

## Pre-operative echocardiography: Evidence or experience based utilization in non-cardiac surgery?

Pre-operative echocardiography has been utilized in perioperative period for decades in patients with active cardiac conditions scheduled for non-cardiac surgery to aid in risk stratification. Echocardiography enables direct visualization of the various chambers of the heart, valves, adjacent structures and major connecting vessels like pulmonary artery and aorta. In the majority of patients, trans-thoracic echocardiography (TTE) has been used for screening with few exceptional clinical conditions such as endocarditis, severe calcific aortic stenosis, suspected intra cardiac thrombus etc., where trans esophageal echocardiography has been performed pre-operatively. TTE as a cardiac imaging offers safety, portability and repeatability in addition to high quality imaging. The pertinent question raised is “Is pre-operative resting or stress TTE evidence based?” This editorial scrutinizes if the pre-operative echocardiography utilization is based on the guidelines or individualistic expert opinion.

Cardiac disease is a potential source of perioperative complications in any non-cardiac surgery. Perioperative physicians and anesthesiologists realize the importance of risk stratification by evaluation of the nature and severity of cardiac disease prior to anesthesia. Major non-cardiac surgeries with prolonged hemodynamic and cardiac stress are associated with major cardiac complications (between 2.0% and 3.5%) and mortality (between 0.5% and 1.5%).<sup>[1]</sup> This difference in the incidences is mainly explained by patient selection and the endpoints defined for myocardial infarction. The morbidity and mortality depends on various factors like the nature of the patient’s pre-existing clinical condition (e.g., ischemic heart disease [IHD], left ventricular [LV] dysfunction and significant valvular heart disorders), its severity and the type of surgical procedure being performed.

Currently, British Society of Echocardiography (BSE) as well as American Society of Echocardiography (ASE) is establishing guidelines for Echocardiography in the pre-operative assessment with periodic revision. BSE recommends TTE in patients with documented IHD with reduced functional capacity (<4 metabolic equivalents [METs]), unexplained shortness of breath in the absence of clinical signs of heart failure, if electrocardiogram (ECG) and/or chest X-ray are abnormal, murmur in the presence of cardiac or respiratory symptoms, murmur in an asymptomatic individual in whom clinical features or other investigation suggest severe structural heart disease. TTE should not be used just to repeat the assessment of previous echocardiogram with no intervening change in clinical status within 12 months.<sup>[2]</sup> ASE has no clearly defined indication for resting echocardiogram, except for high-risk vascular procedures in patients with reduced functional capacity (<4 METs) where only stress echocardiography is recommended.<sup>[3]</sup>

Clinical evidence showing appropriate utilization of pre-operative echocardiography in non-cardiac surgery is scanty. The resting echocardiography has relatively weak evidence in predicting post-operative outcomes even in patients with active cardiac conditions and poor functional status.<sup>[4]</sup> American Heart Association (AHA) guidelines for perioperative cardiac risk stratification state that cardiac evaluation in any form should help the perioperative care providers by doing more than just giving medical clearance for the surgery.<sup>[5]</sup> It should rather fortify informed clinical judgment in terms of existing cardiac status, recommendations for managing of cardiac issues and collaborating with perioperative anesthesiology team for management that might affect short or long-term cardiac outcomes.

Few prospective and retrospective studies validate a positive correlation between LV dysfunction and post-operative morbidity or mortality.<sup>[6,7]</sup> Any degree of LV dysfunction has been found to be associated with perioperative myocardial infarction or cardiogenic pulmonary edema (odds ratio [OR] 2.1, 95% of the confidence interval 1-4.5,  $P < 0.05$ ).<sup>[8]</sup> This finding of predictive post-operative events had a very poor sensitivity (43%) and predictive value (13%) but at the same time had significant specificity (76%) and negative predictive value (94%). It was found that the overall greatest risk of complications was associated with ejection fraction <35%.<sup>[9]</sup> Hence it makes cardiac risk stratification pertinent pre-operatively. Flu *et al.* in their prospective trial on more than 1000 vascular surgical patients found 40% asymptomatic LV failure of which majority had isolated diastolic dysfunction and this doubled the 30 day cardiovascular morbidity and

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quadrupled the long-term mortality more in open than endovascular procedures. They suggested including TTE routinely for asymptomatic open vascular procedures in the pre-operative risk stratification.<sup>[10]</sup> Technology advancements with newer echocardiography features such as strain analysis and 3D echo helps to quantify diastolic function more precisely and thereby improve overall perioperative management.<sup>[11,12]</sup>

A meta-analysis of 25 echocardiography and 50 nuclear scanning in non-cardiac surgical patients, found out superior likelihood ratio (true positive to false positive rate) with stress echocardiography compared with thallium scanning (4.09 vs. 1.83) in predicting post-operative outcomes.<sup>[13]</sup> In terms of cost effective analysis, Kertai *et al.*<sup>[14]</sup> demonstrated a positive trend for dobutamine stress echo (DSE) to have better diagnostic performance than ambulatory ECG, exercise ECG, radionuclide ventriculography, myocardial perfusion scintigraphy and dipyridamole stress echo, in their meta-analysis of 8119 vascular patients. Mantha *et al.* suggested DSE is not an ideal test in predicting post-operative outcomes as suggested by the Kertai *et al.*<sup>[14]</sup> by proposing two stage hierarchic model to combine information about likelihood ratio separately for positive and negative outcomes.<sup>[15]</sup>

It has been seen that pre-operative echocardiography used based on the international guidelines in the targeted population influences perioperative management including the anesthesia technique. This information is predominantly from expert opinion and retrospective review.<sup>[16]</sup> Unfortunately, till date there exists no objective evidence in terms of randomized control trial on utilization of pre-operative echocardiography on the perioperative outcome. In a large population based retrospective cohort review 2,64,823 patients were analyzed and echocardiography performed in 15.1% of these patients. They found the pre-operative echocardiography was not associated with improved outcomes or shorter hospital stay in major non-cardiac surgery, casting doubts on proper utilization of the very common pre-operative test.<sup>[17]</sup>

Is there a better way to analyze if pre-operative echocardiography improves post-operative outcome? May be yes, with a large number of prospective cohort studies or with randomized control trials, but these studies are not devoid of their own inherent limitations. Cohort studies would be subjected to selection and information bias along with many confounding factors like severity of illness. Blinding is a pertinent concern even with a randomized trial leading to the observer and performance bias. Is there a way to optimize the pre-operative condition such as altering medications, fluid therapy etc. based on the echocardiography to assess the outcome? One should realize the ethical issues for the control group in these interventional trials. Thus, study designs in various

forms for assessing the relationship between pre-operative echocardiography and post-operative outcome may have major clinical and logistical concerns.

Since multiple issues may be encountered while performing clinical trial on the utilization of the pre-operative echocardiography, perhaps a web-based survey may answer these issues. In a web-based survey on the simulated patients, Vigoda *et al.* found out that only 40% of responders follow the recommendations for patients without active cardiac conditions but 82% of responders followed the guidelines when faced with simulated patients with active cardiac issues.<sup>[18]</sup> This observation casts doubt on the recommendations advised by AHA/American College of Cardiology including utilizing echocardiography. We (SS) are currently doing web based questionnaire study on the pre-operative utilization of TTE in non-cardiac and non-vascular simulated patients with varying cardiac conditions. Participants are asked to report in terms of anesthetic induction, invasive lines, cardiac output monitoring, planned post-operative care before and after reading the echocardiography. However, these types of surveys are handicapped due to a large selection prejudice.

Evolution of computer technology aids miniature of versatile echo probes such as Vscan thus facilitating bedside availability including pre-operative clinic. Authors are expecting significant progression in the usage of TTE for limited examination on ventricular function and assessment of the valves and major vessels as proposed by BSE and cardiac society of Australia and New Zealand, which has also suggested inclusion of hemodynamic assessment in addition to diagnostic screening.<sup>[19]</sup> Canty and Royse audited echocardiography as point of care in the pre-operative clinic.<sup>[20]</sup> Although there was no available data for change in the outcome, they realized major impact in these techniques in terms of newly diagnosed end stage cardiac disease, change in the anesthetic and hemodynamic management and avoiding postponement of the surgery.

In conclusion, appropriate utilization of the pre-operative echocardiography to improve over all perioperative outcomes is a challenging task, encountered by every perioperative physician during pre-operative assessment. With recent increase in echocardiography training amongst anesthesiologists, we envisage increased integration with conventional anesthetic assessment. Utilization of pre-operative echocardiography can be extended to intraoperative as well as post-operative period as a new standard in monitoring. Cardiologists, cardiac anesthesiologists and anesthesiologists need to formulate a new strategy for utilizing echocardiography in an assessment paradigm in peri-operative risk stratification of patients afflicted with cardiac pathology.

Adequate training for use is essential as these imaging technologies require both skills in acquisition of diagnostic quality images, as well as knowledge and experience in their interpretation. Every perioperative physician needs to understand that it might not affect outcomes directly though it influences perioperative anaesthetic and medical management, indirectly.

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