Case study: 17-year-old motorcycle driver hit by a truck

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Introduction

At approximately 16:00, Jim, a 17-year-old male, is hit by a truck while riding his motorcycle. He is transported, by ambulance, to the emergency department (ED) of a community hospital. Jim arrives in the ED at 17:00. Initial assessment reveals: A. airway patent; B. breathing spontaneously, but with decreased air entry to bases; C. no obvious external bleeding and vital signs are BP 99/52, HR 110, RR 18, and T 38.3° C (no oxygen saturation recorded); D. alert and oriented. The only major findings during secondary assessment are a fractured left femur and tibia. Treatment at the community hospital includes O_2 by nasal prong, IV access, and a Thomas splint on the left leg. The decision is made to transfer Jim to a regional trauma centre.*

Jim arrives at the trauma centre approximately 18 hours post-injury (delay in transfer due to bad weather). Jim is alert and breathing spontaneously (on room air) when he arrives at the ED of the trauma centre. He is pale and denies chest pain. At this point his oxygen saturation is 80%, BP 115/60, HR 108, RR 24 and T 37.9°C. His skin is warm and dry, but petechiae are noted on his chest. His left leg remains stabilized with the Thomas splint. During the course of his stay in the ED, Jim's HR ranges between 106 and 179 bpm while his BP remains stable. His oxygen saturation increases to 97% after three hours of 100% O_2 by non-rebreather mask. Both ICU and anesthesia are consulted for assessment due to his low oxygen saturation. The decision is made to admit Jim to the trauma unit – an intermediate care unit with cardiac and hemodynamic monitoring capabilities – rather than the ICU. Prior to admission, Jim is sent for a CT scan of his chest. He is finally admitted to the trauma unit six hours after his arrival in the trauma centre.

What do you suspect may be causing Jim's respiratory distress?

Discussion

If you suspect fat embolism as the cause of Jim's respiratory distress, you are correct! Fat embolism is defined as the presence of fat globules in the lung parenchyma and peripheral circulation, resulting in acute respiratory distress. Fat embolism syndrome (FES) is defined as acute respiratory deficiency due to decreased alveolar diffusion of oxygen (Hager & Brncick, 1998).

The literature reports that the incidence of FES can range from 0.5% to 2.2% of all cases that involve long bone (femur, humerus, tibia) fractures, but this statistic will increase if there is more than one fracture, especially if one is a pelvic fracture (Hager & Brncick). Fat embolism may occur in other forms of trauma including massive soft tissue injury, severe burns and liposuction, as well as in non-traumatic conditions such as diabetes and pancreatitis (Walsh, 2002). FES may occur from within one hour after injury up to 72 hours later, with the average time of occurrence being 12 to 24 hours (Hager & Brncick).

This is significant for the ED nurse who may believe that fat embolism is a post-admission complication. It is essential to have a high index of suspicion and intervene early (Walsh).

Hypoxia is the hallmark symptom of FES (Walsh). Other symptoms of a respiratory nature include tachypnea, dyspnea, productive cough, hyperventilation, moist crackles, pulmonary edema, hemoptysis, and cyanosis. A chest x-ray may reveal a classic snowstorm or ground glass appearance. This respiratory failure will result in an increased cardiac workload (reduced cardiac output and hypotension) and alveolar collapse. Other symptoms that may develop include cardiac

* *a pseudonym was used to protect the identity of the patient*

arrythmias (specifically RBBB, inverted T waves, prominent S waves in lead I, prominent Q waves in lead III, and depressed ST segments), vague chest pain, restlessness, a rapid spike in temperature and decreased urine output (Hager & Brncick; Walsh). Drowsiness and coma are later signs (Walsh). Neurological (cerebral dysfunction) and dermatological (petechiae) symptoms may also be evident in FES (Walsh).

Diagnosis is considered definite if all three of the following criteria are present within 72 hours of a traumatic fracture:

- Unexplained dyspnea, tachypnea, arterial hypoxia with cyanosis and diffuse alveolar infiltrates on chest x-ray
- Unexplained signs of cerebral dysfunction such as confusion, delirium or coma
- Petechiae over the upper half of the body, conjunctiva, oral mucosa and retinae (Walsh; Prazeres, 2002). Bear in mind, however, that petechiae appear only in 50 to 60% of patients, usually within 24 to 48 hours, and can disappear after a few hours (Hager & Brncick).

Another classic sign is a rapid temperature spike (38 to 40° C) with no obvious precipitating cause (Walsh).

Diagnostic tests

Arterial blood gases will provide an early indication of hypoxemia. The patient will exhibit respiratory alkalosis at first, due to their tachypnea and dyspnea, and then they will progress to respiratory acidosis as their PaCO2 increases and their PaO2 decreases. Complete blood count may reveal a decrease in hemoglobin by three to five grams and a platelet count of less than 150,000/ml. Platelets may drop as low as 50,000/ml (Hager & Brncick).

Management

Prevention and early recognition are the keys to managing FES. Early stabilization and immobilization of fractures will also reduce the incidence and are essential (Hager & Brncick). This is especially pertinent for the ED nurse who has a key role in ensuring that any suspected fracture is immobilized correctly and any movement is minimized. If any splints are removed during assessment, the injured extremity should be immobilized/re-splinted afterwards. If we know which patients may be at risk, we can provide adequate oxygenation and ensure adequate fluid resuscitation to flush the fatty acids through the system and prevent renal failure (Hager & Brncick).

Baseline vital signs, including temperature and oxygen saturation, must be documented. Ongoing monitoring of vital signs and neurological status are essential for all patients at risk. Any abrupt change in behaviour or mental status may be the first sign of deterioration in the patient's condition (Walsh).

Treatment includes oxygen and frequent ABGs. If the PaO_2 cannot be maintained above 60 mm Hg, the patient may need to be mechanically ventilated with PEEP. Some patients will be managed well with noninvasive positive pressure ventilation (Hager & Brncick).

While some feel that the mortality from isolated FES is as low as 10% (Prazeres), if it occurs with other sequelae such as acute respiratory distress syndrome, pneumonia, congestive heart failure or coma, then the outcome is less likely to be positive and may be fatal in up to 87% of patients (Hager & Brncick).

Jim's course in hospital

Jim's course in hospital was not smooth. A chest x-ray on day two post-admission suggested a grade two acute respiratory distress syndrome (ARDS). There are four phases of ARDS which range from mild physical symptoms and a normal chest x-ray (Grade 1) to severe alternations in lung compliance resulting in difficult ventilation (Grade 4) (Horn & Lewis, 1991). He was subsequently transferred to the ICU when his oxygen saturation dropped to 75% and his PaO_2 was 82. In the ICU, intubation was considered but Jim was maintained on BiPAP.

Jim was also transfused after repeat bloodwork revealed his hemoglobin had dropped from 100 (on arrival) to 70. He was started on Fragmin for DVT prophylaxis. Jim was also noted to have weakness of his extensor hallucis longus in his left foot, paresthesia to the sole of his left foot, and he was unable to dorsiflex the great toe.

Once Jim's condition stabilized (on day 14), he was taken to the operating room for intramedullary fixation of his left femur and left tibia. Post-op he was seen by physiotherapy and occupational therapy. Jim's respiratory status gradually improved, but he developed neuropathic pain in his left foot as the result of a nerve injury. Twenty-two days after his admission to the trauma centre Jim was transferred back to his community hospital for rehabilitation.

Conclusion

Complications from fractures can occur at any time post-injury. Early recognition and stabilization of lower extremity injuries will minimize the risk of trauma patients developing pulmonary or other complications. Emergency nurses, in both community hospitals and trauma centres, have a key role in assessment and intervention of trauma patients to reduce the risk of complications.

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