FAST Ultrasound
More Information: The Movement of Fluid in the Abdomen

The detection of hemopericardium is relatively straightforward since the fluid is confined between the parietal and visceral layers of the pericardium and can be readily detected with US. The presence of clotting or prior cardiac surgery may result in localized fluid accumulation but the fluid will still be located between the two layers of the pericardium. In contrast the detection of hemoperitoneum is dependent on factors such as body habitus, injury location, history of prior surgeries, presence of clotted blood, patient position, and the amount of fluid present. Free intraperitoneal fluid continually circulates throughout the peritoneal cavity and will preferentially collect in dependent intraperitoneal compartments formed by mesenteric attachments and peritoneal reflections.[66] A basic understanding of the fluid movement from various locations within the peritoneal cavity is essential and will help improve the performance and interpretation of the FAST exam (Figure 4).

Figure 4. Pattern of free-fluid movement within the peritoneal cavity.

The peritoneal cavity consists of the greater sac and lesser sac. The greater sac is the main part of the peritoneal cavity and it extends from the diaphragm to the pelvis. The lesser sac, which is a diverticulum of the greater sac, is confined largely to the left side of the upper abdomen, and communicates on the right with the greater sac through a passage known as the epiploic foramen. The greater sac is divided into supramesocolic and inframesocolic compartments with the transverse colon and its mesocolon being used as the boundary. The rectovesicular pouch is the most dependent area in the supine male, while the rectouterine pouch (pouch of Douglas) is the most dependent area in the supine female. The most dependent supramesocolic location in both the supine male and female is the hepatorenal fossa (Morison's pouch).

The paracolic gutters connect the supramesocolic and inframesocolic compartments. The right paracolic gutter is wider and deeper than the left paracolic gutter and it connects the pelvis with Morison's pouch and the right subphrenic space. In comparison, the left paracolic gutter is shallower and its course to the left perisplenic space is frequently blocked by the phrenicocolic ligament.[67] The falciform ligament prevents fluid from traveling between the left and right subphrenic spaces (Figure 4).

Physiologic factors such as intraperitoneal pressure gradients, patient positioning, and gravity will all have an effect on intraperitoneal fluid distribution. Overholt, using an animal model, demonstrated that the hydrostatic pressure in the upper abdomen is less than that of the lower abdomen and varies with respiration.[68] Drye found that the pressure in the lower abdomen is three times as great as in the upper abdomen with the patient in the erect position.[69] This pressure gradient is so great that it can even result in fluid traveling up the paracolic gutters with the patient standing.[70]

Fluid introduced into the right supramesocolic space (i.e. hemorrhage from a liver injury) has been shown by Meyers to preferentially flow directly into Morison's pouch in the supine patient with overflow fluid traveling to the right subphrenic space and ultimately to the pelvis via the right paracolic gutter (Figure 5).[67] Less commonly, fluid will travel to the splenorenal fossa via the epiploic foramen. The falciform ligament will prevent fluid from traveling directly between the right and left subphrenic spaces.

Figure 5. Fluid accumulation pattern in a patient with suspected hepatic injury.

Fluid introduced into the left supramesocolic space (i.e hemorrhage from a splenic injury) has been shown by Meyers to preferentially flow cephalad, to the subphrenic space, in the supine patient.[67] Overflow fluid will extend caudally to the splenorenal fossa, across the epiploic foramen to Morison's pouch, and ultimately, to the pelvis via the right paracolic gutter (Figure 6). This emphasizes the point that the subdiaphragmatic region must be visualized on the perisplenic window when scanning a patient with a suspected splenic injury.

Figure 6. Fluid accumulation pattern in a patient with suspected splenic injury.

Fluid introduced into the inframesocolic space (i.e. hemorrhage from a pelvic source) has been shown by Meyers to almost immediately travel to the rectovesicular pouch in the supine male and the pouch of Douglas in the supine female (Figure 7) [67]. Overflow fluid will ascend up the paracolic gutters, with the majority going up the right side to Morison's pouch. As previously mentioned, fluid meets more resistance in the left paracolic gutter and will preferentially travel up the right.

Figure 7. Fluid accumulation pattern in a patient with a pelvic source of hemorrhage.

References:

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