

facilities, reciprocal ST depression should be considered indicative of severe multivessel coronary arterial disease and a risk factor for subsequent cardiac events. Specialist referral for angiography is advised. When there is no reciprocal change early exercise testing provides valuable additional information concerning underlying coronary arterial disease and should be performed routinely.

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The erect abdominal radiograph in the acute abdomen: Should its routine use be abandoned?

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Abstract

The value of erect and supine abdominal radiographs and erect chest radiographs was analysed prospectively in 102 consecutive patients admitted to hospital with acute abdominal symptoms. The radiographs were reported on initially by junior surgeons of the admitting team, special note being made of the value of the erect abdominal radiograph over the combination of the supine abdominal radiograph and erect chest radiograph. On the basis of information obtained from the erect abdominal radiograph alone no changes in patient management were recorded.

A consultant radiologist reported on the same radiographs at a later date. In five cases the erect abdominal radiograph was thought to have contributed useful or additional information, although in four of these cases abnormal features were visible in the supine film. In three of the five cases important but subtle information was missed by junior surgeons. In five of the 102 patients

information obtained from the erect abdominal radiograph was potentially misleading.

The small yield of positive information, potentially misleading features, and lack of effect on surgical management suggest that the routine use of the erect abdominal radiograph in the acute abdomen should be abandoned.

Introduction

Conventional teaching recommends the routine use of both erect and supine abdominal radiography for investigating patients referred to hospital with acute abdominal pain.^{1,2} We have evaluated the erect abdominal radiograph by analysing the additional information which junior surgeons thought had been obtained from this radiograph over that obtained from the combined erect chest and supine abdominal radiographs.

Patients and methods

Between March and June 1984, 117 consecutive patients admitted to the surgical units of the Kent and Canterbury and Margate hospitals with acute abdominal pain, and who required abdominal radiography, were entered into the study. Subsequently 15 patients were rejected, usually because they were too ill to undergo one of the three standard views. Patients with an obvious clinical diagnosis—for example, appendicitis—who would not normally be referred for radiography were also excluded.

At the time of admission radiographs were reported on at two levels of skill by surgeons of the admitting team—for example, senior house

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officer and registrar, or preregistration house officer and senior registrar. The erect chest radiograph and erect and supine abdominal radiographs were reported on separately and a particular note made of the value of the information obtained from the erect abdominal film over that obtained from the combined supine abdominal and erect chest films. All radiographs were subsequently reported on, using a similar form, by one consultant radiologist, who was aware of the clinical history and findings but not of the final diagnosis.

The clinical differential diagnosis was recorded on admission, after radiography, and at discharge from hospital.

Results

SURGICAL REPORTS

Two hundred and four separate reports on patients' radiographs were generated at two levels of surgical skill. One hundred and twelve reports on erect abdominal radiographs (55%) recorded some form of abnormality. One hundred and twenty six reports on supine abdominal radiographs (62%) recorded abnormal findings. Ninety eight out of 204 reports on erect chest films (48%) identified radiological abnormalities. Of these, seven were identified below the diaphragm; 70 in the heart, lungs, or rib cage only; and 21 radiographs were thought to show mixed abnormalities above and below the diaphragm. After further analysis of the surgical chest x ray reports with the consultant radiologist there was agreement that 36 of the 98 "abnormal" chest films were either incorrectly reported—for example, increased hilar shadowing—or showed only minor age related changes—for example, calcified or unfolded aortas. Apart from two possible rib metastases no major abnormalities were missed by junior surgeons in the chest radiographs.

Seventeen erect abdominal radiographs were reported as showing "useful" radiological features additional to those seen in the supine abdominal radiograph and erect chest radiograph. After analysis of these reports and further discussion with the junior surgeons concerned there was full agreement that 12 of these 17 had recorded irrelevant or incorrect information. Examples included "renal outlines better seen" (four cases) and "fluid levels in left hypochondrium" (diagnosis cholecystitis). In each of these cases the so called useful information was not relevant either to the suspected clinical diagnosis at the time or to the final diagnosis. No errors in management were made due to these incorrect or irrelevant observations.

Of the remaining five reports of "useful" erect abdominal radiographs, two recorded "fluid levels in dilated bowel, confirming obstruction." These two reports were made by a house surgeon during the first six weeks of appointment. The senior reporting surgeon on duty did not consider the erect abdominal radiograph useful in these two cases, obstruction being diagnosed from the supine film alone. The same houseman did not consider fluid levels to be of value in any subsequent reports. Two more of the remaining five reports recorded abnormal fluid levels, one of which was correctly suspected as lying within an abscess cavity. In the second case the relevance of the abnormal air and fluid level outside bowel and within an abscess cavity was missed by the surgeons. With both these abscesses, however, the abnormal gas shadows were readily identified in the supine radiograph. In the final case of the remaining five some incidental calcification was noted as well as a large, soft tissue mass in the left hypochondrium (this was also diagnosed in the supine abdominal radiograph). Its relevance, however, was not appreciated until a gastric volvulus was discovered at laparotomy.

In none of the 102 cases was there evidence of any change in management resulting from information obtained from the erect abdominal radiograph alone.

CONSULTANT RADIOLOGIST'S REPORTS

For the 102 patients in the survey, 64 erect abdominal radiographs and 74 supine abdominal radiographs showed abnormal features. Thirty four of 102 chest radiographs were also reported as abnormal. Twenty six of these abnormalities were above the diaphragm and eight were below or included the diaphragm. Eight unsuspected acute chest conditions were found, seven complicating acute abdominal conditions and one simulating upper abdominal symptoms. In five patients with proved gastrointestinal perforations free gas was seen in all five erect chest films. One erect abdominal radiograph, however, failed to show free gas, as the dome of the diaphragm was missed off the film. Two possible rib metastases were undetected by junior

TABLE I—Consultant radiologist's reports: "helpful" erect abdominal radiographs

Case No	Diagnosis	Radiological features	Comments
1	Diverticular disease, paracolic abscess	Small bowel loop fixed to inflammatory mass visible in supine abdominal radiograph	Missed by surgeons. Laparotomy and Hartmann's procedure on clinical grounds
2	Leaking duodenal stump, subhepatic abscess	Fixed collection of abnormal extraluminal gas shadows in abscess. Visible in supine abdominal radiograph	Missed by surgeons. Laparotomy on clinical grounds 36 hours after radiography
3	Peritonism, known uterine carcinoma	Gas in biliary tree. Area excluded from supine abdominal radiograph but seen in subsequent supine film	Missed by surgeons. No surgery undertaken in view of known inoperable cancer
4	Left paracolic abscess	Gas/fluid level in erect abdominal radiograph. Gas/soft tissue shadow in supine abdominal radiograph	Abscess drained on clinical grounds 24 hours after radiography
5	Emphysematous cholecystitis	Constant right subhepatic gas shadow. Visible in supine abdominal radiograph	Laparotomy and emergency cholecystectomy on clinical grounds

TABLE II—Consultant radiologist's reports: potentially "misleading" erect abdominal radiographs

Case No	Clinical details/diagnosis	Radiological features	Comments
6	Upper abdominal pain. Diagnosis uncertain. ?Gastroenteritis	12 fluid levels seen in small and large bowels	To some, fluid levels suggest obstruction. No dilated bowel in supine abdominal radiograph
7	Small bowel obstruction. Small bowel volvulus	Small bowel obstruction diagnosed by dilated small bowel in supine abdominal radiograph	No fluid levels seen in erect abdominal radiograph
8	Sudden onset of lower abdominal pain. Clinically obscure diagnosis. Diverticular disease	Multiple fluid levels in right iliac fossa	No dilated bowel in supine abdominal radiograph, but to some, multiple fluid levels suggest obstruction
9	Epigastric pain only. (Duodenal ulcer found later)	Huge air/fluid level in transverse colon	Thought by one surgeon to be an abscess cavity
10	Right pyonephrosis	Large right soft tissue mass not visible in erect abdominal radiograph	Would have been missed if erect abdominal radiography only had been undertaken

surgeons, but no changes in management were made, or possible changes missed, as a result of surgical misinterpretation of the erect chest radiograph.

Five erect abdominal radiographs contributed information additional to that obtained from the combined erect chest radiograph and supine abdominal radiograph (table I). Relevant abnormalities, however, were clearly visible in the supine abdominal radiograph in four of these cases. In two of the five cases the abnormal features (gas and fluid levels in abscess cavities) were found useful by surgeons. In three cases the features were missed or misinterpreted by surgeons. In one case information from the erect abdominal radiograph was not obtained from the supine film because the area had been excluded from the radiograph.

Five erect abdominal radiographs showed what were considered to be potentially misleading radiological features (table II). Analysis of these had to await the final diagnosis, which was not known at the time of reporting. All five, however, were subsequently confirmed as showing features which could have been misinterpreted by the inexperienced.

Discussion

Although most surgeons and some radiologists consider the routine use of erect and supine abdominal radiography to be a standard investigation for the acute abdomen,^{1,2} the value of this has been questioned.^{3,4} We have therefore analysed prospectively the value of the erect abdominal radiograph as interpreted by junior surgeons. Features traditionally described as diagnostically

useful in the erect abdominal radiograph are free subdiaphragmatic gas in perforation of the gastrointestinal tract and gas and fluid levels in obstructed bowel or abscess cavities.

Miller and Nelson showed clearly the superiority of the erect chest radiograph over the erect abdominal radiograph for detecting small amounts of intraperitoneal free gas.⁵ This was particularly true when the erect chest film was taken after the patient had lain on the left side for 10 minutes, when as little as 1 ml gas could fairly consistently be shown. Subdiaphragmatic free gas was detected in the erect chest radiographs of all five patients in our series who had suffered perforation of the gastrointestinal tract. The same radiological feature was present in the erect abdominal radiographs of four of these patients.

Erect chest radiographs may also disclose unsuspected chest disease. Haywood *et al* found abnormalities in 27% of patients presenting with acute abdominal pain, including eight acute chest conditions out of 100 patients that may have masqueraded as acute abdominal pain.³ We found abnormalities in 33% of chest x ray films, including eight acute chest conditions. The routine preoperative chest radiograph for non-emergency surgery has not been shown to be of value in the follow up of post-operative pulmonary or abdominal conditions.⁶ We, however, believe that it may provide a valuable baseline in the follow up of any postoperative pulmonary or subdiaphragmatic complications in patients presenting acutely with abdominal pain—particularly in view of the relatively large number of acute chest conditions that occur in these patients. This warrants further large scale investigation.

Detection in an erect abdominal radiograph of fluid levels in bowel already noted in the supine abdominal radiograph to be dilated is of dubious value.⁷ One of us (SF) has long been convinced that the routine use of the erect abdominal radiograph does not offer a measurable contribution to the investigation of these patients; and since about 1976, after discussion and agreement with local clinicians, it has been the policy of this health district to undertake supine abdominal radiography and erect chest radiography only in the first instance. Although we continue to receive unanimous support from local surgeons and radiologists, it is apparent from widespread discussion that this policy has not been widely accepted outside our own health district. It was therefore decided to put this policy to scientific test, although Haywood *et al* have already given support in their pilot study of radiographs of the acute abdomen. They showed a higher yield of useful information from the supine than from the erect abdominal radiograph and that the erect film did not alter management in any case.³ Both these findings are confirmed in our series.

Multiple fluid levels were visible in erect abdominal radiographs of two patients in our series without clinical obstruction of the small bowel or dilated small bowel being evident in the supine radiograph. Conversely, in one patient with intestinal obstruction and dilated small bowel evident in the supine abdominal radiograph the erect film failed to show any fluid levels. Thus the relation between intestinal obstruction and the appearance of fluid levels is inconsistent. This, together with the known superiority of erect chest radiography in detecting subdiaphragmatic free gas,⁵ casts serious doubt on the continued practice of routinely requesting erect abdominal radiographs in the acute abdomen.

The value of erect abdominal radiography in detecting intra-abdominal abscesses is well recognised by radiologists and is confirmed in this study. We recommend its use when an abscess is suspected clinically or when localised symptoms fail to resolve quickly and immediate surgery is not indicated on clinical grounds. Gas shadows in the supine radiograph suspected of being outside bowel should also be investigated further by erect and lateral decubitus radiography.

We suggest that initial routine radiographs should be restricted to an erect chest film and supine abdominal film. We agree with Lee¹ that in view of the failure of some surgeons to observe important, if subtle, radiological abnormalities abdominal radiographs should be reported on by radiologists at the time of

radiography, or as soon as possible afterwards if surgery is not performed.

We recommend regular clinicoradiological meetings to enable surgeons and other clinicians to understand both the limitations and the value of abdominal radiographs in acute abdominal conditions.

Finally, thoughtless requests for erect abdominal radiographs cause unnecessary discomfort to patients and are a source of considerable waste, both in radiographers' time and x ray materials. De Lacey *et al*, in their retrospective analysis of 100 consecutive patients referred from an accident and emergency department for abdominal radiography, found that 83% of all patients and 73% of those suffering from renal colic or loin pain had undergone erect abdominal radiography.⁴ Even if intestinal obstruction is considered an indication for erect abdominal radiography (which we strongly contest) De Lacey *et al* found that only 4% of their patients had any indication for the procedure.

Conclusions and recommendations

No changes in management resulted from information available from the erect abdominal radiograph alone in 102 patients. There is therefore no evidence to support its continued routine use in the investigation and management of patients presenting with acute abdominal pain. In particular, there is no evidence that the erect abdominal radiograph contributes helpful information in the diagnosis of intestinal obstruction or perforation additional to that obtained from the supine abdominal radiograph and erect chest radiograph.

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100 YEARS AGO

Advices from the Red Sea continue to describe the discomforts experienced at Suakin as very serious. The English soldiers, it is said, are "a pitiful sight," not one man in fairly healthy condition, while even the Indian troops are grumbling bitterly, and almost mutinous. The heat is tremendous, the frequent sandstorms most distressing, and the deaths very numerous. But if Suakin be bad, Massowah, which the Italians have occupied, is worse. A private letter says: "We called in at Massowah, and had to anchor for the night, and a more frightful, horrible night I never spent; not a breath of air, and the thermometer 122° Fahr. This is no exaggeration; we were panting about the deck; the heat seemed to choke you; sleep was out of the question. Some negroes seemed to feel the heat more than Europeans, and were groaning fearfully, and pouring buckets of water over their heads, which, however, was of very little use, as the water was between 95° and 100° Fahr. Five Italian officers have committed suicide, and no wonder! Aden, after Suakin and Massowah, is a perfect paradise." (*British Medical Journal* 1885;ii:559.)