# Evaluation of early abdominopelvic computed tomography in patients with acute abdominal pain of unknown cause: prospective randomised study



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## Abstract

**Objectives** To evaluate the impact of early abdominopelvic computed tomography in patients with acute abdominal pain of unknown cause on length of hospital stay and accuracy of diagnosis.
**Design** Randomised, prospective controlled trial.
**Setting** Teaching hospital in England.
**Participants** 120 patients admitted with acute abdominal pain for which no immediate surgical intervention or computed tomography was indicated.
**Intervention** 55 participants were prospectively randomised to early computed tomography (within 24 hours of admission) and 65 to standard practice (radiological investigations as indicated).
**Main outcome measures** Length of hospital stay, accuracy of diagnosis, and, owing to a possible effect on inpatient mortality, deaths during the study.
**Results** Early computed tomography reduced the length of hospital stay by 1.1 days (geometric mean 5.3 days (range 1 to 31) *v* 6.4 days (1 to 60)), but the difference was non-significant (95% confidence interval, 8% shorter stay to 56% longer stay, P=0.17). Early computed tomography missed significantly fewer serious diagnoses. Seven inpatients in the standard practice arm died. Only 50% (59 of 118) of diagnoses on admission were correct at follow up at 6 months, but this improved to 76% (90) of diagnoses after 24 hours.
**Conclusions** Early abdominopelvic computed tomography for acute abdominal pain may reduce mortality and length of hospital stay. It can also identify unforeseen conditions and potentially serious complications.

## Introduction

Few studies have examined the efficacy of computed tomography in patients with acute abdominal pain, and to our knowledge there have been no randomised controlled trials of its use as a diagnostic aid for acute abdominal pain.[1–3] We aimed to determine if early computed tomography in patients with acute abdominal pain might reduce length of hospital stay and improve the accuracy of diagnosis. We did not anticipate an effect on mortality when the trial was designed, but some patients did die during the study. We therefore present the findings of this potentially important outcome measure.

## Participants and methods

Our study was undertaken at a teaching hospital with over 1000 beds. All patients with acute abdominal pain admitted under the care of the surgical team from 9 am Friday to 5 pm Sunday, October 1999 to September 2000, were eligible for entry into our study. This period was chosen to enable access to imaging facilities within the time frame of our study. Patients were excluded if they were under 18 years of age, pregnant, or required emergency surgery or urgent computed tomography. Patients with rectal bleeding, suspected gynaecological disorders, or perianal abscesses were also excluded.

### Randomisation and interventions

Patients were invited by the surgical team to participate in the study and were randomised by the on-call radiologist to current standard practice or to early computed tomography (within 24 hours of admission) once the surgeon had admitted them. Standard practice included plain radiography and, if appropriate, ultrasonography, computed tomography, and fluoroscopic investigations.

Patients randomised to standard practice were not denied access to computed tomography if it was needed. Similarly, patients randomised to the early computed tomography arm were not denied access to other radiological investigations within the first 24 hours.

Helical computed tomograms were obtained from the diaphragm to the symphysis pubis. Computed tomography was reported by the on-call radiologist.

### Length of hospital stay and diagnostic accuracy

We hypothesised that early computed tomography might reduce the length of hospital stay and improve the accuracy of diagnosis. We reviewed patients' notes 6 months after admission to determine the final diagnosis, management, and investigations during admission and follow up.

Any changes in diagnoses and management were assessed blindly. In the event of change we assessed whether this was to a more severe diagnosis or to a less severe diagnosis. Possible changes in diagnoses were assessed at two intervals: between the initial diagnosis and at 24 hours, and between the diagnosis at 24 hours and the final diagnosis (assessed after surgery or at 6 month follow up).

### Statistical analysis

To account for skewness, we log transformed data on length of hospital stay to normality before analysis. We also present the untransformed data.

Comparison of geometric means led to consideration of a standardised difference of 0.5 and a total sample size of 120 for 80% power, at a two sided significance level of 0.05. Ignoring skewness of data, we considered a sample size of 120 sufficient to detect, at the same power and significance level, a difference in mean length of hospital stay of 4.0 days, assuming a common standard deviation of 8.0 days. A retrospective power calculation for a 10% absolute difference in mortality, similar to our observations and based on the numbers studied, was only around 65%.

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Final diagnosis in patients undergoing randomisation. Values are numbers of patients (numbers who underwent surgery)

| Final diagnosis | Early computed tomography (n=55) | Standard practice (n=63) |
|---|---|---|
| Diverticulitis | 10 | 12 |
| Appendicitis | 7 (6) | 4 (3) |
| Biliary colic or cholecystitis | 4 (1) | 7 (4) |
| Bowel obstruction | 5 (1) | 4 |
| Acute pancreatitis | 4 | 4 |
| Malignancy | 2 (1) | 6 (1)* |
| Perforated viscus | 1 | 5 (3)† |
| Peptic ulcer disease | 2 | 4 |
| Gastroenteritis | 1 | 2 |
| Intra-abdominal collection | 1 | 1 |
| Gynaecological abnormality | 1 | 1 |
| Renal colic | 1 | 1 |
| Ruptured abdominal aortic aneurysm | 0 | 1 (1)‡ |
| Irritable bowel disease | 1 | 0 |
| Intrathoracic disease | 2 | 2‡ |
| Other | 3 | 1 |
| Non-specific abdominal pain§ | 10 | 8 (1) |

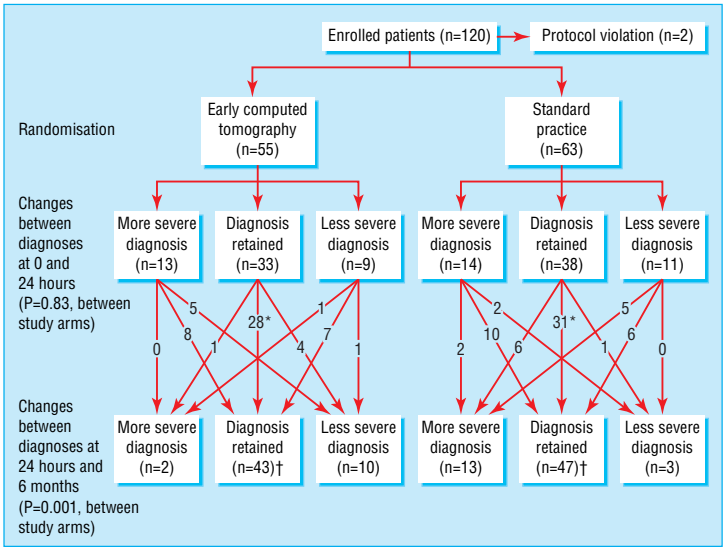
*Two patients died during admission. †Three patients died.
‡One patient died. §No cause for pain found.

## Results

Overall, 120 patients were recruited, of whom 57 (48%) were randomised to early computed tomography and 63 (53%) to standard practice. Two patients were excluded because one required surgery on admission and one was randomised after undergoing other radiological tests. In total, 118 patients completed our study. The table presents the final diagnoses at 6 month follow up.

Hospital stay was 1.1 days shorter in the computed tomography arm than in the standard practice arm (geometric mean 5.3 days (range 1 to 31) *v* 6.4 days (1 to 60), respectively), but the difference was non-significant (95% confidence interval −0.034 to 0.194; P=0.17). This corresponded to patients in the standard practice arm staying 20% longer than those in the early computed tomography arm (95% confidence interval 8% shorter stay to 56% longer stay). Untransformed means (SDs) were 6.6 (5.8) days for the early computed tomography arm and 9.2 (9.8) days for the standard practice arm, both with a median length of stay of 5 days (P=0.20).

The figure presents a summary of changes in diagnosis. Only 50% (59 of 118) of diagnoses on admission were correct at 6 month follow up: 51% (28 of 55) in the early computed tomography arm and 49% (31 of 64) in the standard practice arm. This improved to 76% (90 of 118) after 24 hours (78% (43 of 55) and 75% (47 of 63), respectively). We found a significant difference between the two groups for accuracy of diagnoses at 24 hours (figure). This difference was mainly due to significantly more serious diagnoses being missed in the standard practice arm than in the early computed tomography arm. A small contribution came from an increased tendency for computed tomography to overstate the seriousness of diagnoses. Seven inpatients in the standard practice arm died during the study (0% (0 of 55) early computed tomography *v* 11% (7 of 63) standard practice, P=0.014).




Flow of patients through trial. *Number of admitting diagnoses correct at follow up; †number of diagnoses at 24 hours correct at follow up

## Discussion

Abdominopelvic computed tomography undertaken early in patients admitted with acute abdominal pain improves the accuracy of diagnosis, may reduce length of hospital stay, and may reduce mortality. Compared with the early computed tomography arm, seven deaths occurred in the standard practice arm. In some, early computed tomography might have correctly identified the diagnosis. Three patients were later found to have bowel perforations (two in association with diverticulitis and one with appendicitis) and one patient to have a ruptured abdominal aortic aneurysm; on admission these patients had been thought to have uncomplicated acute diverticulitis. Two of the other deaths were associated with malignancy and one with myocardial infarction. Caution is needed in generalising our results as mortality was not an a priori end point of our study.

Accurate diagnosis in patients with acute abdominal pain is fraught with difficulty—only 50% of the initial diagnoses in our population were correct at 6 months' follow up. This poor accuracy is similar to that reported by other (uncontrolled) studies of similar patient groups (range 47-76%).[1–3] In these studies accuracy of diagnosis after computed tomography improved to 90-95%. We were neither able to reproduce such accuracy nor to show that early computed tomography was significantly better than standard practice for overall accuracy of diagnosis at 24 hours (around 75% in both arms). Early computed tomography did, however, identify significantly more of the serious diagnoses than standard practice, and it was probably this aspect that affected mortality.

Computed tomography is more sensitive and accurate at detecting abnormalities than plain radiography because of its cross sectional nature. The superiority of computed tomography in detecting free intraperitoneal gas is a good example.[4] The disadvantages of computed tomography include availability of resources and radiation dose.[5–11] Computed tomography should therefore be used with caution in acute abdominal pain; it is probably best reserved for patients with pain of unknown cause. Computed tomography is not infallible and clinical evaluation and review remain crucial.[2 3 12]

We attempted to control for the effects of time by having patients re-evaluated 24 hours after admission, as change in symptoms and signs can be an important adjunct in diagnosis. This was arguably both a strength and a weakness. One weakness was the possibility for confounding factors—seven patients receiving early computed tomography underwent other radiological investigations and 13 patients receiving standard practice underwent off-study or delayed computed tomography. No differences emerged in the results between the intention to treat and as treated analyses. Limiting the study to weekends may have influenced referral patterns, timeliness of investigations, and clinical decision making.

The most likely reason for the non-significance of the results of our main outcome measures is that our study was underpowered, being based on a difference in length of hospital stay of 1.5 days.

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## What is already known on this topic

Computed tomography improves the accuracy of diagnosis of several acute abdominal conditions

Uncontrolled studies have shown improvements in accuracy of diagnosis after computed tomography; none have described an effect on mortality

## What this study adds

Early abdominopelvic computed tomography for acute abdominal pain can identify unforeseen serious abdominal conditions

It may also reduce length of hospital stay and may reduce inpatient mortality

# Prevalence of gastroschisis at birth: retrospective study

Gian Luca Di Tanna, Aldo Rosano, Pierpaolo Mastroiacovo

Gastroschisis is a congenital defect of the abdominal wall, characterised by herniation of abdominal viscera outside the abdominal cavity through a defect in the abdominal wall to the side of the umbilicus.[1] Recent studies showed an increase in the prevalence of gastroschisis at birth but gave no convincing explanation.[2 3] We describe the temporal and geographical variation in this prevalence, using data from the International Clearinghouse For Birth Defects Monitoring Systems, founded in 1974, which fosters sharing information and collaboration among the programmes that monitor birth defects worldwide. Currently, 36 programmes from Europe, the Americas, Asia, Australia, and South Africa participate in the clearinghouse and cumulatively monitor 3.3 million births each year. The head office of the clearinghouse, the International Centre for Birth Defects, registers and evaluates these data.

## Participants, methods, and results

We selected registries that provided information on at least 10 consecutive years including 1998 and analysed births occurring between 1974 and 1998 from 19 registries (see bmj.com). The numerators of the prevalences (see table) include liveborn and stillborn babies with gastroschisis (isolated or associated with other defects); denominators are the total numbers of births. Registries used their own diagnostic criteria and definitions of gastroschisis and omphalocele, but we found no substantial differences.

We estimated annual prevalence at birth and 95% confidence intervals from the data and analysed temporal trends using Poisson regression. We used $\chi^2$ tests to test for heterogeneity of birth prevalence among registries. We compared the time distributions of gastroschisis and omphalocele by using the Spearman non-parametric correlation test to exclude negative correlations that might suggest shifts in classification of defects from omphalocele to gastroschisis.

The 19 registries recorded 3073 cases of gastroschis. The overall prevalence at birth was 0.29 (95% confidence interval 0.21 to 0.40) per 10 000 births in 1974 and 1.66 (1.51 to 1.85) per 10 000 births in 1998. Prevalences varied among programmes. Nine areas had significant increases in the prevalence of gastroschisis at birth (table 1) from Europe (five registries), Australia, Japan, and the Americas (two registries).

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