POSTOPERATIVE CARDIAC ARREST DUE TO CARDIAC SURGERY COMPLICATIONS

Ahmad Ebadi 1, Asghar Ramezani 2, Fakher Rahim3, Nasrin Afraee4

ABSTRACT

Objectives: To examine the role of anesthetists in the management of cardiac arrest occurring in association with cardiac anesthesia.

Methodology: In this retrospective study we studied the potential performances for each of the relevant incidents among 712 patients undergoing cardiac operations at Golestan and Naft Hospitals Ahwaz between November 2006 and July 2008.

Results: Out of total 712 patients undergoing cardiac surgery, cardiac arrest occurred in 28 cases (3.9%) due to different postoperative complications. This included massive bleeding (50% of cardiac arrest cases, 1.9% of patients); pulseless supra ventricular tachycardia (28.5% of cardiac arrest cases, 1.1% of patients); Heart Failure (7% of cardiac arrest cases, 0.2% of patients); Aorta Arc Rupture (3.5% of cardiac arrest cases, 0.1% of patients); Tamponade due to pericardial effusion (3.5% of cardiac arrest cases, 0.1% of total patients); Right Atrium Rupture (3.5% of cardiac arrest cases, 0.1% of patients) were detected after cardiac surgery. Out of 28 cases 7 deaths occurred (25% of cardiac arrest cases, 0.1% of patients). The most prevalent reason for cardiac arrest during post operative phase was massive bleeding (50%) followed by pulseless supra ventricular tachycardia (28.5%). Six patients had some morbidity and the remaining 15 patients recovered.

Conclusion: There are often multiple contributing factors to a cardiac arrest under cardiac anesthesia, as much a complete systematic assessment of the patient, equipment, and drugs should be completed. We also found that the diagnosis and management of cardiac arrest in association with cardiac anesthesia differs considerably from that encountered elsewhere.

KEY WORDS: Cardiac anesthesia, Arrest, Pulseless supra ventricular tachycardia, Massive bleeding.

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INTRODUCTION

Many studies of cardiac arrest in association with anesthesia have been published recently. Five major studies among them includes: over five hundred thousand cases of all ages in the USA,1,2 one million pediatric cases in the USA,3 2.3 million cases in Japan,4 and over one hundred thousand in France.5 The findings are remarkably consistent. Cardiac arrest attributable to anesthesia occurred at the rate of between 0.5 and 1 case per 10 000 cases overall and at
the rate of 1.4 per 10,000 cases for the pediatric series; 55% of these were in children less than one year of age. The overall rate of cardiac arrest is up to 10 times higher than this, with uncontrolled bleeding, technical surgical problems, extensive co-morbidity, and advanced age all featuring prominently.

In-hospital mortality in the anesthesia related group was considerably lower than the surgical rate, with 80% of these patients leaving hospital fully recovered. Most of the anesthesia related cardiac arrests were thought to be preventable and to have involved human error or inadequate human resources. Anesthesia in cardiac surgery is one of the most difficult fields of anesthesiology. The most difficult patients, whose adaptive reserve of cardiovascular system is very poor, are met in this field. These patients have ischemic heart disease and arterial hypertension often. All these factors increase the risk of anesthesia. So it is very important to choose medications thoroughly and save the compensatory mechanisms of cardiovascular system under conditions of surgical stress.6,7

Arrhythmias are frequent after cardiac surgery. The most common arrhythmias are supraventricular.8-12 Proposed hypotheses to explain the high incidence of atrial fibrillation (AF) include the increased adrenergic drive in the postoperative period, atrial ischemia/necrosis associated with atriotomy, incomplete or prolonged atrial cardioplegia, and electrolyte abnormalities during and following cardiopulmonary bypass or pericarditis. De novo ventricular arrhythmias following cardiac surgery is an uncommon but serious complication.13,14 Some patients are clearly at risk for ventricular arrhythmias. The patients included in the coronary artery bypass grafting (CABG) patch trial,19 for example, had an ischemic dilated cardiomyopathy with an ejection fraction (EF) <0.36 and an abnormal signal-averaged electrocardiograph (ECG). Significant advances in perioperative medical management and surgical techniques have both contributed to decreasing the incidence of severe bleeding in patients undergoing cardiac surgery. Refractory bleeding secondary to severe coagulopathy, however, still occurs occasionally in patients undergoing complex cardiac procedures.20,21 The correction of this condition requires the administration of large amount of blood products, which has limited efficacy and is often associated with increased postoperative morbidities and mortality.21 The aim of this study was to evaluate the causes of severe complications occurring after cardiac surgery.

**METHODOLOGY**

The study was approved by the Ethics Committee of the Ahwaz Jondishapur University of Medical Sciences and written consent was taken. We retrospectively and prospectively studied 712 patients undergoing cardiac operations at Golestan and Naft Hospitals Ahwaz between November 2006 and July 2008. Twenty eight patients (22 men, 6 women; age 42–71 years, mean 57.6 ± 11.02 years) developed postoperative cardiac arrest in the study group.

Data Collection: Data was obtained on patient characteristics and details of the mode and timing of presentation, the relevant investigations, and treatment received were also recorded. The information collected regarding the cardiac operation included: type of operation, degree of urgency, method of myocardial protection, bypass time, and cross-clamp time. Intensive care notes were reviewed to find out time to extubation and length of stay in the intensive care unit. A note was made of inotrope requirements, intra-aortic balloon pump support, perioperative arrhythmias, and any prolonged periods of hypotension.

Left ventricular function was assessed angiographically and graded by use of criteria of the Coronary Artery Surgery Study.22 Carotid artery duplex scanning was performed as previously described in patients>65 years old and in younger patients with carotid artery bruits, including transient ischemic episodes.23 Carotid artery stenosis was graded as insignificant or no disease (luminal narrowing<50%); moderate disease (narrowing >50% but <80%); severe disease (narrowing >80 but <99%); and complete occlusion. For the analysis, severe disease
and complete occlusion were combined. The atherosclerosis was graded independently by two blinded investigators as insignificant or no atherosclerosis; mild atherosclerosis (intimal thickening <3.0 mm without intimal irregularities); or moderate to severe atherosclerosis (intima thickening ≥3.0 mm with diffuse irregularities, large mobile or protruding atheromata, ulcerated plaques, and/or thrombi). Complications documented included myocardial infarction (new Q waves on the 12-lead ECG or ratio of fractionated lactic dehydrogenase [LDH1/LDH2] >1 during the first 72 hours), low cardiac output syndrome (cardiac index of <2.0 L/min/m² for >24 hours after surgery regardless of treatment), renal failure (requiring dialysis), and death. Continuous telemetry ECG monitoring was performed until the time of hospital discharge to document atrial fibrillation.

**Statistical Analysis:** Continuous data are expressed as mean values ± SD. Univariate comparison was made by the *t* test or chi-square analysis when appropriate. A p-value <0.05 was considered significant.

**RESULTS**

Demographic and other characteristics of all 712 study patients are listed in (Table-I). Cardiac arrest occurred in 28 patients (3.9%) due to different postoperative complications which included massive bleeding (50% of cardiac arrest cases, 1.9% of patients); pulseless supraventricular tachycardia (28.5% of cardiac arrest cases, 1.1% of patients); Heart Failure (7% of cardiac arrest cases, 0.2% of patients); Aorta Arc Rupture (3.5% of cardiac arrest cases, 0.1% of patients); Tamponade due to pericardial effusion (3.5% of cardiac arrest cases, 0.1% of patients); Right Atrium Rupture (3.5% of cardiac arrest cases, 0.1% of patients) were detected after cardiac surgery (Fig-1). Unfortunately, out of 28 cases 7 deaths occurred (25% of cardiac arrest cases, 0.1% of patients) in patients with cardiac arrest. The most prevalent reason for cardiac arrest during post operative phase was massive bleeding (50%) followed by pulseless supra ventricular tachycardia (28.5%). Six patients had some morbidity and the remaining 15 patients recovered. There were no deaths in the remaining 15 patients (one suffered temporary morbidity but was “fully recovered” at 48 hours). Pre-existing medical or surgical disease was one of the aetiological factors in four deaths, surgery in two, and drugs in one. Characteristics of the 28 patients who developed cardiac arrest in postoperative phase has been shown in (Table-II). Fig-2 presents the numbers

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number (%)</th>
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<tbody>
<tr>
<td>Age, years (mean ± SD)</td>
<td>62 ± 12</td>
</tr>
<tr>
<td>Male/female</td>
<td>527/185</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>226 (31.7)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>389 (54.6)</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>214 (30)</td>
</tr>
<tr>
<td>Pulmonary disease</td>
<td>451 (63.3)</td>
</tr>
<tr>
<td>Normal</td>
<td>228 (32)</td>
</tr>
<tr>
<td>Moderate right stenosis</td>
<td>112 (15.7)</td>
</tr>
<tr>
<td>Severe right stenosis</td>
<td>84 (11.8)</td>
</tr>
<tr>
<td>Moderate left stenosis</td>
<td>210 (29.5)</td>
</tr>
<tr>
<td>Severe left stenosis</td>
<td>87 (12.2)</td>
</tr>
<tr>
<td>Coronary stenosis</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>141 (19.8)</td>
</tr>
<tr>
<td>One vessel</td>
<td>225 (31.6)</td>
</tr>
<tr>
<td>Two vessel</td>
<td>165 (23.2)</td>
</tr>
<tr>
<td>Three vessel</td>
<td>181 (25.4)</td>
</tr>
</tbody>
</table>
| *Moderate* and *severe* carotid artery stenosis* refer to stenosis of >50% but <80% and >80% to <99%, respectively.

Supra ventricular tachycardia (28.5%). Six patients had some morbidity and the remaining 15 patients recovered. There were no deaths in the remaining 15 patients (one suffered temporary morbidity but was “fully recovered” at 48 hours). Pre-existing medical or surgical disease was one of the aetiological factors in four deaths, surgery in two, and drugs in one. Characteristics of the 28 patients who developed cardiac arrest in postoperative phase has been shown in (Table-II). Fig-2 presents the numbers
of cardiac arrest detected in postoperative days among 28 patients. Twenty eight reports mentioned capnography. In seven reports the capnography waveform and end-tidal value was normal even though the patient was pulseless, suggesting that normal pulmonary blood flow may continue in the presence of extremely low systemic arterial pressure.

**DISCUSSION**

The traditional guidelines for diagnosis are to assess the conscious state, and then check the Airway, Breathing, and Circulation (ABC). The diagnosis of cardiac arrest in association with cardiac anesthesia is problematic for two reasons. Firstly, there is a continuous range of reduction of cardiac output which makes it difficult to determine the point at which it becomes significant. In the few patients in this study who had intra-arterial pressure monitoring in place at the time of cardiac arrest, the impression was gained that, because a pressure trace was visible on the monitor, the anesthetist was less inclined to manage the patient as a cardiac arrest. Secondly, an arbitrary decision has to be made about what constitutes a significant duration of arrest. For example,
should a vagal arrest of 30 seconds with prompt recovery be counted? The diagnosis should be made at the C stage of COVER, although other factors (listed below) often precede or accompany pulselessness.

Cardiac arrest may not be suspected if the oximeter signal is poor, if the ECG looks normal, or if the arterial pressure trace is present but the pressure is low. In these situations the circulation may be dangerously inadequate and delay in diagnosis may occur. The patient’s pulse should be felt in all these situations and the oximeter probe should be removed from the patient and the oximeter function confirmed by placing it on one’s own finger. Once cardiac arrest is detected, because there are often multiple aetiological factors a complete systematic assessment of the patient, equipment, and drugs should be completed even if a cause has already thought to have been found.

Perhaps anaesthetists are concerned by the hazards of treatment, especially during surgery in progress. Administration of 100% oxygen leads to awareness in some cases although, clearly, oxygen should be administered in an inspired concentration of 100% in all cases of cardiac arrest. Knowledge of appropriate oxygen circuits and their use is still insufficient. Adrenaline easily causes hypertension, myocardial ischaemia, and pulmonary oedema. Many of the patients given adrenaline received intermittent intravenous injections with consequent cardiovascular instability when an infusion would have been more appropriate. The preparation of an adrenaline infusion is an appropriate task for delegation. Cardiac compression may result in trauma to the heart, lungs, or chest wall with life threatening pneumothorax but, clearly, should not be delayed if indicated. The risk of continuing with surgery after ECC or defibrillation needs careful consideration.

The diagnosis and management of cardiac arrest in association with cardiac anesthesia differs significantly from that encountered elsewhere. Cardiac anesthetists in training should be specifically instructed and practicing anesthetists should regularly attend refresher course in diagnosis and management of cardiac arrest in association with cardiac anesthesia. The differences from non-anesthetic cardiac arrest should be emphasized. The diagnosis is made earlier and with greater precision; standard therapeutic modalities are used less frequently and to a lesser degree; and measures directed at alleviation of specific anesthetic and surgical causes are often possible. The outcome is generally good with the majority of patients leaving hospital alive and apparently well.

REFERENCES