

## CT scan quiz: a 13-year-old boy who fell from height

電腦掃描猜謎：一名由高處墮下的13歲男孩

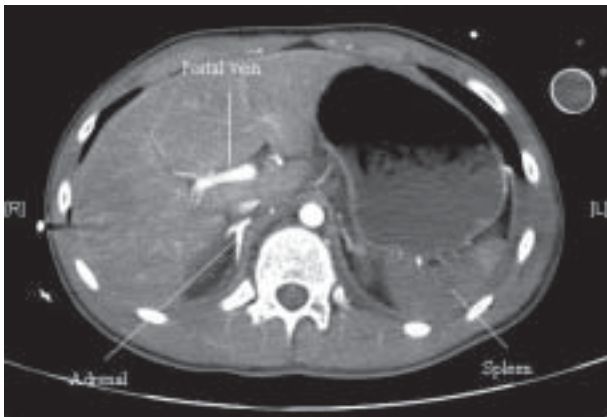
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### Case

A 13-year-old boy fell from height and sustained multiple injuries. On admission, his GCS was 3/15. The blood pressure was about 100/80 mmHg and the pulse rate was 100/min. X-ray was taken showing fractured left femur and tibia, lung contusion and left pneumothorax. Urgent CT was also performed to look for organ injury (Figures 1-4).

### Questions

1. What are the radiological abnormalities?
2. What is the clinical / radiological diagnosis?



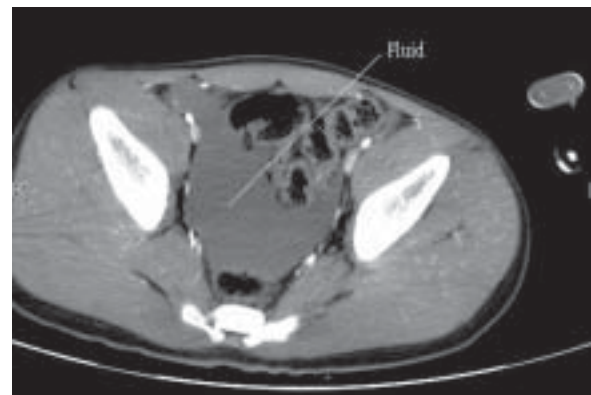
**Figure 1.** Contrast enhanced CT scan axial cut of upper abdomen (porto-venous phase), including liver, spleen, adrenal, and stomach.



**Figure 2.** CT scan axial cut of upper abdomen including liver, kidneys, and pancreas.



**Figure 3.** CT scan axial cut of mid-abdomen including small bowel and large bowel.



**Figure 4.** CT scan axial cut of pelvis.

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## Answers

1. The contrast enhanced CT demonstrates a small calibre inferior vena cava when compared to the adjacent aorta. There is increased contrast enhancement of small bowel, adrenals and pancreas. Poor enhancement of the spleen and kidneys are noted. There is presence of intraperitoneal fluid at the lower pelvis.
2. Hypovolemic shock / hypoperfusion complex.

## Discussion

The hypoperfusion complex was first described by Taylor et al in 1987.<sup>1</sup> Sivit et al further found that the complex was seen more frequently in younger children.<sup>2</sup> The mortality rate for children with hypoperfusion is high, and therefore rapid recognition of the hypoperfusion complex is vital.

In children with hypovolaemic shock, a compensated state occurs with increased sympathetic response to maintain the blood pressure with vasospasm and adequate perfusion of vital organs. This explains the CT findings of the hypoperfusion complex. The small calibre of aorta and inferior vena cava is due to vasospasm. Increased bowel wall enhancement is related to vasoconstriction of mesenteric vessels. The adrenal hyperenhancement is due to the central role of the adrenal glands in generating the sympathetic response.<sup>3</sup> Other less vital organs like the spleen would then have decreased blood supply and therefore decreased enhancement.

In this patient, the hypoperfusion complex was noted on the CT scan with the presence of intraperitoneal fluid at the lower pelvis which was likely due to haemoperitoneum. Suspicious contrast extravasation was also noted at the spleen (not shown). Emergency operation was performed showing haemoperitoneum and splenic avulsion. Unfortunately the patient developed cardiac arrest during the operation and succumbed afterwards.

One uncommon finding of the hypoperfusion complex in this scan is the absence of contrast enhancement of both kidneys. Catalano et al described it as the "black kidney sign" indicating a very advanced phase of shock, when blood is further redistributed to maintain brain and heart blood flow.<sup>4</sup> It indicates an even worse prognosis.

## References

1. Taylor GA, Fallat ME, Eichelberger MR. Hypovolemic shock in children: abdominal CT manifestations. *Radiology* 1987;164(2):479-81.
2. Sivit CJ, Taylor GA, Bulas DI, Kushner DC, Potter BM, Eichelberger MR. Posttraumatic shock in children: CT findings associated with hemodynamic instability. *Radiology* 1992;182(3):723-6.
3. O'Hara SM, Donnelly LF. Intense contrast enhancement of the adrenal glands: another abdominal CT finding associated with hypoperfusion complex in children. *AJR Am J Roentgenol* 1999;173(4):995-7.
4. Catalano OA, Napolitano M, Vanzulli A. Black kidney sign: a new computed tomographic finding associated with the hypoperfusion complex in children. *J Comput Assist Tomogr* 2005;29(4):484-6.