Imaging of gastrointestinal perforation: Is there a place for plain radiography?

Poster No.:  R-0243  
Congress:  2014 CSM  
Type:  Scientific Exhibit  
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Keywords:  Abdomen, Gastrointestinal tract, Conventional radiography, CT, Technical aspects, Pathology  
DOI:  10.1594/ranzcr2014/R-0243  

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Aim

The aim of this study was to retrospectively compare the sensitivity of plain radiography and CT in the detection of GI perforation.

Methods and materials

Patient histories whose interpretations of plain radiographic and/or CT examinations suggested GI perforation were retrospectively reviewed. A computer-based keyword search was conducted using the Radiology Information System (RIS) at the Western Health radiology department. The RIS program accessed all patients’ data in three public metropolitan hospitals with acute services within the Western Health Network (Western Hospital, Sunshine Hospital and Williamstown Hospital). All radiology reports that contain the keyword ’perforation’ from 1 October 2011 to 28 February 2013 were evaluated. Only radiology reports of plain radiography and CT examinations were selected. Each radiology report was reviewed to select cases suggestive of GI perforation.

All plain radiographic examinations that showed evidence of GI perforation were reviewed. If a CT examination reported evidence of GI perforation, this patient's request history in the Radiology department was evaluated in the Synapse software. The patient was included if the patient had a plain radiographic examination prior to the CT examination within a 24-hour time window. This time window was set to guarantee that CT did not have a significant time advantage over plain radiography because a lapse of time may allow more intraperitoneal gas to leak and to be visualised more clearly on images 1,2.

The interpretations of the radiology reports were compared with patient discharge summaries which were accessed in the BOSSnet Digital Medical Report program. Patient discharge summaries recorded the clinical assessments, interventional procedures and surgical reports of patients. So they were used as the gold standard to compare the performance of plain radiographic and CT examinations in the detection of GI perforation.

Exclusion criteria:

1. Patients younger than 18 years old. This is done to exclude paediatric and neonatal patients
2. The follow-up cases of patients who had already undergone a radiology examination which confirmed GI perforation during the keyword search time period. This is because findings of GI perforation would have been demonstrated in the previous imaging examinations
3. Patients presented with trauma. This study evaluated only non-traumatic GI perforation. Trauma patients may be referred to CT with clinical indications other than query GI perforation.

4. If the time window between the initial radiographic examination and the subsequent CT examination was larger than 24 hours.

For analysis, all patients were categorised in two groups based on the interpretations of the plain radiographic examinations: One group of evidence of GI perforation and the other group of no evidence of GI perforation. These two groups were compared with the CT reports and patient discharge summaries.

**Results**

A total of 2777 radiology reports were found with the keyword 'perforation'. Of these, 158 radiology reports suggested GI perforation. In all 158 suggestive GI perforation reports, 10 cases were follow-up examinations of patients with confirmed GI perforation, so these examinations were excluded. A total of 148 cases reported new findings of GI perforation.

Among these 148 cases, 65 patients underwent only CT examinations without a plain radiographic examination prior within the 24-hour time window. Thus these examinations were not taken into analysis. The remaining 83 patients all underwent plain radiographic examinations. Two patients were deceased and thus no discharge summaries were provided.

In total, 81 patients were selected for data analysis in this study (Figure 1). Of the 81 patients included in this study, 36 were females and 45 were males. The mean age of patients was 62 years (age range from 22 to 97 years). One patient (1.2%) was an outpatient, 25 patients (30.9%) were inpatients and 55 patients (67.9%) were emergency patients.

In 81 plain radiographic examinations, 25 cases (30.9%) showed evidence of GI perforation and 56 cases (69.1%) did not show evidence of GI perforation. In those 25 plain radiographic examinations that suggested GI perforation, 17 cases (68.0%) were reported based on the plain radiography findings. Seven out of the 17 cases (41.2%) were confirmed with GI perforation on the patient discharge summaries and the patient discharge summaries of the other 10 cases (58.8%) disproved the interpretations of plain radiography examinations. Eight cases (32.0%) of the 25 plain radiographic examinations proceeded to CT examinations and the CT reports agreed with the interpretations of plain radiographic examinations in all 8 cases. Of which 5 cases (62.5%) were confirmed with GI perforation on patient discharge summaries.

Fifty-six of 81 plain radiographic examinations (87.5%) that did not suggest GI perforation proceeded to CT examinations within 24 hours since the initial plain radiographic
examinations were performed. CT showed positive findings of GI perforation in all 56 cases, of which 44 cases (78.6%) were confirmed with GI perforation on the patient discharge summaries. This means that plain radiography examinations were false negatives in those 44 cases.

Overall, 64 of the 81 patients (79.0%) had follow-up CT scans after preliminary radiographic examinations. Eight of the 64 (12.5%) plain radiographic examinations demonstrated evidence of GI perforation but further imaging examinations were required. The average time window between the initial plain radiographic examination and the subsequent CT scan was 6 hours and 10 minutes, ranging from 50 minutes to 24 hours.

The sensitivity of plain radiography and CT in the detection of GI perforation was 23% and 78% respectively with highly significant difference (p<0.001).

Images for this section:

![Flowchart of 81 patients presented for plain radiographic examinations with suspected GI perforation](image-url)
Conclusion

In summary, our study disapproved the use of a plain radiographic examination to query GI perforation due to its low sensitivity and limitations. In contrary, CT has a relatively high sensitivity to detect GI perforation and can provide crucial information for patient managements. Therefore, CT should be used as the preliminary imaging modality for patients with suspected GI perforation as patients could be beneficial in terms of minimising radiation dose, reducing diagnosis times and improving the efficiency of health services.

Personal information

Acknowledgement and special thanks to Monash University for supporting me in conducting this research and sponsoring me to present in the 18th ISRRT World congress in Finland in July 2014.

References
