Leclerc Y, Lepage G, DeGuise P, Dyrda I. Porcine versus pericardial bioprosthesis: a comparison of late results in 1,593 patients. Ann Thorac Surg 1989;47:352–61.
[9] Eichinger WB, Botzenhardt F, Keithahn A, Guenzinger R, Bleiziffer S, Wagner I *et al.* Exercise haemodynamics of bovine versus porcine bioprostheses: a prospective randomized comparison of the Mosaic and Perimount aortic valves. J Thorac Cardiovasc Surg 2005;129:1056–63.
[10] Walther T, Lehmann S, Falk V, Metz S, Doll N, Rastan A *et al.* Prospectively randomized evaluation of stented xenograft hemodynamic function in the aortic position. Circulation 2004;110(II):II-74–II-78.
[11] Czer LS, Matloff JM, Chaux A, DeRobertis MA, Gray RJ. Comparative clinical experience with porcine bioprosthetic and St Jude valve replacement. Chest 1987;91:503–14.
[12] Dalmau MJ, Gonalez-Santos JM, López-Rodríguez J, Bueno M, Arribas A, Nieto F. One year haemodynamic performance of the Perimount Magna pericardial xenograft and the Medtronic Mosaic bioprosthesis in the aortic position: a prospective randomized study. Interact CardioVasc Thorac Surg 2007;6:345–9.
[13] Borger MA, Nette AF, Maganti M, Feindel CM. Carpentier-Edwards Perimount Magna valve versus Medtronic Hancock II: A matched hemodynamic comparison. Ann Thorac Surg 2007;83:2054–9.
[14] Wagner IM, Eichinger WB, Bleiziffer S, Botzenhardt F, Gebauer I, Guenzinger R *et al.* Influence of completely supre-annular placement of bioprostheses on exercise haemodynamics in patients with a small aortic annulus. J Thorac Cardiovasc Surg 2007;133:1234–41.
[15] Suri RM, Zehr KJ, Sundt TM, Dearani JA, Daly RC, Oh JK *et al.* Left ventricular mass regression after porcine versus bovine aortic valve replacement: a randomized comparison. Ann Thorac Surg 2009;88:1232–7.
[16] Dalmau MJ, González-Santos JM, Blázquez JA, Sastre JA, López-Rodríguez J, Bueno M *et al.* Haemodynamic performance of the Medtronic Mosaic and Perimount Magna aortic bioprostheses: five-year results of a prospectively randomized study. Eur J Cardiothorac Surg 2011;39:844–52.

**eComment. The current bioprosthesis of choice for aortic valve replacements**

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I read with great interest the paper by Yap *et al.* regarding the best valve substitute for aortic valve replacement [1]. In their results, they included six randomized

controlled trials and nine cohort studies yielding a total of 9880 patients from 1974 to 2006. However, we found two additional relevant articles investigating the long-term durability of pericardial and porcine valves.

Brown *et al.* from the Mayo clinic recently published an interesting article assessing the incidence of early thrombosis in patients with biological valves [2]. The paper was in favour of bovine valves because all patients with early valve thrombosis requiring reoperation were implanted with porcine valves. The calculated incidence of valve thrombosis was 1.26% for the Biocor valve, 0.84% for the Hancock valve and 0.37% for the Mosaic valve. There were no patients with valve thrombosis in the pericardial valve cohort. One possible explanation of this discrepancy is related to the design of the porcine valve stent, which promotes blood stasis between the rail of the stent and the belly of the leaflet. Based on their findings, they recommended the implantation of a mechanical or a pericardial valve, in case of early thrombosis of a porcine valve.

Grunkemeier *et al.* reviewed the long-term durability of the Carpentier-Edwards pericardial and bovine aortic valves in 2955 patients [3]. The likelihood of explantation by 15 years was similar for both valves (7% for the porcine valve and 8% for the pericardial valve). However, the modes of failure were different: structural valve deterioration was seen mainly in the form of a leaflet tear for porcine valves and calcification and fibrosis for pericardial valves.

According to the available literature, we concur with the conclusion of Yap *et al.* that the bovine valve is superior in its haemodynamic profiles and has a lower rate of complications. Another advantage of the pericardial valve is the very low rate of valve thrombosis with only one case report of early bioprosthesis thrombosis in the aortic position [4].

**Conflict of interest:** none declared

**References**

[1] Yap K, Murphy R, Devbhandari M, Venkateswaran R. Aortic valve replacement: is porcine or bovine valve better ? Interact CardioVasc Thorac Surg 2013;16:361–74.
[2] Brown ML, Park SJ, Sundt TM, Schaff HV. Early thrombosis risk in patients with biologic valves in the aortic position. J Thorac Cardiovasc Surg 2012;144:108–11.
[3] Grunkemeier GL, Furnary AP, Wu Y, Wang L, Starr A. Durability of pericardial versus porcine bioprosthetic heart valves. J Thorac Cardiovasc Surg 2012;144:1381–6.
[4] Mestras C, Gardcia-Real FJ, Fuentes M. Early postoperative thrombosis of pericardial xenograft aortic valve. Asian Cardiovasc Thorac Ann 2000;8:50–1.

**eComment. Choice of bioprosthesis for aortic valve replacement**

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We read with great interest the best evidence topic by Yap *et al.* regarding the best bioprosthesis for aortic valve replacement [1].

We would like to present the results of our relative prospective multicentre randomized study. The aim of the study was to compare the haemodynamic performance and the sizing characteristics of the Medtronic Mosaic Ultra porcine and Carpentier-Edwards Perimount Magna bovine pericardial bioprosthetic stented aortic valve in relation to the patient's true aortic annulus size [2]. After the aortic valve excision, the annulus was measured by blinded sizers prior to the randomization of 141 patients (Ultra, $n = 72$; Magna, $n = 69$) [2]. The median patient age was 75 years, and 89% of the patients had aortic valve stenosis. A good left ventricular function was present in 75% of patients, and the EuroSCORE-predicted mortality was equal to 9%. Concomitant procedures (coronary artery bypass grafting, mitral/tricuspid valve repair, septal myectomy, modified maze procedure with radiofrequency) were performed in 61% of patients. The in-hospital mortality was 3%, and at six months postoperatively, 96% of the patients were in NYHA class I/II, with no inter-group differences. The mean 'true aortic annulus' size was 23.0 ± 1.4 mm for the Ultra valve, and 22.6 ± 1.8 mm for the Magna valve ($P$ = not significant). The implanted labeled valve size was > or = 23 mm for 83% of Ultra valves, and for 52% of Magna valves ($P$ <0.01), and smaller than the measured true aortic diameter (44% Magna vs 33% Ultra). The mean echo gradients were lower with Magna valves (11 ± 6 mmHg) than with Ultra (17 ± 6 mmHg; $P$ <0.01), while the effective orifice area (EOA) was higher with Magna than with Ultra (1.6 ± 0.4 versus 1.4 ± 0.4; $P$ <0.01). Both groups showed a similar left ventricular mass regression (Ultra -48 ± 83 g; Magna -42 ± 70 g). Trivial to moderate regurgitation was noted in 24% of Ultra valves compared to 48% of Magna valves ($P$ <0.01) [2]. According to the results of our study, the selection of the Ultra bioprosthetic valve allowed the implantation of larger valve sizes. However, when compared to the 'true aortic annulus', the Magna was associated with lower transprosthetic gradients and larger EOAs. However, the long-term significance of these observations remains inconclusive in terms of bioprosthesis selection [2].

In conclusion, the choice of bioprosthetic heart valve should not be influenced solely by the early systolic gradients, but also by the expected long-term durability [2]. Rahimtoola has suggested that bovine valves have a lower incidence of structural valve degeneration based on a 2001 meta-analysis of both Hancock and Carpentier-Edwards valves [2, 3]. A recent report on the Hancock II bioprosthesis reported a freedom from structural valve degeneration at 20 years of 85% in patients aged 60-70 years, and of 99.8% in patients aged >70 years [2,4]. The results of in vitro studies have also suggested that the Perimount Magna ThermaFix anticalcification treatment may be inferior to the Mosaic Ultra anti-calcification, and would result in an earlier reversal of the initially favorable Magna gradients [5].

**Conflict of interest:** none declared

**References**

[1] Yap K, Murphy R, Devbhandari M, Venkateswaran R. Aortic valve replacement: is porcine or bovine valve better? Interact CardioVasc Thorac Surg 2013;16:361–74.
[2] von Oppell UO, Segadal L, Busund R, Johnston GG, Dimitrakakis G, Masani N, Lung TH. Aortic annulus diameter and valve design each determine the valve size implanted. J Heart Valve Dis 2012;21:591–8.
[3] Rahimtoola SH. Choice of prosthetic heart valves in adults; an update. J Am Coll Cardiol 2010;55:2413–2426.
[4] David TE, Armstrong S, Maganti M. Hancock II bioprosthesis for aortic valve replacement: The gold standard of bioprosthetic valve durability? Ann Thorac Surg 2010;90:775–781.
[5] Bakhtiary F, Dzemali O, Steinseiffer U *et al*. Opening and closing kinematics of fresh and calcified aortic prostheses: An in vitro study. J Thorac Cardiovasc Surg 2007;134:657–662.