Future of Awake Cardiac Surgery

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THORACIC EPIDURAL ANESTHESIA (TEA) has been in use for several decades in the armamentarium of anesthesiologists. It is used either as an adjunct to general anesthesia (GA) or to provide postoperative pain relief after cardiothoracic surgery. Its use during high-risk surgical procedures may reduce complications.[1] Other benefits of TEA are improved analgesia,[2] reduced ventilation time,[2–4] better pulmonary function, reduced incidence of renal failure and myocardial infarction,[5] coronary vasodilation or cardio-protection,[6,7] lowered stress response,[7] better cardiac function,[8] and reduced psychological morbidity.[1] Additional benefits (which have limited evidence in the literature) are reduction in the incidence of atrial fibrillation,[1] cost,[9] and length of stay, both in an intensive care unit and a hospital.[10] Fears about permanent neurologic deficits after use of TEA in cardiac surgical patients were expressed.[11] There were two concerns: the concomitant use of antiplatelet medications in cardiac patients, and use of heparin intraoperatively. Two cases of permanent neurologic deficits were reported.[12,13] Following this, several other authors expressed fear about the safety of epidural use in cardiac surgery and questioned its continued use.[14–16] It is not surprising to find such a reaction from the community of cardiac anesthesiologists, considering the reluctance among surgeons and patients to accept anesthetic complications. Additionally, prevailing defensive medical practice might stop the use of TEA in cardiac surgical patients and, therefore, awake cardiac surgery (ACS).

The combination of off-pump coronary artery surgery and TEA appeared to lead inevitably towards awake surgery. It was thought that it would be impossible to carry out midline sternotomy and off-pump coronary artery surgery in non-intubated patients until the first report.[17] Carrying out cardiac surgery under TEA in an awake non-itubated patient is called "ACS". Ever since ACS was reported in the year 2000,[17] several authors have reported their experiences.[18–22] Potential benefits of ACS described by these authors were benefits in patients with pulmonary disease[23] and airway difficulties,[24] easy monitoring of cerebral function,[25,26] benefits secondary to TEA,[2–9] facilitation of fast-tracking,[27] and cost reduction.[9] Finally, the disadvantages that may be caused by administration of GA obviously are avoided.

The details of global experience of ACS may be found in Table 1.[17,25,33–37] All these authors showed absence of permanent complications, neurologic or other. Despite this, many anesthesiologists continued to express apprehension about the safety of epidurals.[28,29] Several "pro/con" debates about this topic were held in many congresses; there was no consensus, and the anesthesiologists continued to remain undecided as to whether or not to take up ACS as a viable option in existing practice. Once the feasibility of ACS was shown, even surgeries requiring cardiopulmonary bypass were conducted in awake patients.[30,31] As an extension of this technique, awake transapical aortic valve implantation was reported.[32] The dilemma of whether or not to routinely conduct ACS may have arisen due to the lack of overwhelming evidence supporting the use of TEA and ACS. Showing significant benefits of ACS may not be likely now or in the future, considering the decline in the rate of insertion of TEA due to extensive use of antiplatelet medications in cardiac surgical patients. It also is possible that, in an era of defensive medical practice, evidence may be required prior to the clinical use of a novel technique, which is the case for conducting ACS. Additionally, the medical fraternity expects anesthesia to be complication free, and complications due to anesthesia are unacceptable to patients and surgeons. The possibility of symptomatic epidural hematoma has prevented many from practicing TEA; the question of practicing ACS appears even more remote in their perspective. This review aims at touching upon these issues. It is common for novel techniques to go through such phases. William James (1842-1910), a famous American philosopher of the 19th century, said: "A new idea is first condemned as ridiculous and then dismissed as trivial, until finally, it becomes what everybody knows." ACS is no exception to this quotation.

CURRENT STATE OF AWAKE SURGERY

ACS appeared to be a logical extension of minimally invasive surgery. ACS first was reported by Karagoz et al.[17] These were termed "awake cardiac coronary artery bypass (ACAB) surgery"[18] and "conscious off-pump coronary artery bypass graft (COPCAB) surgery."[24] Karagoz and colleagues suggested that conducting awake surgery might be one additional technique to minimize the "invasiveness" during surgery.[17] Following this, several clinicians, including the author of this review, published their reports on various aspects of awake cardiac surgery.[22–27] Initial reports included only off-pump coronary artery bypass surgeries while, subsequently, even cardiac surgeries requiring cardiopulmonary bypass were

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Table 1. International Series of Awake Cardiac Surgery

Author	Year	Country	n	Surgery	Conversion to GA	Intraoperative Difficulties	Complications
Aybek[33]	2003	Germany	34	OPCABG	1 incomplete analgesia	1 pneumothorax	1 graft occlusion
Karagoz[17]	2005	Turkey	137	OPCABG	None	None	No mortality, no neurologic complications
Chakravarthy M[25]	2005	India	151	OPCABG + cases on CPB	3 conversions	1 conversion to CPB	No mortality, no neurologic complications
Bottio[34]	2007	Italy	50	Valve surgeries	3 - mechanically ventilated	None	3 short-term mortalities unrelated to anesthesia
Al-Abdullatief[35]	2007	Saudi Arabia	79	Thoracic + thoracoscopic	1	None	ICU admission decreased
Pompeo[36]	2007	Italy	14	Thoracoscopic metastatectomy	2	None	No difference in outcome in comparison to controls
Kortoglu[37]	2009	Turkey	76	MIDCAB	None	None	Length of stay in ICU decreased

Abbreviations: OPCABG, off-pump coronary artery bypass grafting; CPB, cardiopulmonary bypass; MIDCAB, minimally invasive direct coronary artery bypass; ICU, intensive care unit; GA, general anesthesia.

reported.[30,31] Although the feasibility to perform surgery and lack of complications were acknowledged by all authors, apprehension about reproducibility of the technique arose in the minds of other anesthesiologists. This concern was discussed in many pro/con debates and invited commentaries and editorials.[28,29,33,38] The debated issues were two-fold: first, the perceived absence of safety of epidurals in patients undergoing cardiac surgery and, second, the issues during ACS. These were not at all issues under conventional endotracheal general anesthesia.[28] Because of lack of evidence, ACS continues to be a debated entity. Both issues are relevant to ACS. Epidural hematoma is due to TEA rather than ACS. The other issues with ACS have improved over time. The improvement in surgical and patient outcome in clinicians' experience is a testimony to that. The combined effect of widespread use of anticoagulants in patients with ischemic heart disease (thus precluding the use of TEA) and the fear of symptomatic epidural hematoma have prevented cardiac surgical teams from embracing this novel technique.

INDICATIONS FOR ACS

The following were considered indications for conducting ACS:[39] The target coronary artery more than 2 mm in size, absence of left ventricular dysfunction and valve regurgitation, and normal airway. Presence of pulmonary disease was not a contraindication for epidural use.

Contraindications to the use of epidural anesthesia automatically would eliminate the possibility of carrying out ACS. In addition, the following also may contraindicate ACS: Absence of patient consent, surgeon's unwillingness, recent myocardial infarction, requirement of coronary artery endarterectomy, acute complications of myocardial infarction such as left ventricular free wall rupture/ventricular septal defect, and anticipated technically difficult surgery.

Benefits of performing ACS may result either from avoidance of endotracheal GA and/or from administration of TEA.

Benefits Due to Avoidance of GA

Although GA has been used for a large number of patients daily without significant complications, documented hemodynamic responses to tracheal intubation, suction of the endotracheal tube, and extubation may lead to myocardial ischemia; this may pose a potential risk in patients with coronary artery disease.[40,41] The avoidance of GA potentially may benefit the patient.[42,43] However, never before was the avoidance of endotracheal intubation in cardiac surgery deemed necessary or feasible.[17] In addition to these adverse effects of GA, endotracheal intubation has been shown to play an important role in causing pulmonary infection in intubated and mechanically ventilated patients.[44] Endotracheal intubation has been shown to cause mucosal injury, reduced mucociliary function, bypassing upper airway defenses, and reduced effectiveness of cough. Avoiding any factors contributing to increased incidence of nosocomial pulmonary infection may benefit patients, especially those with cardiac implants. To many anesthesiologists, these benefits may not appear attractive enough to embark on the use of TEA in cardiac surgery.

A conscious patient can serve as the cerebral function monitor while undergoing ACS.[25] Despite advances made in monitoring brain activity, no final word can be said about the safety and efficacy of commercially available cerebral function monitors. Monitoring cerebral function during ACS is useful. The author has reported patients getting irritable during phases of hypotension, which could be reversed by restoration of arterial pressure by placing the heart in a pericardial cradle.[25] In yet another report, it was shown that patients undergoing ACS after carotid endarterctomy became unresponsive during clamping of the "culprit" internal carotid artery, which was reversed by declamping.[28] Thus, a potentially serious problem of cerebrovascular ischemia was averted and surgery completed after insertion of an intravascular shunt. It is not known whether these potential advantages translate to clinical benefits; large-scale multicentric studies may be needed to arrive at conclusive