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Echocardiographic Evaluation of Patients with Blunt Chest Injury: Correlation with Perioperative Hypotension

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Unlike myocardial infarction, neither the risks of anesthesia nor the appropriate anesthetic management following myocardial contusion have been well defined. In the one study examining this issue, an increased risk of anesthesia was not demonstrated.[1] However, the authors did not exclude patients with pre-existing cardiac disease, and myocardial contusion was defined by ECG and creatine-kinase-MB (CPK-MB) criteria, which are neither sensitive nor specific for contusion.[2,3]

Recently, both radionuclide angiography[4] and two-dimensional echocardiography (2-D echo)[5,6] have been shown to be more specific markers for clinically significant myocardial contusion. Our institution has recently introduced the routine use of 2-D echo in the evaluation of patients sustaining blunt chest trauma. We retrospectively reviewed this group to assess the risks of perioperative hemodynamic instability in patients with 2-D echo evidence of myocardial contusion.

MATERIALS AND METHODS

Seventy-six patients sustaining blunt chest trauma, free of pre-existing cardiac disease, were admitted between November 1979 and September 1984 and underwent general anesthesia within 6 months of injury (130 operations; 67% within 1 week, 88% within 1 month). Sixty-five were injured in motor vehicle accidents, four were injured in falls, and seven suffered other types of accidents.

All patients had bedside 2-D echo examinations during their acute stay. All had creatinine phosphokinase (CPK) isoenzyme determinations at least twice at 8-hour intervals following admission, and 89% had at least one ECG. Charts were reviewed for past medical history, extent of injury, laboratory data, timing and type of surgery, anesthetic technique, and hemodynamic data. Hypotension was defined as systolic blood pressure (BP) $\leq$ 90 mmHg, increased central venous pressure (CVP) as CVP $\geq$ 12 mmHg, and dysrhythmia as any rhythm other than normal sinus or sinus tachycardia.

Blunt chest trauma patients with abnormalities on 2-D echo examination were compared with patients who had normal 2-D echo results. Variables were compared using the Student's two tailed t test for paired data and Fisher's exact test. Values are ±standard error of the mean (SEM). A probability level of $P < 0.05$ qualified as statistically significant. To minimize the chance of a beta error, uncorrected t tests were used and exact P values included.

RESULTS

Twenty-three of the 76 patients with blunt chest trauma had abnormal 2-D echo examinations. Two-D echo abnormalities were: 1) segmental wall motion abnormality (16 patients), 2) enlarged right ventricle (10), 3) pericardial effusion (6), 4) acute valve abnormality (2) 5) and, right ventricular thrombus (1).

Patients with abnormal 2-D echo examinations had an increased incidence of preoperative and intraoperative hypotension, hypotension with increased CVP, and intraoperative dysrhythmias (table 1). Intraoperative dysrhythmias observed were bradycardia, supraventricular tachycardia, and ventricular fibrillation in the abnormal 2-D echo group and bradycardia in the normal 2-D echo group. Complications were not correlated with the type of surgery or anesthetic drug. No complications were present in procedures occurring more than 1 month after injury. There were two deaths in each group, with no deaths of cardiac origin. Follow-up at an average of 10 months revealed no symptoms of cardiac disease. Pulmonary artery catheters were inserted without incident in five patients with abnormal 2-D echos, and the additional hemodynamic data were helpful in diagnosing a case of cardiac tamponade, a case of right ventricular failure, and a case of acute left ventricular failure.

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Patients with abnormal 2-D echo examinations (23) did not differ from those with normal 2-D echo results (53) regarding age (32 ± 2.8 yr for both groups combined, range 6–81 yr) or male:female ratio (58:18). Specific injuries according to major organ system involvement are listed in Table 2. Chest roentgenography abnormalities between the two groups of patients differed only in the incidence of cardiomegaly (13% in the abnormal-echo group, 0% in the normal-echo group).

Preoperative ECG findings did not differ between groups. Overall, 34% were normal, 26% had nonspecific ST–T changes, 16% had conduction delays, 12% had dysrhythmias, and 11% had focal ST–T changes. CPK-MB levels (% MB, total MB, and % of patients with MB > 40 U/l) did not differ between groups, although the peak CPK was higher in the abnormal group (1330 ± 330 *vs.* 720 ± 90).

Time from injury to surgery was similar in both groups. Type of procedure (craniotomy, thoracotomy, laparotomy, or orthopedic) differed only in the incidence of laparotomy (12% in the abnormal group, 2.3% in the normal group; $P = 0.02$). Anesthetic drug used (halothane, enflurane, isoflurane, N_2O/narcotic) differed only in the incidence of N_2O/narcotic (21% in the abnormal group, 5.7% in the normal group; $P = 0.008$).

Discussion

In this study, evidence of myocardial contusion by 2-D echo was present in 30% of patients undergoing general anesthesia following blunt chest trauma. Patients with and without 2-D echo evidence of myocardial contusion did not differ in age, average number of major organ system injuries, and type and severity of injuries. As previously reported,[2,3] ECG findings were poor markers of myocardial contusion, correlating neither with 2-D echo abnormalities nor with subsequent cardiovascular morbidity.

Evidence of myocardial contusion by 2-D echo correlated with an increased incidence of hemodynamic instability (hypotension with increased CVP, dysrhythmia) both before and during anesthesia. Although our definition of hemodynamic instability (systolic BP ≤ 90 mmHg, cardiac rhythm other than normal sinus, or sinus tachycardia) is arbitrary, when these conditions occurred and were noted in the record, they were considered serious enough for drug therapy 58% of the time. The lack of complications in operations performed greater than 1 month from the initial injury agrees with the reported complete functional recovery in most of these patients in 4–6 weeks.[4,7]

Pulmonary artery catheters were inserted in 22% of patients with 2-D echo evidence of myocardial contusion and were helpful in the diagnosis and treatment of hemodynamic instability. In patients with evidence of myocardial contusion by radionuclide angiography, Sutherland *et al.*[8] noted decreases in both right and left ventricular ejection fractions and increases in pulmonary vascular resistance (PVR) and suggested use of pulmonary artery catheters in this group of patients. Recommendations concerning intraoperative use of pulmonary artery catheters in these patients await a larger prospective study.

This study is limited by the usual biases inherent in a retrospective design. In particular, inconsistency may occur in observation and recording of hemodynamic data, guidelines for invasive hemodynamic monitoring, and decision to treat hemodynamic instability. Although our

TABLE 1. Incidence of Complications

	Abnormal 2-D Echo Group		Normal 2-D Echo Group		*P* Value
	Present	n*	Present	n†	
Preoperative					
Hypotension	10	23	9	53	.01
with ↑ CVP‡	4	7	0	7	.02
Intraoperative					
Hypotension	10	43	9	87	.05
with ↑ CVP§	5	10	0	8	.02
requiring drug therapy	8	43	3	87	.004
Dysrhythmia	5	43	2	87	.03
requiring drug therapy	3	43	1	87	NS

* n observations in 43 procedures in 23 patients.
† n observations in 87 procedures in 53 patients.
‡ CVP measured in 7 patients in each group.
§ CVP measured in 10 patients in abnormal group and 8 patients in normal group.

TABLE 2. Patterns of Injury (%)

	Abnormal 2-D Echo Group (n = 23)*	Normal 2-D Echo Group (n = 53)
Chest		
Rib fractures	17	32
Clavicle fractures	13	13
Pulmonary contusion	35	47
Hemopneumothorax	26	25
Tracheal rupture	0	2
Abdomen		
Liver fracture	4	2
Spleen fracture	4	9
Hepatic artery laceration	4	0
Renal laceration	4	6
Ruptured bladder	9	2
Cranial injury		
Closed head injury	61	53
Subdural hematoma	0	9
Facial fractures	22	19
Orthopedic fractures (pelvic, long bone, spinal)	83	68
Injuries/patient	3.0	2.9

* No significant differences between groups.

findings could have been due to more severe noncardiac injuries in patients in the abnormal 2-D echo group, this was not suggested by analysis of the groups using established rating systems of injury severity.[1,4,8]

In conclusion, we reviewed our experience with the anesthetic management of patients sustaining blunt chest trauma and with evidence of myocardial contusion by 2-D echo. Patients with abnormal 2-D echo examinations had an increased incidence of preoperative and intraoperative hypotension associated with an increased CVP. This suggests that preoperative 2-D echocardiography is a sensitive test for predicting which patients are likely to experience hypotension in association with an increased CVP.

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Diabetic "Stiff Joint Syndrome" as a Cause of Difficult Endotracheal Intubation

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"Stiff joint syndrome" consists of juvenile onset diabetes mellitus, (JODM), nonfamilial short stature, and joint contractures. The fourth and fifth proximal phalangeal joints, the most frequently involved small joints, exhibit contractures and tight waxy skin. Large joints, notably those of the cervical spine, are less frequently involved.[1–3]

In the following case, limited motion of the atlanto–occipital joint made endotracheal intubation of a patient with this syndrome impossible.

Report of a Case

A 36-year-old man with JODM was scheduled for elective cholecystectomy after evaluation for renal transplantation revealed asymptomatic cholelithiasis. Preanesthetic evaluation revealed a 26-year history of JODM complicated by diabetic retinopathy resulting in blindness in the left eye, hypertension, and near end-stage renal disease. He had had no recent episodes of diabetic ketoacidosis, despite poor control of his serum glucose. He had had two previous anesthetics 5 years previously for ophthalmologic procedures. Anesthetic records for those procedures were on microfilm at an off-site storage facility and unavailable preoperatively. Later examination of those records revealed that endotracheal intubation for general anesthesia had been difficult on both occasions. Significant physical findings included height of 157 cm and an arterial blood pressure of 180/100 mmHg. Mouth opening and cervical spine mobility were judged to be normal, and no difficulty with endotracheal intubation was anticipated. Body temperature was 37° C. Hemoglobin was 8.9 g/dl. Serum glucose varied between 160 and 564 mg/dl on the day prior to scheduled surgery and was 169 mg/dl at 0600 the next morning.

Preoperative medication consisted of diazepam 15 mg po and one-half his usual insulin dose with simultaneous administration of 5% dextrose in 0.5% normal saline infusion. Intraoperative monitoring of serum glucose and treatment of abnormal values were planned. Anesthesia was induced with thiopental 450 mg, meperidine 50 mg, and atracurium 30 mg iv. In spite of repeated attempts by a resident and two staff anesthesiologists, direct visualization of the vocal cords and intubation of the trachea were unsuccessful. Although cervical spine extension was normal, tilting of the head on the atlas was severely limited. Surgery was cancelled. Ventilation was with oxygen and nitrous oxide *via* a mask for 45 min, due to what appeared to be failure of return of neuromuscular function. It was then noted that there was a marked discrepancy between the twitch response of the facial versus the ulnar nerve, with that of the latter being much attenuated. It was at this time that tight skin and stiff joints in the fingers were appreciated. The neuromuscular blockade was then antagonized with glycopyrolate and neostigmine, and the patient was awakened. His postanesthetic

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