



Fusion Imaging and Needle Tracking Techniques Enable Visualization in Drainage of Air-Containing Cavities

Drainage of Air-Containing Cavities Guided by Image Fusion involving Ultrasound and Electromagnetic Needle Tracking

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Summary and Methods

Abscess drainage under ultrasound guidance has advantages over using other imaging modalities. Real-time visualization of the area of interest and drain placement can be accomplished within a department or portably at the patient bedside. Unfortunately, ultrasound has limitations imaging through air-containing cavities or behind bone. In this pictorial essay, the authors describe three patient cases where the use of ultrasound and electromagnetic needle tracking, eTRAX™ Needle Tip Tracking System (CIVCO Medical Solutions, Kalona, IA) in combination with image fusion (GE Healthcare LOGIQ E9, Milwaukee, WI) with CT or MRI data sets successfully treat air filled intra-abdominal cavity abscesses.

Discussion and Results

A 64 year-old male with adenocarcinoma of the ascending colon underwent a laparoscopic right hemicolectomy and postoperatively suffered a small bowel obstruction. A second laparotomy was performed. A follow-up CT scan was performed fourteen days later and revealed a subhepatic, air-containing cavity. Using the CT data set, fusion imaging was used with real-time ultrasound to locate the area. The eTRAX Needle Tip Tracking System was used to place the 7 French drainage catheter into the cavity. X-ray contrast was injected through the catheter and a subsequent CT scan revealed the source to be an ileocolic anastomosis leakage. Irrigation for five days resulted in no further complications and patient discharge five days later.

A 57 year-old male with a history of adenocarcinoma underwent a left hemicolectomy and developed an initial subhepatic abscess which was drained under ultrasound guidance prior to his discharge. Follow-up CT imaging was performed 51 days later and revealed an air-containing cavity near the bladder. Fusion imaging and electromagnetic needle tracking guided the 7 French catheter into the cavity for draining and irrigation. An additional CT scan identified a fistula between the cavity and the colon.

A 68 year-old female with a history of adenocarcinoma and subsequent right hemicolectomy developed a perforated duodenal ulcer that led to septic shock. After surgical drainage of free fluid adjacent to the duodenum, the patient recovered in ICU. After discharge, 39 days after the initial surgery, a subhepatic air-containing cavity resulted from a fistula from the skin to the duodenum. Once again, the authors describe the use of fusion imaging and electromagnetic tracking to percutaneously drain and irrigate the air-containing cavity, resulting in no further complications.

Conclusions

Air-containing cavities can be a complication following intra-abdominal gastrointestinal surgery. Ultrasound-guided percutaneous drain placement can be difficult due to ultrasound's limitations when imaging behind air. The addition of fusion imaging between CT data sets and real-time ultrasound enable visualization of structures not appreciated with ultrasound imaging alone. Electromagnetic needle tracking technique enable the virtual route of puncture and the actual needle tip to be visualized independent of the limitation of imaging.

Author Commentary

"We successfully evaluated image fusion using CT and US and electromagnetic needle tracking for US-guided percutaneous drainage of air-containing cavities with poor US overview in three patients with severe, complicated postoperative courses. These patients were all saved from re-laparotomy, which would inherently have implicated an increased risk. The challenge in all three cases was that the cavities contained air, thus limiting the overview of the cavity and the needle guidance by conventional US."

