

Agostini *et al.* [4] conducted a retrospective cohort study of 312 patients undergoing OPCAB at a single centre. Based on surgeon operative volume, they demonstrated no difference in mortality, postoperative complications and conversion to ONCAB between low- and high-volume surgeons. However, there was a significant difference demonstrated in the mean number of grafts per patient and the degree of completeness of revascularization in favour of high-volume surgeons.

Plomondon *et al.* [5] conducted a retrospective multicentre cohort study of 5076 patients undergoing OPCAB and analysed the effects of hospital volume on operative outcomes. They demonstrated no difference between the four quartiles of hospital volume in terms of short-term mortality, intermediate-term mortality and perioperative morbidity.

Glance *et al.* [6] conducted a retrospective multicentre cohort study of 36 930 patients undergoing CABG (5207 OPCAB). Analysing surgeon operative volume, they demonstrated no difference in mortality between three volume categories for OPCAB; however, there was a significant surgeon volume-outcome relationship demonstrated for ONCAB surgery.

Brown *et al.* [7] conducted a retrospective multicentre cohort study of 16 988 patients undergoing CABG (2491 OPCAB), comparing hospital volume and operative outcomes. They demonstrated no relationship between hospital volume and mortality in OPCAB; however, this volume-outcome relationship did exist for postoperative complications of surgery.

CLINICAL BOTTOM LINE

The evidence presented represents a very large cohort of patients (309 327) undergoing OPCAB across a wide range of centres. There is also an equal divide between the studies in terms of the unit of analysis of volume; three studies focusing on surgeon volume and three on hospital volume. However, based on our assessment of the methodological quality and strength of the study, the quality of studies analysed is not very high and the most reliable sources of evidence come from some large and medium-sized studies from administrative databases. While the volume-outcome relationship has been very well documented for CABG, our review demonstrates that, surprisingly, this relationship may not be so clearly defined for OPCAB. The two largest and most recent studies [2, 3] do present a significant volume-outcome relationship in mortality and postoperative complications following OPCAB. However, the four smaller studies [4–7] do not reach similar conclusions for mortality, although one study [7] does report a significant relationship for postoperative complications and another study [4] reports a significant relationship for the number of grafts and the degree of completeness of revascularization following OPCAB. One possible explanation for the discrepancy in outcomes (and specifically mortality) between large and small studies is the wide variation in sample size, an issue which requires analysis by larger, higher-quality studies. Off-pump coronary artery bypass poses a technically challenging operation and one may have a long learning curve. It is also widely accepted that the greatest benefits from OPCAB are observed in the high-risk patient; hence, populations studied here will have a significantly higher risk profile than those undergoing routine CABG, in whom a volume-outcome relationship is far easier to predict. Our findings do somewhat support the idea of a volume-outcome relationship with OPCAB; however, the results will need to be interpreted with caution and there is certainly a need for larger, higher-quality

studies addressing training and surgeon experience in OPCAB, case selection for OPCAB, timing and effect of conversion to on-pump surgery and the impact of the degree of revascularization.

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] Lapar DJ, Mery CM, Kozower BD, Kern JA, Kron IL, Stukenborg GJ *et al.* The effect of surgeon volume on mortality for off-pump coronary artery bypass grafting. *J Thorac Cardiovasc Surg* 2012;143:854–63.
- [3] Konety SH, Rosenthal GE, Vaughan-Sarrazin MS. Surgical volume and outcomes of off-pump coronary artery bypass graft surgery: does it matter? *J Thorac Cardiovasc Surg* 2009;137:1116–23.
- [4] Agostini M, Fino C, Torchio P, Di Gregorio V, Feola M, Bertora M *et al.* High OPCAB surgical volume improves midterm event-free survival. *Heart Surg Forum* 2009;12:E250–5.
- [5] Plomondon ME, Casebeer AW, Schooley LM, Wagner BD, Grunwald GK, McDonald GO *et al.* Exploring the volume-outcome relationship for off-pump coronary artery bypass graft procedures. *Ann Thorac Surg* 2006;81:547–53.
- [6] Glance LG, Dick AW, Osler TM, Mukamel DB. The relation between surgeon volume and outcome following off-pump vs. on-pump coronary artery bypass graft surgery. *Chest* 2005;128:829–37.
- [7] Brown PP, Mack MJ, Simon AW, Battaglia SL, Tarkington LG, Culler SD *et al.* Comparing clinical outcomes in high-volume and low-volume off-pump coronary bypass operation programs. *Ann Thorac Surg* 2001;72:S1009–15.
- [8] Halm EA, Lee C, Chassin MR. Is volume related to outcome in health care? A systematic review and methodologic critique of the literature. *Ann Intern Med* 2002;137:511–20.
- [9] Halm EA, Lee C, Chassin MR. How is volume related to quality in health care? A systematic review of the research literature. In: Hewitt M (ed). *Interpreting the Volume-outcome Relationship in the Context of Health Care Quality*. Washington, DC: Institute of Medicine 2000 Appendix C: 27–102.
- [10] Mayer EK, Purkayastha S, Athanasiou T, Darzi A, Vale JA. Assessing the quality of the volume-outcome relationship in uro-oncology. *BJU Int* 2009;103:341–9.

eComment. Quality management and learning curve after coronary artery off-pump heart surgery

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We congratulate the authors on the interesting topic regarding surgeon-department cases volume and their relationship to surgical outcome concerning off-pump coronary artery heart surgery [1]. We concur and present our personal experience on the subject.

We believe that mortality as well as morbidity (as expressed by perioperative ischaemia/myocardial infarct, need for reoperation, perioperative stroke, perioperative renal failure requiring dialysis) following off-pump heart surgery is highly associated with the volume of cases operated in each centre and by each surgeon separately. We have observed that an experienced on-pump surgeon, commencing to deal with off-pump surgery requires a learning curve period necessary for acquiring method-specific surgical skills of about two years and 200–250 cases. The same goes for the whole surgical team, which needs to be trained so that all perioperative procedures, from induction to anaesthesia until transfer to the intensive care ward become fully standardized. After this point, there is a significant improvement in results regarding the aforementioned parameters of morbidity and mortality, to a point where these are comparable or even better than the ones of

patients operated on heart-lung machine. This also includes the hot topic of the number of revascularized coronary vessels, traditionally a weak-point of beating coronary artery heart surgery.

Conflict of interest: none declared

Reference

- [1] Sepehripour AH, Athanasiou T. Is there a surgeon or hospital volume-outcome relationship in off-pump coronary artery bypass surgery? *Interact CardioVasc Thorac Surg* 2013;16:202–8.

eComment. Learning curves in coronary revascularization

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We would like to comment on the interesting article by Sepehripour and Athanasiou [1], and the related comment by Bougioukakis *et al.* [2]. We totally agree that the matter of learning curve is one of utmost importance for every medical and surgical diagnostic or therapeutic procedure. This applies to both the

individual physician as well as to the surrounding team, as all of them require a procedure-related time and cases period in order to get acquainted with the method and offer the best possible results. However, we would like to have, if possible, the authors' and commentators' opinion on the off-pump procedure itself. In addition to the relatively long learning curve, it is believed that many of the alleged advantages of beating heart over on-pump surgery, such as benefits regarding the postoperative neurocognitive function, do not really exist. This is based on more recent data [3], unlike with what was believed in the past [4]. Do the authors believe that the junior surgical staff of a cardiothoracic department must be directed towards the training of off-pump heart surgery rather than other more promising procedures, such as minimal invasive aortic and mitral valve procedures?

Conflict of interest: none declared

References

- [1] Sepehripour AH, Athanasiou T. Is there a surgeon or hospital volume-outcome relationship in off-pump coronary artery bypass surgery? *Interact CardioVasc Thorac Surg* 2013;16:202–8.
- [2] Bougioukakis P, Mandewirth M, Babin-Ebell J, Diegeler A. eComment. Quality management and learning curve after coronary artery off-pump heart surgery. *Interact CardioVasc Thorac Surg* 2013;16:207–8.
- [3] Selnes OA, Gottesman RF. Neuropsychological outcomes after coronary artery bypass grafting. *J Int Neuropsychol Soc* 2010;16:221–6.
- [4] Tagarakis GI. Neurological disorders and neuroprotection after heart surgery. *Recent Pat CNS Drug Discov* 2008;3:226–9.