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Clinical paper

Outcomes of patients with trauma and intraoperative cardiac arrest☆

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ABSTRACT

Background: Although the occurrence of intraoperative cardiac arrest is rare, it is a severe adverse event with a high mortality rate. Trauma patients have additional causes for intraoperative arrest, and we hypothesised that the survival of trauma patients who experienced intraoperative cardiac arrest would be worse than nontrauma patients who experienced intraoperative cardiac arrest.
Objectives: The aim of the present study was to compare the outcomes of trauma and nontrauma patients after intraoperative cardiac arrest.
Methods: In a tertiary university hospital and trauma centre, the intraoperative cardiac arrest cases were evaluated from January 2007 to December 2009, excluding patients submitted to cardiac surgery. Data were prospectively collected using the Utstein-style. Outcomes among the patients with trauma were compared to the patients without trauma.
Results: We collected data from 81 consecutive intraoperative cardiac arrest cases: 32 with trauma and 49 without trauma. Patients in the trauma group were younger than the patients in the nontrauma group (44 ± 23 vs. 63 ± 17, $p < 0.001$). Hypovolaemia (63% vs. 35%, $p = 0.022$) and metabolic/hydroelectrolytic disturbances (41% vs. 2%, $p < 0.001$) were more likely to cause the cardiac arrest in the trauma group. The first documented arrest rhythm did not differ between the groups, and pulseless electrical activity was the most prevalent rhythm (66% vs. 53%, $p = 0.698$). The return of spontaneous circulation (47% vs. 63%, $p = 0.146$) and survival to discharge with favourable neurological outcome (16% vs. 14%, $p = 0.869$) did not differ between the two groups.
Conclusions: The outcomes did not differ between patients with trauma and nontrauma intraoperative cardiac arrest.

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1. Introduction

Despite significant advances in intraoperative physiologic monitoring and surgical anaesthetic techniques, perioperative cardiac arrest still represents the most catastrophic complication during surgery and compromises the postoperative recovery of many patients. The mechanisms related to intraoperative cardiac arrest differ from those responsible for out-of-hospital events. Hypovolaemia due to bleeding is the most frequent cause of cardiac arrest reported during surgery.[1,2] The reported incidence of intraoperative cardiac arrest varies widely from 3 to 39 cases in 10,000 operations.[1,3] Because of the increasing age of patients, preexisting diseases or trauma, and new surgical interventions, cardiac arrests remain a serious concern.[3,4]

Trauma is a worldwide problem with severe and wide-ranging consequences for individuals and society as a whole. Trauma affects all nations and people from all walks of life and remains the leading cause of death in people under the age of 40 years.[5,6] In this context, trauma patients may present cardiac arrest due to an association of complex lesions and/or various organic disorders, increasing the mortality rate.[5]

The occurrence of cardiac arrest during surgery in trauma patients is not a rare event because of the severity of the patients' conditions, but there are few reports and studies that report cardiac arrest associated with trauma.[7] The causes of arrest in victims of trauma during surgery are numerous, and common examples include the severity of the patients' injuries, hypovolaemia associated with bleeding, and electrolyte disturbances.[6,7]

In the present study, we hypothesised that the survival of patients with trauma and subsequent intraoperative cardiac arrest (the trauma group) would be less likely to attain a return of spontaneous circulation (ROSC) and survive to hospital discharge with a favourable neurological outcome compared with nontrauma intraoperative cardiac arrest patients (the nontrauma group).

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2. Methods

The present was a prospective and observational study. A Portuguese translation of the National Report of Cardiopulmonary Resuscitation (NRCPR) was used. The data forms contain precisely defined variables derived from the Utstein-style guidelines.[8] Specifically, the forms included information regarding patient demographics, pre-arrest, arrest, process of care, and outcomes. In addition, information was collected on the characteristics of the anaesthesia and surgical procedures that were employed. The data were recorded by the attending anaesthesiologist during and immediately after resuscitation, and the patient data were prospectively tracked. The Institutional Committee on Human Research approved this observational study with a waiver of informed consent.

2.1. Patients

From January 2007 to December 2009, all of the adult patients (≥18 years old) with intraoperative cardiac arrest were evaluated and prospectively followed until in-hospital death or discharge. Intraoperative cardiac arrest was defined as an event that occurred during the induction, maintenance or recovery of anaesthesia. Trauma patients with cardiac arrest were all patients that arrived at the emergency department with acute injuries as a consequence of an extrinsic agent.[7] Cardiac arrest was defined as the cessation of cardiac mechanical activity and was determined by the absence of a palpable central pulse. Among the patients with more than one episode of cardiac arrest, only the first arrest was analysed.

2.2. Outcome measures

The prospectively selected primary outcome was survival to hospital discharge with a favourable neurological outcome. Neurological outcomes were determined using cerebral performance category (CPC) scales: CPC 1 is normal, 2 is mild to moderate disability, 3 is severe disability, 4 is coma/vegetative state, and 5 is cerebral death.[8–11] The neurological statuses pre-arrest and at discharge were determined by chart review. A favourable neurological outcome was defined as survival to hospital discharge with CPC 1 or 2. The secondary outcome measure included ROSC for more than 20 min.

2.3. Statistical analysis

Continuous data were expressed as the mean ± standard deviation. Continuous variables were compared using paired or unpaired Student's *t*-tests. Continuous values with non-Gaussian distributions were compared by Wilcoxon rank-sum or Mann–Whitney *U* tests. Categorical variables were compared by the chi-squared test or Fisher's exact test as indicated. Patient and event variables associated with the relevant outcomes by univariate analysis ($p < 0.10$) were included in the multivariable logistic regression analyses. Adjusted odds ratios (OR) and 95% CIs were determined for variables that were independently associated with each outcome. The SPSS software (SPSS Inc., Chicago, IL, USA, version 13.0) was used for the statistical analysis. A sample size was not planned. All of the tests were two-tailed, and *p*-values of <0.05 were considered statistically significant.

3. Results

During the study period, 81,587 procedures were performed under anaesthesia, and we collected the data of 81 consecutive intraoperative cardiac arrest cases: 32 in trauma patients and 49 nontrauma patients. The intraoperative cardiac arrest incidence at the hospital during the 3-year study period was 9.92:10,000 patients. ROSC (47% vs. 63%, $p = 0.146$) and survival to discharge with a favourable neurological outcome (16% vs. 14%, $p = 0.869$) did not differ between the two groups (Fig. 1).

Patient, pre-arrest, and arrest characteristics are described in Tables 1 and 2. Patients in the trauma group were younger than the patients in the nontrauma group (44 ± 23 vs. 63 ± 17, $p < 0.001$). In addition, the patients in the trauma group were less likely to have medical illnesses, including diabetes mellitus, renal insufficiency and hypertension. Interestingly, the patients in the trauma group were more likely to be classified as ASA I. All of the patients in the trauma group were taken to the operating room with an indication of emergency surgery. Hypovolaemia and metabolic/hydroelectrolytic disturbances were more commonly the cause of arrest in the trauma group (63% vs. 35%, $p = 0.022$ and 41% vs. 2%, $p < 0.001$, respectively). First arrest rhythms and the process of care, however, were similar in the two groups. Pulseless electrical activity was the most prevalent rhythm (66% vs. 53%, $p = 0.698$). The type of anaesthesia and the phase of anaesthesia (induction, maintenance or recovery) during which the arrest occurred did not differ between the two groups. Vascular surgery

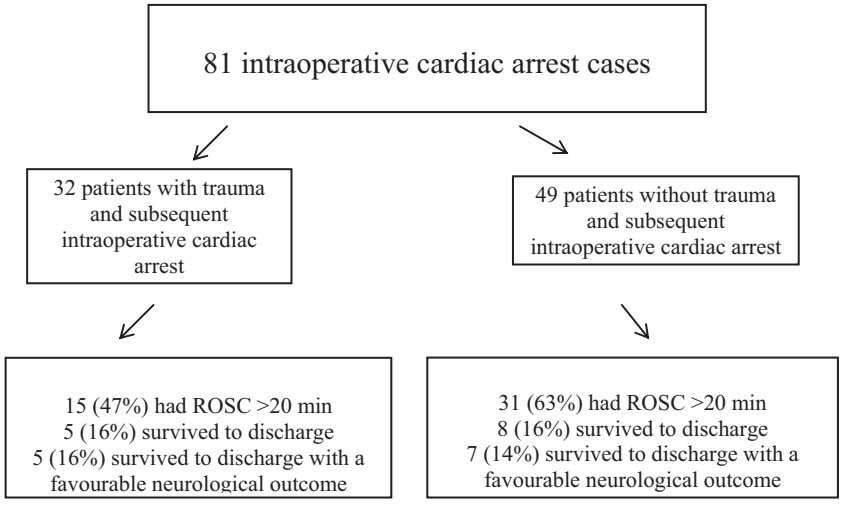

Fig. 1. Enrolment and outcomes: ROSC indicates return of spontaneous circulation.

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