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Is direct radiologist supervision of abdominal computed tomography (CT) scans necessary?

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AIM: To determine the effect of direct radiological supervision of patients attending for abdominal CT by assessing the frequency of protocol alteration subsequent to radiologist review of the images obtained.

MATERIALS AND METHODS: A prospective questionnaire-based observational study was performed of 187 consecutive patients undergoing abdominal CT. The CT protocol was determined by a radiologist in advance, with reference to the request form. Any subsequent change in the prescribed study that was contingent on radiologist review of the images obtained was documented on the questionnaire. Comparison was made with a second (control) group of 100 patients undergoing cranial CT.

RESULTS: A protocol change was undertaken following radiologist review of the CT images of 17 (9%) of the group undergoing abdominal CT, compared with 14 (14%) of the group undergoing cranial CT. In the abdominal CT group, further scanning was performed for lesion characterization, to guide a subsequent interventional procedure, because of inadequate anatomical coverage or to evaluate an unexpected lung tumour. There was no significant difference in proportions between the two groups ($p=0.23$).

CONCLUSION: When abdominal and cranial CT studies were compared, there was no significant difference in the proportion of studies requiring a change in the prescribed protocol following radiologist review of the images obtained. There was no evidence to suggest that abdominal CT was any less suited to protocol.

Introduction

Radiological workload has increased significantly over the past decade.[1,2] In particular, computed tomography (CT), once regarded as a restricted resource, is now commonplace in the United Kingdom: 1,488,752 examinations were recorded in England alone for 2000–2001.[3] CT is now perceived as central to the diagnosis and clinical management of many cases and, as such, has been subject to an inexorable increase in demand. This has been exacerbated by technological developments such as multidetector row imaging, which allows more complex acquisition, post-processing and analysis, further increasing its appeal to requesting physicians.[4]

The average annual workload for UK radiologists is currently in the order of 20,000 patient examinations,[5] and there are many competing demands on their time. As a result, it is now commonplace for radiologists to "multitask" their clinical sessions in an attempt to increase throughput. With particular reference to CT, it is increasingly popular for the study protocol to be prescribed in advance according to the clinical information stated on the request form, so that the examination itself does not require direct radiological supervision. Historically,

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this practice has been perceived as more acceptable for some body parts (for example, brain; ears, nose and throat; and musculoskeletal system) than others (notably abdomen and pelvis); abdominal and abdominopelvic examinations are perceived as more technically demanding and most likely to benefit from direct radiological supervision. However, in reality practice is variable; a recent North American survey showed that abdominal and abdominopelvic CT is reviewed on the spot in only 38% of institutions.[6]

Our aim was to determine the effect of direct radiological supervision of patients attending for abdominal CT by assessing the frequency of protocol alteration subsequent to radiologist review of the images obtained. Comparison was made with patients attending for cranial CT.

Materials and methods

Consecutive patients attending for abdominal or abdominopelvic CT in a large district general hospital setting (catchment 500,000) were recruited prospectively over a period of 2 months. Subjects were identified by the details on the written request forms triaged in the CT scanner suite. All referrals were eligible and taken from the accident and emergency department and inpatient and outpatient requests. All technical parameters for each CT study were determined in advance by the radiologist supervising the CT list during which the patient was examined, according to the clinical indication stated on the request form. Protocol instructions were then written on the request form so that they were subsequently available to the examining CT radiographer. The radiologist was either a trainee or consultant, depending on the list in question and according to day-to-day practice. Documented departmental CT protocols were available to all trainees.

All studies were performed using a single four-row multidetector CT scanner (LighspeedPlus, GE Healthcare Technologies, Waukesha, Wisconsin, USA). According to normal practice in our institution, a senior trainee or consultant radiologist directly supervised each CT study and reviewed it immediately after acquisition to ensure that it was technically adequate, and that any lesions had been fully demonstrated. Studies supplementary to the original protocol were requested where indicated. All studies were subsequently reported by both consultants and trainees in consensus, which is usual in our institution.

A questionnaire was completed after each individual examination by the supervising radiologist. This detailed the clinical indication, initial CT protocol, any changes to protocol contingent upon the subsequent radiologist review of the study, and the nature of and reason for such changes. The grade of the supervising radiologist was also noted. Comparison was made with a second group of patients attending for cranial CT, whose examinations were conducted in an identical fashion.

Completed questionnaires were subsequently analyzed to determine the frequency of any protocol change and the factors underlying this, and raw frequencies for abdominal and cranial studies were compared.

Results

Fully completed questionnaires were available for 187 abdominal and 100 cranial CT studies. The median age of the subjects was 66 years (range 4 to 96 years; 100 males and 87 females) for the abdominal CT group, and 71 years (range 0.02 to 98 years; 41 males and 59 females) for the cranial CT group. There was no significant difference in age between the two groups ($p=0.14$, Mann–Whitney *U*-test).

The indications for abdominal and cranial CT are shown in Table 1. The majority of abdominal CT studies were protocolled (148 studies, 79%) and monitored (153 studies, 82%) by senior radiology trainees according to usual practice at our institution. There was a protocol change in 24 cases (13% of total). In 7 of these, the change preceded acquisition and was due to inability to administer intravenous contrast medium because of abnormal renal function (3 cases), previous contrast reaction

Table 1 Clinical indications for abdominal CT (study group) and cranial CT (control group)

Clinical indication for abdominal CT	Number (%)
Malignancy	79 (42)
Abdominal pain	43 (23)
Intra-abdominal collection	19 (10)
Renal lesions	13 (6)
Liver lesions	9 (4)
Aortic aneurysm	8 (4)
Trauma	5 (3)
Others	16 (8)
Total	187 (100)
Clinical indication for cranial CT	**Number (%)**
Haemorrhage	39 (39)
Cerebrovascular accident	24 (24)
Tumour	28 (28)
Others	9 (9)
Total	100 (100)

(3 cases) or inability to gain intravenous access (1 case). There were therefore 17 cases (9% of total) in which a protocol change was required subsequent to image acquisition as a direct result of radiological supervision.

The clinical indications for CT of these 17 cases were varied: 6 were performed for renal tract evaluation, 5 for possible intra-abdominal collections, 3 for abdominal pain, 2 following trauma and 1 for assessment of a known liver lesion. The protocol change made and the rationale behind it are detailed in Table 2: 15 cases (88%) were protocolled and checked by a senior trainee, and 6 cases (35%) were protocolled initially as "plain and see", in the context of renal tract evaluation.

The majority of cranial CT studies were also protocolled (95 studies; 95%) and checked (83 studies; 83%) by senior radiology trainees, and the protocol was changed in 15 (15%) cases. Of these, 1 (1%) was changed immediately before CT, because intravenous contrast was contraindicated owing to renal failure. Therefore, additional scanning followed radiological review in 14 cases (14% of total). With the exception of 1 case, where additional slices were required because of the subject's movements, additional CT was performed to further characterize identified lesions (Table 2). Of these 14 cases, 10 (71%) were protocolled initially as "plain and see". The indication for the majority of these (90%) was to exclude an underlying space-occupying lesion; 13 cases (93%) were protocolled and 11 (79%) were checked by a senior trainee.

There was no significant difference between the two groups in the number of studies in which the protocol was changed following radiologist review of the images obtained (17 of 187 versus 14 of 100, $p=0.23$, Fisher's exact test).

Discussion

Unsupervised CT sessions, managed by experienced radiographers, have been generally perceived as a means to tackle increasing radiological workload in the face of inadequate radiological manpower. However, at the time of writing we could find no peer-reviewed studies that directly evaluated the effect of radiologist supervision in the UK, with which to support or refute this approach. Our departmental policy at present is to ensure that all CT lists are supervised by a radiologist if possible: we were able to carry out the present investigation because all studies in our department are protocolled in advance, with the intended protocol written directly onto the request form. All studies are then subsequently evaluated by the supervising radiologist. Because this is general practice in our department, there was no spectrum bias in patient selection and more straightforward cases were not channelled towards unsupervised lists.

A higher proportion of changes were made immediately before scanning in the abdominal CT group, which was due to the increased frequency with which intravenous contrast was protocolled in this group. During unsupervised sessions, radiologists rely on the radiographer to identify cases with risk factors precluding intravenous contrast administration, by direct questioning immediately before intravenous cannulation or inspection of medical records. This is well within a radiographers' remit, but should not include the decision whether to perform additional acquisitions contingent upon image review, as radiographers are generally not trained to interpret CT studies.

We found that 9% of abdominal studies required additional CT following image acquisition and radiologist review (the primary endpoint of our

Table 2 Protocol changes following initial CT examination, and reasons for change

Abdominal protocol change ($n=17$)	Initial protocol (n)	Reason for change	Number (%)
Additional scanning phase	"Plain and see" (6) Portal venous study (2) Triphasic study (1)	Further characterization	9 (50)
Additional slices	Portal venous study (6)	Inadequate anatomical coverage	6 (33)
Additional examination	Portal venous study (2)	Unexpected chest tumour (1) Interventional procedure (1)	2 (17)
Total			17 (100)
Cranial CT protocol change ($n=14$)	Initial protocol (n)	Reason for change	Number (%)
Additional examination	"Plain and see" (10) Unenhanced (3)	Further characterization	13 (93%)
Additional slices	Unenhanced (1)	Patient movement	1 (7%)
Total			14 (100%)

study), in comparison with 14% of cranial studies. It was surprising that there was no significant difference between these proportions because, anecdotally, cranial CT is frequently thought of as suitable for unsupervised sessions, whereas abdominal studies are believed to be more complex and to require direct supervision. Our data did not bear this assumption out, which has implications for our clinical practice. "Scan and go" policies have been heralded as a solution to the increasing radiological workload, and we have found no evidence that abdominal examinations are less suited to protocolled sessions than cranial examinations.

Interestingly, our results differ from data presented by a North American institution that assessed the effects of implementing a "scan and go" policy for body CT in an outpatient setting, reporting no effect on patient care.[7] The authors' recall rate was less than 1% (for a total of 4089 examinations). However, a radiologist was contacted if patients needed "immediate attention", and it was unclear whether this included review of the images obtained where there was radiographic uncertainty.[7]

It could be argued that the percentage of protocol changes might have been less if a consultant rather than a trainee had prescribed a larger proportion of the advance protocols. However, the trainees used in this study were generally senior and had access to written departmental protocols, and thus we have no reason to believe that there would be a significant difference between their approach and that of a more experienced consultant.

In summary, the CT protocol was changed following radiologist review of the images obtained in 9% of abdominal CT studies compared with 14% of cranial studies. There was no evidence to suggest that abdominal CT is any less suited to protocolled sessions than cranial studies.

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