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Simultaneous multisystem surgery: An important capability for the civilian trauma hospital

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ABSTRACT

Head injury commonly presents in association with torso or limb injuries, especially in blunt trauma mechanisms. Stopping life-threatening thoraco-abdominal hemorrhage and preventing secondary brain injury are time critical priorities. Although simultaneous operative management by multiple teams has been common practice in the recent wars in Iraq and Afghanistan, simultaneous surgery is rare in most civilian settings. Nevertheless, situations arise whereby simultaneous craniotomy and chest or abdominal surgery is necessary to prevent mortality or reduce severe morbidity. We discuss two recent cases at our level one trauma centre, the challenges that surgeons and the operating room staff face and propose that with appropriate planning this surgical capability can be integrated into the systems of contemporary advanced trauma units.

Contents

1. Introduction

Concurrent life-saving airway, ventilatory and circulatory interventions are commonly employed in the reception and resuscitation of severely injured trauma patients in whom the presence of multiple cranial, torso and limb injuries has high rates of mortality [1,2]. However the concept of multiple surgical teams operating simultaneously on a critically injured patient has received far less attention especially in the civilian context [3,4].

Damage Control Surgery is a well-established concept in trauma surgery whereby initial surgery aims only to control hemorrhage and contamination following which deranged physiology is corrected and definitive surgery is delayed until the patient is in optimal condition [5,6]. The practice of simultaneous surgery in patients with multi-trauma is consistent with this paradigm. Combinations of simultaneous damage control thoraco-abdominal surgery, limb surgery (vascular and orthopedic) and cranio-facial or neck surgery with two or three surgical teams operating on the injured soldier with blast induced polytrauma became common

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practice in the Iraq and Afghanistan wars with good outcomes and more efficient use of operating theatre resources [7].

The combined and synchronous surgery strategy is not well articulated in military surgery manuals, however, and has yet to become commonplace in the civilian setting. Civilian surgeons tend to take turns depending on what is perceived to be more urgent, with hemorrhage control usually taking priority. However, unrecognized expansion of a small acute subdural or epidural hematoma may occur whilst a damage control laparotomy is being performed with deleterious effects. Moreover, without accurate monitoring of intracranial pressure (ICP), optimization of cerebral perfusion pressure (CPP) cannot be accurately achieved intraoperatively [8].

We present two recent civilian cases where operations by neurosurgical and general surgical teams were undertaken simultaneously in multiply injured patients at our level one trauma centre. These cases highlight the potential benefits of simultaneous surgery in acutely injured patients and outline important practical aspects in undertaking this type of surgery. We also undertake a review of the literature available regarding simultaneous surgery in the multi- trauma context. We searched, English language publications, in MEDLINE (PubMed and Ovid), EMBASE, CINAHL, Google Scholar, and the Cochrane Library from with a time restriction. We used, in various relevant combinations, keywords and MeSH terms pertinent to the area of interest: simultaneous; surgery; simultaneous surgery; military; neurotrauma; dual surgery; concurrent surgery and civilian. Relevant articles were incorporated into the discussion.

2. Methods and results

2.1. Case 1

A 30 year-old male crashed into a wall at high speed while Kite-surfing. His initial Glasgow Coma Score (GCS) was 13, but dropped to 3 in the emergency department while undergoing a computer tomography (CT) of his brain. The patient was intubated and underwent an urgent focused abdominal sonography for trauma (FAST) scan that was positive for free abdominal fluid. The CT brain imaging revealed large acute extradural and subdural hematomas (SDH). The patient's international normalized ratio (INR) was 6.4 on admission. The patient was urgently transferred to the operating room, while simultaneously receiving packed red cells, fresh frozen plasma and platelets to reverse the coagulopathy. Upon positioning, the patient had a cardiac arrest and required five minutes of cardiopulmonary resuscitation. At this point it was unclear whether the patient was arresting from abdominal injury, or from cardiac instability secondary to the subdural hematoma. As both procedures were possible and in the best interest of the patient an emergency laparotomy and emergency craniectomy were performed simultaneously. Both extradural and subdural hematomas were evacuated and the patient stabilized. The laparotomy identified an intraperitoneal bladder rupture as the cause of the positive FAST scan and the bladder was repaired. While the anesthetic team initially focused on resuscitation, the simultaneous findings from the two operations, allowed the anesthetic team to refocus on ICP management. The patient made a gradual recovery and was discharged to a rehabilitation facility. At three months review he was communicative with a modified Rankin Score (mRS) of 3.

2.2. Case 2

A 47 year-old male was struck at high speed by a motor vehicle in the middle of the night. He sustained obvious craniofacial, thoracoabdominal and limb injuries. He was intubated at the scene and resuscitated en route to the trauma center. CT scan of the head, neck, chest, abdomen and pelvis revealed diffuse axonal injury with cerebral contusion, bilateral hemopneumothoraces and free intra-abdominal fluid. He also had a major lower limb injury with evidence of vascular compromise and increasing signs of severe shock. Bilateral chest tubes were inserted and he was immediately transferred to the operating room. A simultaneous laparotomy and insertion of ventriculostomy were performed. The former demonstrated a mucosal tear of the small bowel mesentery, which was repaired. The latter enabled monitoring of ICP and CPP by the anesthetic team, and allowed control of ICP (which transiently rose to greater than 25mmH_2O) with venting of cerebrospinal fluid (CSF) to ensure stability of CPP sufficient to allow follow-on of an 8-h limb salvage procedure by the vascular and orthopaedic teams. After the surgery the patient was transferred to the intensive care unit (ICU) to be stabilized. Over the following days the patient underwent further operative procedures with his ICP and CCP under control. He was awoken and extubated uneventfully and was discharged to rehabilitation with four viable limbs and in a state of moderate post-traumatic amnesia on day 18 post injury. At three months follow up, the patients mRS had improved to 0.

3. Discussion

There is a paucity of literature concerning the value, indications and practical issues involved in operations by simultaneous surgical teams for civilian multi-trauma. Reports of simultaneous operations have tended to focus on extreme situations, such as in head injuries in pregnant patients, where the mother receives a craniectomy for acute subdural hematoma and the fetus is delivered by caesarean section [9]. However, it has been suggested that operating time can in some cases be reduced by two surgical teams working simultaneously [3]. Our cases demonstrate the feasibility, and potential benefits, of simultaneous operating in the multi-trauma patient in the civilian setting.

The first case demonstrates the potential life saving benefits of simultaneous intervention. The Advanced Trauma Life Support Guidelines recommend an urgent laparotomy for a patient with a positive FAST scan and hemorrhagic shock [1]. Wisner et al., argued that combined head and abdominal injuries requiring intervention were relatively rare and suggested immediate laparotomy if diagnostic tests suggest abdominal hemorrhage [4]. However, our first case also highlights the importance of treating both abdominal and head injuries simultaneously in selected patients. In this case, sequential treatment as taught in advanced trauma life support (ATLS) guidelines, may have led to an unacceptable delay in the treatment of the acute SDH, which seemed to have been the main determinant in his cardiovascular instability.

Due to simultaneous placement of the ventriculostomy at the beginning of the second case, the anesthesiologist was able to monitor and treat ICP and maintain optimal cerebral perfusion during the subsequent laparotomy and limb salvage surgeries. The risk of secondary brain injury was therefore minimized. It also provides an early warning system, should the patient develop a new or expanding intracranial hematoma, which may go undetected beneath the surgical drapes where the patient is not readily accessible. On the other hand, placing the ventriculostomy in the emergency room would have delayed the laparotomy.

Strasser et al. makes the important point that simultaneous surgical intervention, not only involves the surgeons, but also involves multiple levels of health care infrastructure [10]. Indications for dual operating need to be recognized early (often by emergency department staff, specialists residents and registrars) if it is going to be implemented in a timely fashion. In the resuscitation of unstable polytrauma patient, time is critical, especially in head injured patients, as even brief periods of hypotension or hypoxaemia are