Case reports

Peritoneal Lavage Cell Count Ratio in Blunt Abdominal Trauma - A Useful Tool in Hollow Viscus Injury?

R. NAGAPPAN*, J. D. FRANK†
**Intensive Care Unit, Monash Medical Centre, Clayton, VICTORIA*
†Department of Radiology, Western General Hospital, Melbourne, VICTORIA

ABSTRACT

A 40-year-old man suffered severe orthopaedic and maxillo-facial injuries in a motor vehicle accident. After resuscitation he underwent extensive orthopaedic surgery to manage his fractures. A diagnostic peritoneal lavage just prior to his operation revealed a red blood cell count of 0.15 x 10^{12}/L and white blood cell count of 3.3 x 10^{12}/L. However, as the patient was haemodynamically stable, a non-operative approach was adopted. Despite a normal abdominal ultrasound, near-normal abdominopelvic computed tomography, haemodynamic stability and tolerance of enteral feeding, the patient suffered a delayed sigmoid colonic perforation eight days after the initial trauma.

While abdominal computed tomography has replaced diagnostic peritoneal lavage in evaluation of blunt abdominal trauma, this case highlights the need for a more effective tool for diagnosing hollow viscus injury. In this regard, the peritoneal lavage cell count ratio (which in retrospect in our patient indicated hollow viscus injury) may be useful. (**Critical Care and Resuscitation 2001; 3: 92-94**)

Key words: Blunt abdominal trauma, peritoneal lavage, cell count ratio, hollow viscus injury

Correct management of blunt abdominal trauma can reduce morbidity and mortality and increase the cost-effectiveness of trauma services. In these patients, accurate assessment of a hollow viscus injury with the need for operative repair is imperative for a successful outcome.

Many diagnostic tests can be used to evaluate patients with blunt abdominal trauma. Complementing a thorough physical examination, the tests include: diagnostic peritoneal lavage, ultrasonography and computerised tomography. Peritoneal lavage cell count ratio may also be useful for early detection of hollow viscus injury.

CASE REPORT

A previously well 40-year old man was involved in a major motor vehicle accident. The car rolled many times and the patient was trapped for 60 minutes.

When the paramedic team first assessed him, he was conscious with a Glasgow Coma Score of 14 (E3, M6, V5). His systolic blood pressure was 85 mmHg, heart rate 145 beats per minute and his respiratory rate was 50 per minute. Pulse oximetry revealed an oxygen saturation of 95% breathing 4 L of oxygen by face mask. After the rapid administration of 1 L of intra-venous fluid, the patient was transported by helicopter to the nearest base hospital.

Correspondence to: Dr. R. Nagappan, Intensive Care Unit, Monash Medical Centre, Clayton Rd, Clayton, Victoria 3168
(e-mail: rameshnagappan@yahoo.com)

On arrival at hospital his haemodynamic observations were unchanged. His haemoglobin was 81 g/L. During the first three hours he received 1.5 L of 4% albumin in 0.9% saline, 1 L of Haemaccel®, 3L of 0.9% saline, 1.8 L of packed red blood cells (RBC) and 1.2 L of fresh frozen plasma. An abdominal ultrasound did not detect any peritoneal fluid or abnormalities within the liver, spleen or kidneys. The trauma survey revealed extensive orthopaedic and maxillo-facial injuries.

Following his initial resuscitation, head and neck computed tomography (CT) was performed which revealed no abnormality of the brain. However, the CT of his face confirmed Le Forte II and III fractures with considerable soft tissue facial swelling. The latter progressively increased causing upper airway obstruction, so an endotracheal intubation was performed in the operating theatre. An abdominal CT had been planned but was deferred for the insertion of the endotracheal tube.

He then underwent surgery for his orthopaedic injuries, which included open reduction and internal fixation of a fractured right mid-femoral shaft and external fixation of a fracture of the proximal and mid left tibial shaft. At the commencement of surgery, a closed diagnostic peritoneal lavage was performed. The lavage red blood cell (RBC) count was 0.15 x 10^{12}/L and white blood cell (WBC) was 3.3 x 10^{12}/L. A laparotomy was considered but not performed.

Thirty-six hours after his admission he underwent a CT of his abdomen, which revealed a small amount of fluid lining the reflections of the pelvic peritoneal recesses, which was thought to be consistent with the diagnostic peritoneal lavage fluid. Otherwise, the scan appeared within normal limits. The patient remained haemodynamically stable in the intensive care unit and tolerated enteral feeding at 80 mL/hour.

Over the first three days, cephradine 1 gm i.v. 8-hourly was administered and the patient remained apyrexial. His WBC count was 13.9 x 10^{12}/L on admission, 12.8 x 10^{12}/L a day later, 9.2 x 10^{12}/L on day two and 9.0 x 10^{12}/L on day 3. Three days after his admission, he was transferred to another hospital for management of his maxillo-facial injuries. On transfer he was mechanically ventilated, haemodynamically stable and enterally fed.

Five days after he was transferred (8 days after his initial trauma) he developed abdominal distension with signs of intra-abdominal sepsis. He underwent a laparotomy which revealed a perforated sigmoid colon with an iliac fossa abscess. The acute abdominal disorder had developed as a result of the proximal sigmoid colon perforating at the site of the abscess. A Hartmann's procedure was performed and a Marlex mesh was inserted for abdominal decompression.

Maxillo-facial surgery was subsequently performed and his abdominal disorder was managed later with a bi-staged closure. After ten days in the intensive care unit he was transferred to a surgical ward where he continued to improve.

DISCUSSION

A variety of diagnostic aids can be used to help the clinician detect significant intra-abdominal injury in a patient with blunt abdominal trauma. Speed and efficiency are important factors in the use of such tests.[1] Diagnostic peritoneal lavage (DPL) is sensitive in identifying haemoperitoneum and associated hollow viscus injury (HVI),[2] although it has been criticised for its invasive complications (1 - 2%) and its frequency in leading to non-therapeutic laparotomy (10 - 20%).[3,4] In many hospitals, abdominal CT has replaced DPL from the investigative armamentarium for blunt abdominal trauma (BAT).

The use of ultrasonography in the primary trauma survey to diagnose intra-abdominal injuries is increasing, as it is a convenient, cheap and noninvasive test. A positive study is defined as evidence of free fluid or solid-organ parenchymal injury. In a study of 899 sonograms the sensitivity was 86%, specificity 99% and accuracy 98%.[5] However, it is operator-dependent and its sensitivity is poor for intestinal injuries.[6]

Abdominal CT is also useful in the diagnosis of abdominal injuries as it delineates solid organ injuries and retroperitoneal lesions accurately. While some advocate limiting CT to evaluation of patients with DPL-positive results and haemodynamic stability,[7] CT remains the preferred tool in the evaluation of BAT.[8] Even in a low-volume trauma institution, the accuracy of abdominal CT for evaluating blunt abdominal trauma can be comparable to that reported from higher-volume trauma centres.[8] However, CT has a false negative rate of 3 - 10% for the diagnosis of HVI.[9]

Diagnostic peritoneal lavage, while sensitive for haemoperitoneum, does not detect retroperitoneal damage and compared with other diagnostic modalities has a higher rate of non-therapeutic laparotomy (NTL),[3,4,10] due to injuries such as a minor mesenteric tear and trivial mesenteric venous ooze.

Injuries of the hollow viscera are far less common in BAT than in penetrating abdominal trauma.[11] In a sample of nearly 20,000 patients with BAT, 0.8% of adults and 1.0% of children suffered injury to a hollow viscus.[12] Solid viscus injury predicts major hollow viscus injury in blunt abdominal trauma and the frequency of HVI increased with the number of solid organs injured.[13] In a series of three thousand patients with BAT, 9.6% of patients with solid viscus injury also had a HVI.[13]

Given the high incidence of non-therapeutic laparotomy with a positive DPL, and the popularisation of non-operative treatment for blunt solid organ injuries, an additional tool is needed to detect HVI in patients with BAT. The cell count ratio (i.e. WBC/RBC) of the DPL effluent has been reported to be a very sensitive and specific indicator of hollow organ perforation.[14] The ratio in the lavage fluid is divided by the WBC/RBC ratio in the peripheral blood to give the cell count ratio.

In a study of 212 DPL positive patients, 44 patients with a cell count ratio greater than 1 were reported.[14] A cell count ratio greater than or equal to 1 predicted hollow organ perforation with a specificity of 97% and a sensitivity of 100%. In our patient the lavage WBC was 3.3 X 10^{12}/L; lavage RBC was 0.15 X 10^{12}/L. A corresponding peripheral blood WBC was 19.6 and RBC 3.66, giving a cell count ratio of 4.11.

In retrospect, the positive cell count ratio in the peritoneal lavage fluid in our patient was strongly predictive of hollow viscus injury, although it is possible that our patient may have had a bowel wall contusion which suffered a delayed perforation. Had we been aware of the cell count ratio utility we may have performed a laparotomy at this early stage. While others have reported the utility of peritoneal lavage amylase and alkaline phosphatase in diagnosing HVI,[15] these were not measured in our patient.

After blunt abdominal trauma, hollow viscus injury may not be detected by ultrasound or abdominal CT. Peritoneal lavage, while sensitive for diagnosing haemo-peritoneum, has a high incidence of non-therapeutic laparotomy. Our patient highlights the need for a more effective diagnostic tool for detecting HVI. If DPL is performed, the cell count ratio may be useful in the early diagnosis of hollow viscus injury.

Received: 16 February 2001
Accepted: 3 April 2001

REFERENCES

1. Davis JW, Hoyt DB, McArdle MS, et al. An analysis of errors causing morbidity and mortality in a trauma system: a guide for quality improvement. J Trauma 1992;32:660-664.
2. Root HD, Hauser CW, McKinley CR, et al. Diagnostic peritoneal lavage. Surgery 1965:57:633-637.
3. Matsubara TK, Fong HM, Burns CM. Computer tomography of abdomen (CTA) in management of blunt abdominal trauma. J Trauma 1990;30:410-414.
4. Meyer DM, Thal ER, Weigelt JA, Redman HC. Evaluation of computer tomography and diagnostic peritoneal lavage in blunt abdominal trauma. J Trauma 1989;29:1168-1172.
5. McKenney KL, Nunez DB, McKenney MG, Asher J, Zelnick K, Shipshak D. Sonography as the primary screening technique for blunt abdominal trauma: experience with 899 patients. AJR Am J Roentgenol 1998;170:979-985.
6. Yoshii H, Sato M, Yamamoto S, et al. Usefulness and limitations of ultrasonography in the initial evaluation of blunt abdominal trauma. J Trauma 1998;45:45-51.
7. Schreiber MA, Gentilello LM, Rhee P, Jurkovich GJ, Maier RV. Limiting CT to patients with DPL positive results reduces cost and unnecessary celiotomies in blunt trauma. Arch Surg 1996;131:954-958.
8. Jhirad R, Boon D. Computer tomography for evaluating blunt abdominal trauma in the low-volume non designated trauma centre: the procedure of choice? J Trauma 1998;45:64-68.
9. Allen GS, Moore FA, Cox CS, Mehall JR, Duke JH. Delayed diagnosis of blunt duodenal injury: an avoidable complication. J Am Coll Surg 1998;187:393-399.
10. Bain IM, Kirby RM, Tiwari P, et al. Survey of abdominal ultrasound and diagnostic peritoneal lavage for suspected intra-abdominal injury following blunt trauma. Injury 1998 29:65-71.
11. Neuberger H, Wallenboeck E, Hungerford M. Seventy cases of injuries of the small intestine caused by blunt abdominal trauma: a retrospective study from 1970-1974. J Trauma 1999;46:116-121.
12. Allen GS, Moore FA, Cox CS, Wilson JT, Cohn JM, Duke JH. Hollow visceral injury and blunt trauma. J Trauma 1998;45:69-75.
13. Nance ML, Peden GW, Shapiro MB, Kauder DR, Rotondo MF, Schwab CW. Solid viscus injury predicts major hollow viscus injury in blunt abdominal trauma. J Trauma 1997;43:618-622.
14. Fang JF, Chen RJ, Lin BC. Cell count ratio: new criterion of diagnostic peritoneal lavage for detection of hollow organ perforation. J Trauma 1998;45: 540-544.
15. McAnena OJ, Marx JA, Moore EE. Peritoneal lavage enzyme determinations following blunt and penetrating abdominal trauma. J Trauma 1991;31:1161-1164.