Valve positions upon which cardiac surgeons operate should be taken into consideration

We read the article entitled "Mechanical versus bioprosthetic valves in chronic dialysis: a systematic review and meta-analysis" by Kim and colleagues,[1] with great interest. The authors attempted to address limitations of previous meta-analyses by expanding the searching strategy and exhausting more databases without placing any language restriction. They concluded that the significant benefit of lower all-cause mortality with the use of mechanical prosthesis (MP) was at the expense of higher risks of bleeding and stroke. We appreciated the authors' efforts and contribution, and concur with the authors that most studies were subject to high risk of unmeasured confounding bias owing to unreported demographics, which lowers the quality of evidence considerably. However, we believe that the prosthetic position upon which cardiac surgeons operate is a significant contributor to not only conceptual, but also statistical heterogeneity. Besides, compared with relative risk (RR) that Kim and colleagues selected for the analysis of all-cause mortality, hazard ratio (HR) is supposed to be a more appropriate statistic, as it incorporates time into the consideration.

Thus, we followed Kim and colleagues' inclusion criteria and reconducted the meta-analysis with the introduction of a subgroup analysis based on valve position. There are 8 studies[2–9] providing comparative long-term survival outcome for aortic valve replacement (AVR) between MP and bioprosthesis (BP) in dialysis patients. We showed that dialysis patients using MP for AVR was associated with significantly lower long-term all-cause mortality than those using BP (HR 0.65, 95 % confidence interval [CI] 0.51–0.83, I^2 = 0 %) (Figure 1). On the other hand, the long-term overall survival was comparable between MP and BP (HR 0.91, 95 % CI 0.77–1.07, I^2 = 0 %) (Figure 1) in mixed cohorts of AVR and mitral valve replacement (MVR). Regarding the bleeding events, although the use of MP was associated with a considerably higher risk in studies including mixed cohorts of AVR and MVR (incidence rate ratio [IRR] 2.37, 95% CI 1.34–4.22, I^2 = 41%), we found that there was no significant difference in bleeding events between MP and BP in patients undergoing AVR (IRR 1.18, 95% CI 0.28–4.85, I^2 = 0 %) (Figure 1). One plausible explanation for similar bleeding risk between MP and BP in dialysis patients undergoing AVR may reside in the lower target of international normalized ratio (INR), usually less than 2.5, used in this population, as compared with the target of 3.0 used in MVR.[28] In fact, it

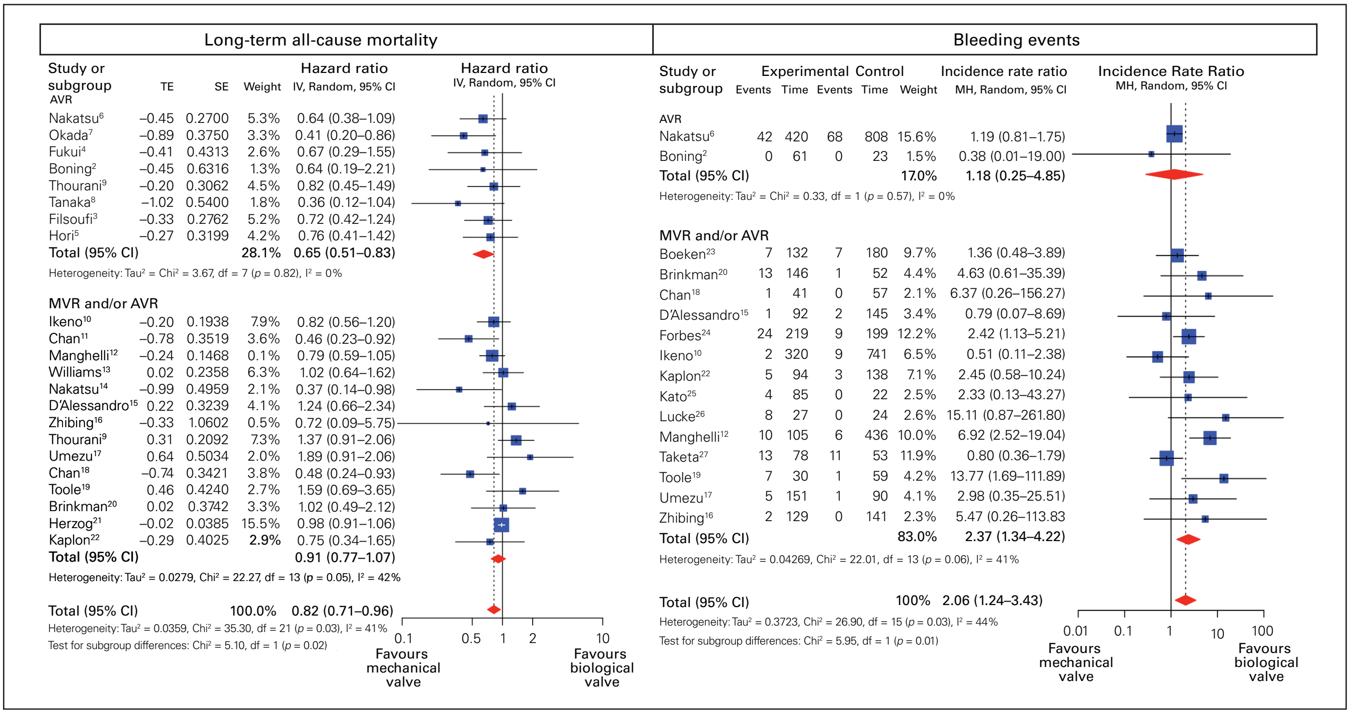

Fig. 1. Forest plot of comparative long-term all-cause mortality and bleeding events between mechanical and bioprosthetic prosthesis. Meta-analyses were carried out using random-effects model with restricted maximum likelihood as an estimator for between-study variance.

has been shown in previous meta-analysis that MP conferred a significantly greater bleeding risk than BP when INR was above 2.5, while bleeding events were comparable when INR was below 2.5.[29] Of note, the valve position appeared to be a significant contributor to heterogeneity as both subgroup analyses revealed significant quantitative interaction between different valve positions (p = 0.02 for long-term, all-cause mortality and p = 0.01 for bleeding events) (Figure 1). In summary, when taking the valve position into consideration, our subgroup analysis revealed that MP may be a feasible choice in dialysis patients undergoing AVR given significant lower long-term all-cause mortality with comparable bleeding risk as compared with BP.

Tsu-Hsien Wang, MD; Yi-No Kang, MA; Wan-Ying Lin, MD; Kuan-Yu Chi, MD

Affiliations: From the Department of Education, Center for Evidence-Based Medicine, Taipei Medical University Hospital, Taipei, Taiwan (Wang, Kang, Chi); the Department of Family Medicine, Taipei Medical University Hospital, Taipei, Taiwan (Lin); the Department of Medicine, Jacobi Medical Center, Albert Einstein College of Medicine, Bronx, N.Y., U.S.A. (Chi).

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Correspondence to: W.-Y. Lin; b101101061@gmail.com. K.-Y. Chi; kuanyuhippo@gmail.com.

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References

1. Kim KS, Belley-Côté EP, Gupta S, et al. Mechanical versus bioprosthetic valves in chronic dialysis: a systematic review and meta-analysis. *Can J Surg* 2022;65:E450.
2. Böning A, Boedeker RH, Rosendahl UP, et al. Long-term results of mechanical and biological heart valves in dialysis and non-dialysis patients. *Thorac Cardiovasc Surg* 2011;59:454-9.
3. Filsoufi F, Chikwe J, Castillo JG, et al. Prosthesis type has minimal impact on survival after valve surgery in patients with moderate to end-stage renal failure. *Nephrol Dial Transplant* 2008;23:3613-21.
4. Fukui S, Yamamura M, Mitsuno M, et al. Aortic valve prosthesis selection in dialysis patients based on the patient's condition. *J Artif Organs* 2012;15:162-7.
5. Hori D, Kusadokoro S, Kitada Y, et al. Prosthesis selection for aortic valve replacement in patients on hemodialysis. *Gen Thorac Cardiovasc Surg* 2020;68:122-8.
6. Nakatsu T, Minakata K, Tanaka S, et al. Intermediate-term outcomes of aortic valve replacement with bioprosthetic or mechanical valves in patients on hemodialysis. *J Thorac Cardiovasc Surg* 2019;157:2177-2186.e3.
7. Okada N, Tajima K, Takami Y, et al. Valve selection for the aortic position in dialysis patients. Ann Thorac Surg 2015;99:1524-31.
8. Tanaka K, Tajima K, Takami Y, et al. Early and late outcomes of aortic valve replacement in dialysis patients. *Ann Thorac Surg* 2010;89:65-70.
9. Thourani VH, Sarin EL, Keeling WB, et al. Long-term survival for patients with preoperative renal failure undergoing bioprosthetic or mechanical valve replacement. *Ann Thorac Surg* 2011;91:1127-34.
10. Ikeno Y, Mukohara N, Fukumura Y, et al. Outcomes of valve replacement with mechanical prosthesis versus bioprosthesis in dialysis patients: a 16-year multicenter experience. *J Thorac Cardiovasc Surg* 2019;158:48-56.e4.
11. Chan PG, Sultan I, Gleason TG, et al. Mechanical versus bioprosthetic valves in patients on dialysis. *J Thorac Dis* 2019;11:1996-2005.
12. Manghelli JL, Carter DI, Khiabani AJ, et al. A 20-year multicenter analysis of dialysis-dependent patients who had aortic or mitral valve replacement: implications for valve selection. *J Thorac Cardiovasc Surg* 2019;158:805-13.e2.
13. Williams ML, Bavaria JE, Acker MA, et al. Valve selection in end-stage renal disease: Should it always be biological? *Ann Thorac Surg*. 2016;102:1531-5.
14. Nakatsu T, Tamura N, Yanagi S, et al. Hemorrhage as a life-threatening complication after valve replacement in end-stage renal disease patients. *Gen Thorac Cardiovasc Surg* 2015;63:386-94.
15. D'Alessandro DA, Skripochnik E, Neragi-Miandoa S. The significance of prosthesis type on survival following valve replacement in dialysis patients. *J Heart Valve Dis* 2013;22:743-50.
16. Zhibing Q, Xin C, Ming X, et al. Should bioprostheses be considered the valve of choice for dialysis-dependent patients? *J Cardiothorac Surg* 2013;8:42.
17. Umezu K, Saito S, Yamazaki K, et al. Cardiac valvular surgery in dialysis patients: comparison of surgical outcome for mechanical versus bioprosthetic valves. *Gen Thorac Cardiovasc Surg* 2009;57:197-202.
18. Chan V, Jamieson WRE, Fleisher AG, et al. Valve replacement surgery in end-stage renal failure: mechanical prostheses versus bioprostheses. *Ann Thorac Surg* 2006;81:857-62.
19. Toole JM, Stroud MR, Kratz JM, et al. Valve surgery in renal dialysis patients. *J Heart Valve Dis* 2006;15:453-8, discussion 458.
20. Brinkman WT, Williams WH, Guyton RA, et al. Valve replacement in patients on chronic renal dialysis: implications for valve prosthesis selection. *Ann Thorac Surg* 2002;74:37-42, discussion 42.
21. Herzog CA, Ma JZ, Collins AJ. Long-term survival of dialysis patients in the United States with prosthetic heart valves: Should ACC/AHA practice guidelines on valve selection be modified? *Circulation* 2002;105:1336-41.
22. Kaplon RJ, Cosgrove DM III, Gillinov AM, et al. Cardiac valve replacement in patients on dialysis: influence of prosthesis on survival. *Ann Thorac Surg* 2000;70:438-41.
23. Boeken U, Schurr P, Feindt P, et al. Cardiac valve replacement in patients with end-stage renal failure: impact of prosthesis type on the early postoperative course. *Thorac Cardiovasc Surg* 2010;58:23–7.
24. Forbes S, Ashman N, Cove-Smith A, et al. SP740: mechanical versus bioprosthetic heart valves: a comparison study in end-stage renal disease. *Nephrol Dial Transplant* 2015;30(Suppl 3):iii622.
25. Kato W, Tajima K, Terasawa S, et al. Results of isolated valve replacement in hemodialysis patients. *Asian Cardiovasc Thorac Ann* 2007;15:386-91.
26. Lucke JC, Samy RN, Atkins BZ, et al. Results of valve replacement with mechanical and biological prostheses in chronic renal dialysis patients. *Ann Thorac Surg* 1997;64:129-32, discussion 132-3.
27. Takeda K, Miyata H, Motomura N, et al. Contemporary perioperative results of heart valve replacement in dialysis patients: analysis of 1,616 patients from the Japan adult cardiovascular surgery database. *J Heart Valve Dis* 2013;22:850-8.
28. Nishimura RA, Otto CM, Bonow RO, et al. 2017 AHA/ACC focused update of the 2014 AHA/ACC guideline for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Circulation* 2017;135:e1159-95.
29. Chi K-Y, Chiang M-H, Kang Y-N, et al. Mechanical or biological heart valve for dialysis-dependent patients? A meta-analysis. *J Thorac Cardiovasc Surg* 2022;163:2057-2071.e2012.