

# ASK THE COMPUTER

## PROBLEM: MULTISYSTEM TRAUMA

Medical education programs from the Laboratory of Computer Science at Massachusetts General Hospital in Boston, adapted by Dr. Hoffer, who is director of ambulatory services at the Memorial Hospital in Worcester and associate professor of medicine at Harvard Medical School. This

month the computer presents a patient with a number of severe injuries while Dr. Hoffer simulates an attending physician whose task, and yours, is to evaluate and treat the patient and learn from the experience. The "physician's" answers are indicated by > and printed in italic type.

A 22-year-old college coed, under the influence of an unknown drug or drugs, leaps from a third-story window of her dormitory. She is brought into the emergency room within 20 minutes of the accident.

When you examine her, she is noted to be comatose. There are abrasions and contusions of the face and forehead and obvious fractures of the maxillae, zygoma, and mandible. A copious flow of blood is emanating from both nostrils. The skin shows cyanosis with poor capillary filling.

The chest wall appears stable, although there is crepitus on the right side. The abdomen is soft; bowel sounds are present. There are open comminuted fractures of both humeri in their midshafts. The left leg is 3 in. shorter than the right and is held in medial rotation and adduction. Blood pressure is 60/?; pulse is 140/min, weak and thready. Respirations are 40/min and shallow. Before your arrival, the house officer instituted oxygen therapy by mask, started an IV with Ringer's lactate, passed a central venous pressure catheter, and placed a catheter in the urinary bladder. Appropriate x-rays of the skull, chest, and extremities have been taken and are being processed.

At this point the most important single treatment that should be immediately carried out is...

> *Transfuse whole blood.*

We agree that treatment of shock is one

of the first actions you should undertake. However, first priority should be given to ensuring an adequate airway. Try again.

Your immediate action is...

> *Intubate.*

(You specified intubate—but you should be more specific. We'll assume you meant endotracheal intubation.)

In any emergency situation, first priority must be given to the establishment of an adequate airway. This is particularly important in this situation, in which there is significant trauma to the head and chest. Some experts would favor tracheostomy because of the severe facial trauma, which will require immediate attention. Remember that the x-ray studies are being processed.

What are the most important additional laboratory studies (other than x-rays) that should be performed?

> *ABG, CBC, urinalysis.*

We agree with your decision to request: Arterial blood gases

Hct and Hgb

The following tests should also be ordered:

BUN or creatinine

There is a significant probability that acute renal failure will develop. You should order a BUN or creatinine to evaluate baseline renal function.

Transfusions

This patient will need multiple transfusions. It is critical that you send

blood immediately for type and cross-match.

Electrolytes

Because of the cardiovascular collapse, it is considered good practice to obtain baseline evaluations of serum electrolytes.

Drug levels

Part or all of the patient's CNS depression may be attributed to the trauma or may be attributed to ingestion of the unknown drug. Commonly available drug levels such as barbiturate or aspirin should be considered not only for baseline studies but also for possible therapeutic procedures.

One hour after you begin therapy, she is still comatose. She is no longer cyanotic, but despite 5 units of whole blood, her blood pressure is 80/40. Her pulse is 120/min (weak); hematocrit is 25%, and central venous pressure is 2 cm H<sub>2</sub>O.

What is the appropriate intravenous therapy at this point?

> *Whole blood.*

Good. Your suggestion to give blood is an appropriate one. The patient is obviously volume depleted, as indicated by the combination of the low blood pressure, fast pulse, and low CVP. Patients with massive trauma such as this often lose large amounts of blood. Some authorities recommend the use of an occasional unit of fresh platelets (since bank blood more than a few days

*continued*

old has a very low platelet count) or the administration of 1 gm of calcium intravenously (to counteract the citrate anticoagulant of the stored blood). However, most experts do not consider that to be a critical feature of treatment until over 12 to 15 units of blood have been administered.

The primary treatment should be whole blood given rapidly in large amounts, with careful monitoring of the CVP.

In addition, you should search carefully for any cause of continuing blood loss. (In an unconscious person with multiple trauma and many more obvious problems, intra-abdominal bleeding can occasionally be overlooked as a cause of shock; always consider this if shock fails to respond to therapy.) The patient has had a tracheostomy and is on a ventilator. She has a tidal volume of 800 cc and a rate of 12. The first 2 units of blood are running in at a rapid rate. The blood-gas analysis shows a  $PO_2$  of 300,  $PCO_2$  of 28, and pH of 7.23.

What is the primary acid-base disturbance?

> *Respiratory acidosis.*

The low pH indicates the presence of acidosis, but in the presence of respiratory acidosis, one would expect a high  $PCO_2$  instead of the low  $PCO_2$  that is observed here. The  $PCO_2$  and pH values for this patient are consistent with an interpretation of metabolic acidosis.

The probable cause of the metabolic acidosis is related to the accumulation of metabolic products such as lactic acid. This is the result of the low blood flow and poor oxygenation of the tissues secondary to the severe blood loss and low cardiac output. If the blood gases had been evaluated prior to the institution of mechanical ventilation, there could also have been a respiratory component to the acidosis related to the inadequate ventilation with resulting accumulation of carbon dioxide.

The nasal bleeding is controlled by transnasal gauze packing. The respiratory and circulatory systems are stabilized. Attention to the bilateral humeral fractures shows ragged skin wounds on both sides but no bone is exposed.

What would you recommend as the appropriate treatment of the humeral fractures at this point?

> *Splinting.*

We agree that you should immobilize the fracture. Our experts would recommend the following action also be taken at this point: debridement. Your first action should be to clean the open wound in order to reduce the risk of infection and to clean the wound of any foreign matter.

The fractures of the humeri have been immobilized. Recall that the left leg is held in medial rotation and adduction. X-ray shows posterior dislocation without fracture.

What is your suggested treatment of the left leg dislocation?

> *Reduce.*

Good. Simple closed reduction is the appropriate therapy in the management of dislocation of the femur.

Emergency treatment has been instituted and the patient's condition has stabilized and her mental status has improved.

On the fifth day postinjury, however, there is a rise in temperature to  $102^\circ$  F. She has a chill and is restless; her blood pressure drops to 70/0, pulse rate rises to 120, respiratory rate is 22, Hct is 28%, and white blood cell count is  $4200/mm^3$ . Her skin is warm and dry. What do you consider the most logical explanation for the sudden deterioration in the patient's condition?

> *Fat embolism.*

That is a good suggestion, since fat embolism does occur in patients with multiple fractures of the long bones. However, fat embolism ordinarily would occur soon after the initial injury and would cause a greater degree of tachypnea and dyspnea with frequent disturbances of consciousness ranging from delirium to coma. Most importantly, hypotension only rarely results from fat embolism and, when it does, is a low cardiac output hypotension with a weak pulse and cold clammy skin. What specific disease do you think is manifest, given the sudden onset of fever and hypotension?

> *Septic shock.*

We agree.

The combination of a chill and fever accompanied by hypotension with evi-

dence of normal to high cardiac output (strong pulse, warm dry skin) is strongly suggestive of septic shock. The low white count suggests that the causative agent is Gram negative but in debilitated patients with compromised cardiovascular systems, septic shock can also follow Gram-positive bacteremia. The source of the infection could be the contaminated fracture site, the genitourinary tract, one of the IV lines, or (less likely) peritonitis due to a ruptured abdominal viscus, an intra-abdominal abscess, or empyema around the chest tube. You should search vigorously for any localizing signs; Gram stain and culture sputum, unspun urine, wound discharges, and drainage from tubes or around IV lines. Take several blood cultures (use separate sites and separate vent punctures); x-ray lungs and fracture sites (look for air in tissues).

Assuming that you have not been able to identify any source for the septicemia, that blood cultures have been taken, that Ringier's lactate is being rapidly infused, that the CVP is 5, now what therapy or therapies would you choose?

> *Cephalothin, gentamicin.*

Yes, broad-spectrum antibiotics, designed to cover the possibilities of *S. aureus* and Gram-negative organisms, are appropriate.

Most experts would agree that there is an immediate need to increase the intravascular fluid compartment in septic shock by rapid infusion of significant amounts of colloid. The CVP should be closely monitored to detect any incipient overload on the heart.

We agree with your decision not to use vasopressors.

Although some experts recommend catecholamines (e.g., norepinephrine), there isn't universal support for this position. (Isoproterenol may be useful in increasing cardiac output.) Most authorities believe that there is already maximal alpha-adrenergic activity and therefore norepinephrinelike compounds are contraindicated.

Some experts recommend large doses of methylprednisolone on the basis that steroids alleviate the vasoconstriction and microcirculatory stagnation. End of case.