What is the diagnostic accuracy of detecting causes of abdominal sepsis with MDCT?

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Introduction

Computed Tomography (CT) of the abdomen and pelvis is the diagnostic choice for abdominal sepsis and abscess. The development of multidetector CT (MDCT) has led to changes in examination technique and increased complexity of scans that are undertaken. There is a need to justify the level and frequency of radiation exposure associated with MDCT. Conditions that require monitoring and follow-up scans are important, with the potential for large cumulative doses should further CT be required. A year-long dose survey of CT scans of patients presenting with symptoms of abdominal sepsis was performed.

Method

The dose survey was performed using patients who underwent CT of the peritoneal cavity (CT abdomen) or scans that extended further to also cover the pelvis (CT abdomen-pelvis). Abdominal sepsis categories considered in the study were those coded and classified by the ICD 10 system. The flow-chart in figure 1 covers the method from study inclusion to data collection and analysis.
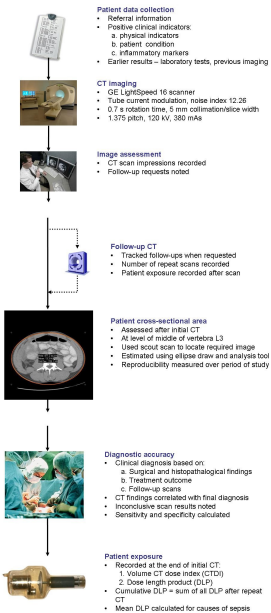

Figure 1. Study method flow-chart covering study inclusion, data collection and analysis.

Results

- 94 patients were included in the study, with a mean age and standard error in the mean (sem) of 59.1 ± 2.1 years.

Clinical indications

- Clinical indications for CT referral are included in Table 1. Combinations of indicators were different for each patient. Known or suspected fluid collection, lower abdominal pain and inflammation were the most frequently recorded indicators.

Clinical indication	Total	TP	TN
Lower abdominal pain	38	17	17
Tenderness	16	8	7
Patient guarding	3	2	1
Gastro-intestinal symptoms	18	9	7
Fever	8	6	2
Leukocytosis	9	6	2
Infection	29	19	8
Previous surgery	31	23	8
Inflammation	35	18	14
Distended abdomen	19	11	6
Fluid/collection/leak	54	40	11
Other	5	3	2

Table 1. Clinical indications leading to CT scan requests. Total number for each indication is listed along with totals for true positive (TP) and true negative (TN) scans.

Scan findings

- Table 2 contains a shortened list of abdominal sepsis conditions considered in the study and the frequency these were encountered during the study. All scan impressions were recorded, including those of other diseases and changes not related to sepsis. Abscesses and ascites were the forms of abdominal sepsis identified most frequently. More than one clinical finding was often recorded per case.

Scan finding	Frequency
Abscess (K65, T81.4)	14
Ascites (R18)	39
Peritonitis (K65, N73.3)	4
Acute appendicitis with abscess (K35.x)	2
Diverticular Disease with abscess (K57.x)	6
Acute/Necrotic pancreatitis (K85)	9
Unrelated inflammation	2
Other inflammation – colitis, etc.	18
Free gas	21
Bowel obstruction – any form	4
Structural change – fistula, thickening,etc.	26
Other	25
Normal	7

Table 2. CT scan findings of clinical conditions. Abdominal sepsis diseases are listed with their ICD 10 codes. One or more clinical findings were recorded per case.

Test result	Disease state	
	Present	Absent
Positive	TP = 57	FP = 0
Uncertain	TU = 3	FU = 3
Negative	FN = 0	TN = 31
Total	60	34

Table 3. Contingency table showing study results. T = true, F = false, P = positive, U = uncertain/inconclusive and N = negative result.

- Table 3 shows the diagnostic accuracy results. There were no false negative or positive scan results but there were six inconclusive scan results. Half the inconclusive scan results were positive and half were negative. **For the detection of abdominal sepsis by MDCT, the prevalence was 0.64, sensitivity 0.95 with a specificity of 0.91 and an accuracy of 0.94.**

- Clinical indications have been sub-divided by TP and TN in Table 1. No distinct group of clinical indications were suggestive of abdominal sepsis (p = 0.35, χ^2 test).

Patient exposure

Number of scanner visits	Frequency	Mean Cumulative DLP ± sem (mGy.cm)	Mean Hospital Stay ± sem (days)
1	58	753.5 ± 51.5	12.2 ± 2.2
2	28	1615.9 ± 91.0	19.9 ± 3.6
3	5	2530.8	36.0
4	2	2267.5	21.5
5	1	4519.8	60.0

Table 4. For the 94 patients in the study, the mean cumulative DLP and mean hospital stay are included for increasing number of scanner visits.

- Repeat exposures were a feature in the study and took two forms:
  - partial scans/repeats during initial investigation.
  - additional referrals for follow-up.

- Table 4 shows the frequencies with which patients had between one and five scanner visits.

- 62 % of patients had a single scanner visit.

- From Table 4, as the number of scanner visits per patient increased from one to three, there were increases in both mean cumulative DLP and mean hospital residences.

Finding	No.	Mean DLP ± sem (mGy.cm)	Mean CTDI ± sem (mGy)	Mean x-sec area ± sem (cm²)
Abscess	14	653.1 ± 78.8	32.2 ± 8.8	666.5 ± 79.3
Ascites	39	838.8 ± 64.7	24.3 ± 3.1	720.2 ± 39.8
Peritonitis	4	1001.9	22.6	862.9
Appendicitis	2	605.2	13.5	776.7
Diverticulitis	6	680.5 ± 74.3	15.1 ± 1.7	680.2 ± 47.8
Pancreatitis	9	789.8 ± 104.2	36.0 ± 14.1	794.7 ± 108.4
Normal	7	566.1 ± 133.8	16.4 ± 4.5	665.7 ± 161.3

Table 5. Mean DLP, Mean CTDI and mean patient cross-sectional area (± 5 cm²) for each abdominal sepsis category (names shortened), along with normals. sem = standard error in the mean.

- The spectrum of DLP exposures used in practice was measured for the causes of abdominal sepsis. In Tables 5 and 6 the causes of abdominal sepsis have been summarised into six groups. For these sub-groups of the study, the mean DLP and mean CTDI are quoted in Table 5.

- The mean DLP for abscesses was found to be lower than for ascites, but more data are required to investigate this difference further. Mean CTDIs and mean patient cross-sectional areas of patients with abscesses and ascites were equivalent. Although it is a small sample, the peritonitis patients had the largest mean cross-sectional area and concomitantly the highest mean DLP.

- From Table 6, patients with abscesses and acute pancreatitis had the highest number of scanner visits. Patients with diverticular disease had the lowest number of scanner visits, lowest cumulative DLP and shortest hospital stay.

Finding	No.	Mean number of scanner visits ± sem	Mean Cumulative DLP ± sem (mGy.cm)	Mean Hospital Stay ± sem (days)
Abscess	14	2.0 ± 0.3	1591.8 ± 267.3	19.2 ± 5.7
Ascites	39	1.6 ± 0.1	1316.5 ± 139.3	21.3 ± 3.5
Peritonitis	4	1.5	1410.5	24.5
Appendicitis	2	1.5	1101.6	12.0
Diverticulitis	6	1.2 ± 0.2	810.3 ± 142.1	8.8 ± 2.6
Pancreatitis	9	1.8 ± 0.2	1439.0 ± 256.4	17.6 ± 5.8
Normal	7	1.1 ± 0.1	599.4 ± 124.5	6.6 ± 4.9

Table 6. Mean number of scanner visits, mean cumulative DLP, and mean hospital stay for each abdominal sepsis category (names shortened), along with normals. sem = standard error in the mean.

Summary

Diagnostic accuracy data confirm CT remains a suitable modality for imaging causes of abdominal sepsis. The clinical role of CT has not changed with the development of new technology.

Sepsis in the abdomen is known sometimes to involve several peritoneal elements and initial diagnostic studies need to be comprehensive. Therefore we recommend:

1. Patients presenting for initial diagnosis, or examination for failed response to treatment should receive CT of the entire peritoneal cavity.

2. Follow-up CT should preferably be avoided if patients have responded clinically to treatment.

3. Low dose and region-specific scans should be used for the specific indications of catheter removal and confirmation that the collection has resolved fully, if required clinically.

4. Emphasis should be on minimising radiation exposure and using ultrasound when appropriate for follow-up scans.

Acknowledgements