Computed tomography of the head by the accident and emergency department—why 24 hour access is vital

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Abstract

Objective—To examine the use made of 24 hour access to computed tomography from an accident and emergency (A&E) department and to assess whether clear benefits for patients could be identified by having such a service.

Methods—Retrospective review of 176 cases where computed tomography was ordered by A&E staff of a large teaching hospital over a one year period.

Results—53% of scans were done “out of hours”; 97% of scans performed (171/176) were studies of the brain. Three examinations were of the cervical spine and two were of the chest. 54% of head scans (93/171) were performed for either confirmed or suspected trauma with 46% (78/171) done for medical indications. Only 16% (11/71) of patients who had a head scan for acute trauma required transfer to the regional neurosurgical unit after consultation. Computed tomography was 100% sensitive in the diagnosis of subarachnoid haemorrhage. In cases where computed tomography was performed for coma of undetermined origin the pathology causing coma was identified on computed tomography in 50% of cases.

Conclusions—Computed tomography facilities allow comprehensive initial evaluation of the head injured patient and minimise hazardous and expensive transfer of these seriously ill patients. Experience shows that it is a vital tool in the initial differential diagnosis of the comatose patient and therefore must be available for use by senior and middle grade A&E staff on a 24 hour basis.

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Recent cases in the media have highlighted the unacceptable practice of patients being transferred due to lack of 24 hour computed tomography facilities in the receiving hospital. Such practice has been excused by the defence that it was an unfortunate and exceptional occurrence. A recent study we performed identified 26 accident and emergency (A&E) departments in the UK which accept sick and injured patients but which had access to computed tomography on a 9-5 basis only.¹ The British Trauma Society guidelines published in 1993 stated that every hospital designated to

receive major trauma patients should have computed tomography with an image link to the regional neurosurgical unit on a 24 hour basis.² Guideline standards for A&E departments to be recognised for the training of senior house officers produced jointly by British Association for Accident and Emergency Medicine and the Faculty of Accident and Emergency Medicine state that computed tomography must be “available and readily accessible for use on head injuries by February 1996”.³ The phrase “readily accessible” is obviously open to interpretation.

The A&E department of the Leicester Royal Infirmary is a large teaching unit seeing over 110 000 patients per year. There are separate medical, surgical, and paediatric admission units in the hospital that receive referrals directly from general practitioners. Computed tomography has been in place in the A&E radiography department of the Leicester Royal Infirmary since 1978. In consultation with our radiology colleagues we developed the following guidelines for selecting head injured patients who required emergency computed tomography based on well recognised recommendations.^{3,4}

The presence of one or more of the following:

- (1) Fractured skull in combination with confusion or other depression of the level of consciousness or focal neurological signs or fits;
- (2) Confusion or other neurological disturbance persisting for more than 12 hours after head injury even in the absence of skull fracture;
- (3) Coma continuing after resuscitation;
- (4) Suspected open injury of the vault or the base of the skull;
- (5) Clinical or radiological evidence of depressed skull fracture.

The scans are performed rapidly as discussion with a radiologist before scanning is not necessary in these agreed cases. Requests for computed tomography for all other reasons are discussed with the radiologist on call by middle grade or consultant A&E staff. All scans, including those done out of hours, are reported on immediately by consultant or middle grade radiology staff.

We studied our use of computed tomography over a one year period in order to determine what use we make of this service, what impact it has on patient management, and to study how this is changing.

Table 1 Timing of computed tomography performed from the A&E department (n=176)

Time	No (%)
09.00–17.00	83 (47)
17.00–00.00	63 (36)
00.00–09.00	30 (17)

Table 2 Indications for computed tomography of the head (n=171); see text for definitions of groups

Indication	No (%)
Acute trauma	71 (42)
? Acute trauma	4 (2)
Delayed trauma	19 (11)
? SAH	27 (16)
Coma ? cause	50 (29)

SAH = subarachnoid haemorrhage.

Table 3 Findings on computed tomography of the head done for acute trauma (n=71)

Main finding	No (%)
Normal	30 (42)
Extradural haematoma	5 (7)
Subdural haematoma	4 (6)
Intracerebral haematoma	9 (13)
Subarachnoid haematoma	1 (1)
Cerebral oedema	4 (6)
Simple fracture	6 (8)
Depressed fracture	5 (7)
Base of skull fracture	3 (4)
Compound fracture	4 (6)

Method

All requests for computed tomography made by A&E staff over a one year period were identified. The case notes were then analysed with regard to person ordering the scan, when the scan was done, indication for the scan, and findings. As over 97% were head scans these form the major part of the study.

The indications for computed tomography of the head were divided into "trauma" scans and "medical" scans. Indications for scanning in trauma cases were those for definite acute trauma ("acute trauma"), those where trauma was a possibility ("? acute trauma"), and those with a history of head injury more than 24 hours previously ("delayed trauma").

Cases where scanning was done for other than trauma reasons were divided into those done where the indication was coma or altered consciousness of unknown aetiology ("coma ? cause") and those where the working diagnosis before scanning was subarachnoid haemorrhage ("? SAH"). Cases where scans were not requested by A&E staff were excluded.

Results

One hundred and seventy six computed tomograms were requested over a one year period. Of these 171 were examinations of the brain; there were three examinations of the cervical spine and two of the chest. These five examinations were all done in cases of trauma. The times when the scans were performed are shown in table 1.

The indications for the 171 computed tomograms of the head are shown in table 2. All scans were requested by either consultant or middle grade A&E staff. Results are presented according to the indication for scan.

ACUTE TRAUMA

Seventy one head scans were done for acute trauma and 41 (58%) revealed an abnormality as shown in table 3. After neurosurgical consultation by phone augmented by image transfer of the scans only 11 of these 71 patients required immediate transfer to the regional neurosurgical facility after initial stabilisation. This group who required immediate transfer included all patients with intracranial haematomas requiring surgical evacuation and selected other cases where it was felt after neurosurgical consultation that they would benefit from neurosurgical intensive care unit management. In four cases semielective transfer the next day was appropriate in patients with closed depressed skull fractures without central nervous system injury.

? ACUTE TRAUMA

Four cases were identified where the history was unclear, the patient was comatose, and trauma was considered a possibility (? acute trauma). Computed tomography of the brain revealed an extradural haemorrhage, which required surgery in one case. A previously undiagnosed metastasis and an intracerebral haemorrhage were also identified in two other patients. One scan was normal.

DELAYED TRAUMA

Nineteen head scans were performed more than 24 hours after initial injury. These patients were of three types: (1) those who presented initially more than 24 hours after injury, (2) patients who had been admitted to the A&E observation ward after injury, and (3) those who reattended the department after initial discharge.

Twelve of the 19 scans were normal. Four scans revealed intracerebral bleeds, one showed evidence of previous neurosurgery, and one showed evidence of a cerebral contusion. One subdural was identified that required transfer to the regional neurosurgical unit. Twelve of the remaining 18 cases were admitted while six patients were discharged after scanning.

? SUBARACHNOID HAEMORRHAGE

Subarachnoid haemorrhage was the working diagnosis before scanning in 27 patients. The diagnosis was confirmed on scan in 19 cases. Computed tomography revealed an intracerebral haemorrhage in two other cases. In the six cases where the scan was normal patients were admitted for further investigation. Lumbar puncture was negative in all six cases indicating that computed tomography was 100% sensitive in the diagnosis of subarachnoid haemorrhage in this series.

COMA ? CAUSE

Fifty examinations were performed to aid diagnosis in cases of coma of undetermined origin. There were abnormalities identified on 29 of the scans. In 25 of these cases the

Table 4 Findings on computed tomography of the head done for "Coma ? cause" (n=50)

Main finding	No (%)
Normal	21 (42)
Cerebral haemorrhage	12 (24)
Subarachnoid haemorrhage	9 (18)
Cerebral infarction	2 (4)
Cerebral atrophy	2 (4)
Chronic subdural	1 (2)
Cerebral oedema	1 (2)
Meningioma	1 (2)
Skull fracture	1 (2)

pathology identified established the reason for coma (cerebral haemorrhage, subarachnoid haemorrhage, cerebral infarction, chronic subdural haemorrhage, and meningioma). In one further case a skull fracture was identified indicating previously unsuspected trauma. Findings of the other scans are shown in table 4.

Discussion

The vast majority of scans (97%) ordered by this department were examinations of the brain. Over half of all scans done were performed "out of hours" by on call radiology staff. This highlights the fact that access to computed tomography on a 24 hour basis is essential for all A&E departments.

Immediate access to computed tomography for cases of head injury is of obvious benefit to the patient if it rapidly establishes the anatomical type of head injury and the need for active neurosurgical intervention. This is facilitated by our policy of direct access to computed tomography in cases of head injury and by the scans being performed by an on site radiographer. The presence of an image transfer system allows full consultation with the regional neurosurgical unit and case selection for transfer based on clinical need rather than for scanning purposes alone. This is highlighted by the finding that only 11 of the 71 patients who required a scan for head injury were transferred to the regional neurosurgical unit on an emergency basis. The corollary of this is that unnecessary and hazardous patient transfers for computed tomography purposes are avoided.⁵⁻¹⁰

Computed tomography is recognised as being up to 95% sensitive for the detection of subarachnoid haemorrhage if performed within 24 hours. This sensitivity decreases with time to 50% at one week.^{11 12}

In our series computed tomography was 100% sensitive for the diagnosis of subarachnoid haemorrhage. Results from a separate study in the same institution with greater numbers of patients found that computed tomography had a false negative rate of 3.8% in subarachnoid haemorrhage.¹³

These findings support the use of computed tomography as the primary investigation in cases of suspected subarachnoid haemorrhage with patients who have a negative scan being admitted and further investigated by lumbar puncture.

In cases of unexplained coma computed tomography revealed pathology in 29 of the 50 cases. In 25 of these 29 cases the pathology identified established the cause for coma and directly determined the further clinical course of the patient. In some instances this directed further active treatment, while in other situations it identified pathology where further aggressive treatment would be inappropriate (for example catastrophic intracerebral haemorrhage). In one case where history initially was suggestive of a stroke computed tomography performed because of clinical suspicion identified an extradural haemorrhage which required surgery. Had this patient been admitted to a ward without the scan being performed it is unlikely the diagnosis would have been made.

In the study period only five scans were requested of areas other than the head. Since then scans of the chest, cervical spine, and abdomen have become more established in the early investigation of the trauma patient. Thus it is likely that the demand for access to computed tomography will continue to increase for A&E patients, however the principle must remain that it is an investigation for the stable trauma patient.

Conclusion

Rapid access to computed tomography and an image transfer link to the regional neurosurgical centre is vital in the initial assessment of moderate and severe head injury in hospitals that do not have neurosurgery on site. Only 16% of cases who required computed tomography for head injury needed immediate transfer to the regional neurosurgical unit after initial stabilisation. Computed tomography is over 95% sensitive in the diagnosis of subarachnoid haemorrhage as well as having a valuable contribution to make in the identification of treatable intracranial pathology in cases of unexplained coma. Early identification of pathology means earlier delivery to appropriate definitive care. We are fortunate in our unit in having a progressive attitude from our radiology colleagues. The feeling that computed tomography is a "semielective" investigation must be dispelled. A&E staff clearly require access to this resource on a 24 hour basis.

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EMERGENCY CASEBOOK

Tracheal deviation as a sign in ill patients: beware ipsilateral pathology

Tracheal deviation is vigorously taught on paediatric and adult life support courses as being one of the "hard" signs often related to contralateral pathology. It is easy and quick to elicit.

A 31 year old man with asthma presented with a four day history of marked dyspnoea and central chest pain radiating to the back. He had had an inguinal hernia repair under general anaesthetic four days before and was told his chest x ray at that time was normal. On examination he was ill looking, with a trachea deviated markedly to the right. Other relevant physical signs included increased left sided chest expansion compared to the right and dullness to percussion on the right base with some associated bronchial breathing. High flow oxygen was instituted, an intravenous cannula placed, and an urgent chest radiograph arranged (fig 1).

The radiograph confirmed massive collapse of the right lung. This responded to intensive physiotherapy with full reinflation of the lung after 24 hours. Bronchoscopy was not thought necessary and the patient was discharged on oral antibiotics after 36 hours. The final diagnosis was mucus obstruction of the pulmonary tree with secondary lung collapse.

Eliciting physical signs from percussion and auscultation can be difficult in the noisy atmosphere of an A&E department. However, they are an essential component of chest examination. Tracheal deviation is a "hard" sign that is easy to assess but beware that it does not send you in the wrong direction when examining ill patients.

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