

Why do accident and emergency doctors request X-rays?

R. A. WARREN AND D. G. FERGUSON

Department of Accident and Emergency Medicine, Royal Hallamshire Hospital, Sheffield

ABSTRACT

A prospective study was carried out to analyse all X-rays requested from the three accident and emergency departments in Sheffield during one week. There were 3253 patients examined, of which 1028 (31.6%) were X-rayed, 1251 sets of X-rays being performed. Few X-rays (4.5%) were requested for medico-legal reasons.

Skull X-rays were studied in particular detail. Only 5 (4.5%) of 112 films were subsequently reported as abnormal by the radiologist.

The accident and emergency doctor's ability to predict X-ray outcome was not very good, their false positive rate being high at 21% while their false negative rate was low at 5.5%. This indicates that the accident and emergency doctors tended to be over cautious to compensate for their lack of experience.

INTRODUCTION

In 1982 an attempt was made to identify potential savings for the Health Service in Sheffield. The high number of X-ray requests from accident and emergency departments seemed to be a potential source of such savings. 'Out of hours' X-rays, that is those requested at night and at weekends were considered especially wasteful. It was mooted that accident and emergency departments were extravagant in ordering X-rays and requested a large number for non-clinical reasons, such as patient expectation or fear of litigation, rather than using the X-ray as a proper adjunct to clinical diagnosis. It was also suggested that even clinically essential X-ray requests were of dubious value if, due to his inexperience, the accident and emergency doctor was not able to interpret them correctly. The economics, clinical value and medico-legal aspects of X-rays requested from accident and emergency departments have long been a source of controversy (Raison, 1976; De Lacey, 1976) and many attempts at analysis and laying down policy guidelines have been given (Bell & Loop, 1971; De Lacey *et al.*, 1979a, 1979b, 1980). This study aimed to provide an analysis by accident and emergency

specialists who see the problems from a different standpoint than other specialists involved with emergency X-rays.

All three accident and emergency departments in Sheffield agreed to participate—The Royal Hallamshire Hospital (RHH) (adults only); the Sheffield Children's Hospital (SCH) (children only) and the Northern General Hospital (NGH) (adults and children).

METHODS

All three accident and emergency departments in Sheffield were studied for a one-week period from 9.00 am Monday until 9.00 am the following Monday in the autumn of 1982. During the study a proforma (Table 1) was attached to every X-ray request card. The completed proforma was compared to the radiologist's report, which was accepted as the final arbiter. The radiologist was a Consultant or Senior Registrar in the majority of cases.

Strict anonymity of accident and emergency medical staff was observed in the hope of reducing any modifying effect on usual practice which the study might induce on these doctors.

Table 1

X-RAY STUDY

Patient:		-RHH Hospital -NGH -SCH	Number
Grade of Requesting Doctor:			(PLEASE TICK)
Consultant			
Associate Specialist			
Clinical Assistant			
Senior Registrar			
Registrar			
SHO			
Pre-Reg HO			
Date of X-Ray Request:			(PLEASE STATE)
Time of Request:	am/pm		
View requested			
What is your PRIME reason for requesting X-ray?			
— Suspected fracture or dislocation			(PLEASE TICK)
— Suspected foreign body			
— Specific request from GP			
— Specific request from patient or relative			
— Possible child abuse			
— Medico-legal			
— Other			(PLEASE STATE)
At the Time of Request, what is your index of suspicion?			
a Positive outcome—STRONG likelihood			(PLEASE TICK)
b Positive outcome—SLIGHT but DEFINITE likelihood			
c Negative outcome—highly likely			

Table 1—continued

On Viewing the X-Ray:

- a Positive finding
- b Negative finding
- c Unsure of interpretation—need senior or specialist help
- d Incidental finding of medical significance

(PLEASE TICK)

RESULTS

As can be seen from Table 4, the most common individual request was for a chest X-ray (11.8% of all requests). The most common reason given for X-raying the chest was infection at all ages, and in the investigation of chest pain, cardiac failure and chronic respiratory disease in the middle aged and elderly.

Skull X-rays were the fourth most commonly requested film, comprising 8.9% of requests. At the SCH the skull X-ray was the commonest film requested.

Taking 'normal working hours' as 9.00 am–5.00 pm Monday–Friday and 9.00 am–1.00 pm on Saturday, then the greater proportion of X-ray requests were made within this period 632 or 50.5%. Out of hours 520 (41.6%) were requested and in 99 (7.9%) no time was entered on the proforma. This is equivalent to an 'X-ray request per hour' rate of 14.4 in the normal working day as opposed to 4.2 out of hours.

Table 2 Patients attending and number of X-rays

	RHH	NGH	SCH	Total
New patients	986	620	526	2132
Return visits	500	241	380	1121
Total attendances	1486	861	906	3253
New patients X-rayed	528 (53.5%)	253 (40.8%)	164 (31.2%)	945 (44.3%)
Return patients X-rayed	32 (6.4%)	19 (7.9%)	19 (5.0%)	70 (6.2%)
Not known	5	3	5	13
Total patients X-rayed	565 (38%)	275 (31.9%)	188 (20.8%)	1028 (31.6%)
Total films requested	714	321	216	1251

Table 3 Doctor's grade compared to positive 'pick-up' rate

Doctor's grade	No. of X-rays requested	No. positive
Consultant	12 (1%)	4 (33.5%)
Associate specialist	2 (0.2%)	0
Clinical assistant	130 (10.4%)	33 (25.4%)
Senior registrar	13 (1%)	5 (38.5%)
Registrar	44 (3.5%)	11 (25.0%)
SHO	669 (53.5%)	178 (26.6%)
Pre-reg HO	381 (30.5%)	51 (13.4%)
Total	1251 (100%)	

Table 4 Breakdown of individual X-ray requests

Skull	112 (8.9%)
Face	26 (2.1%)
Nose	12 (1.0%)
Jaw	8 (0.6%)
Cervical spine	34 (2.7%)
Thoracic spine	6 (0.5%)
Lumbosacral spine	19 (1.5%)
Hips/Pelvis	40 (3.2%)
Shoulder/Clavicle	44 (3.5%)
Humerus	11 (0.9%)
Elbow	48 (3.8%)
Forearm	26 (2.1%)
Wrist	104 (8.3%)
Hand	105 (8.4%)
Digit	93 (7.4%)
Femur	14 (1.1%)
Knee	69 (5.5%)
Tibia/fibula	28 (2.2%)
Ankle	123 (9.8%)
Foot	113 (9.0%)
Toes	27 (2.2%)
Chest	147 (11.8%)
Abdomen	22 (1.8%)
Other	20 (1.6%)
Total	1251 (100%)

Table 5 Accident and emergency doctors clinical suspicion v his interpretation of film

	all X-rays		skull X-rays	
	Films done	Films positive	Films done	Films positive
Strong clinical suspicion of positive outcome	302	167 (55.3%)	10	1 (10%)
Slight but definite suspicion of positive outcome	557	136 (24.4%)	42	1 (2.4%)
Negative suspicion of positive outcome	381	33 (8.7%)	58	2 (3.4%)
Not known	11	—	2	—
Total	1251		112	

Table 6 Accident and emergency doctor's interpretation compared to radiologist's report

	Radiologist's report positive	Radiologist's report negative	Radiologist's report equivocal	Radiologist reports incidental finding	Not known	Total
Doctor's interpretation positive	209 (63.3%)	86 (26.1%)	13 (3.9%)	3 (0.9%)	19 (5.8%)	330 (100%)
Doctor's interpretation negative	42 (5.5%)	665 (86.7%)	24 (3.1%)	12 (1.6%)	24 (3.1%)	767 (100%)
Doctor unsure of interpretation	16	62	5	5	8	96
Doctor finds incidental finding	—	4	—	1	1	6
Doctor's interpretation not known	10	36	—	—	6	52
Doctor's interpretation positive	4 (27%)	5 (46%)	—	—	2 (27%)	11 (100%)
Doctor's interpretation negative	1 (1.1%)	79 (90.8%)	—	—	7 (8%)	87 (100%)
Doctor unsure of interpretation	—	2	—	—	1	3
Doctor finds incidental finding	—	1	—	—	—	1
Doctor's interpretation unknown	—	8	—	1	1	10

Table 7 Main reason for X-ray request

	All X-rays	Skull X-rays
Suspected fracture or dislocation	877 (70.1%)	79 (70.5%)
Suspected foreign body	78 (6.2%)	2 (1.8%)
Specific request from GP	44 (3.5%)	6 (5.4%)
Specific request from patient or relative	21 (1.7%)	2 (1.8%)
Possible child abuse	2 (0.2%)	2 (1.8%)
Medico-legal	56 (4.5%)	18 (16.1%)
Other clinical reason	122 (9.8%)	3 (2.7%)
Not known	51 (4.1%)	—
Total	1251 (100%)	112 (100%)

DISCUSSION

If only first time attenders are considered a greater proportion were X-rayed at the RHH than the other hospitals (Table 2). During the study the RHH was one of the few hospitals in England still employing pre-registration house officers in its accident and emergency department. If they and their X-rays were excluded, the figures would be similar to those from the NGH, where no pre-registration staff were employed.

In this study only 1% of X-rays were requested by consultants and 1% by senior registrars. These low figures are misleading, as these senior doctors are consulted about many more films even though they may not have requested them personally. Because of these low numbers it is impossible to state whether or not consultants and senior registrars are more efficient X-ray users. What can be seen from Table 3 is that the proportion of positive X-rays produced by SHOs, registrars and clinical assistants is almost identical, while pre-registration house officers fare only half as well. This provides further evidence that accident and emergency departments require more senior medical staff than inexperienced juniors for both patient safety and efficiency. Few X-rays were requested for non-clinical medico-legal reasons, only 4.5% overall (Table 7). This is in contrast to the figure of 10% obtained by De Lacey *et al.* (1979a) and to studies showing much higher figures of up to 44% (Evans, 1977). When the accident and emergency doctors were questioned on completion of the study it transpired they were not making such requests to prevent themselves being sued for negligence but to aid their patient in any subsequent claim for industrial or criminal compensation. Interestingly, Pilling (1976) states that after a twenty-year search he was unable to find any case where failure to request an X-ray was established as the basis for a finding of negligence.

The authors did not attempt to determine the effect of the X-ray on clinical management. While this is certainly important (De Lacey *et al.*, 1979b) the place of certain X-rays in clinical management, notably skull X-rays, is controversial (Evans, 1977; Mendelow *et al.*, 1983). The work of the Glasgow neurosurgical school is very influential and holds that a normal or abnormal skull X-ray is of prime importance following head injury (Mendelow *et al.*, 1982, 1983). This inevitably leads to a low yield of abnormal films, 4.5% in this study, and yields as low as 0.7% have been reported (Gibson, 1983). On questioning after the study, the doctors said that they X-rayed the skull even though they thought the outcome would be normal in over half (51.8%), as to miss a positive finding, even though unlikely, might have catastrophic consequences for the patient. Similarly, it is important to appreciate that the absence of a fracture on X-ray may be a positive finding and help in sending a patient home. The use of X-rays in this way is not confined to unusual injuries. If ten old ladies who had fallen clinically had a hip fracture, but only four showed fractures on X-ray, the efficiency of X-ray usage would not be 40%, it would be 100%.

The accident and emergency doctor's clinical suspicion at the time of making the X-ray request is revealing. In those cases when he was strongly suspicious of a positive outcome to the X-ray, he found such a feature in little more than half (55.3%). This shows that the accident and emergency doctor is not very good at relating his clinical impression with the subsequent X-ray finding, as has been shown before (De Lacey *et al.*, 1980). However, the figures imply that the accident and emergency doctors are

aware of their shortcomings, which is why they tend to overestimate the likelihood of a positive outcome i.e. opt on the 'safe side'.

In 381 (30.5%) of cases the accident and emergency doctor thought that the film would be negative at the time of making the request, and he was right in 91.3%. While in some circumstances a negative X-ray is of crucial significance, the actual number requested in one week is disturbing. Even more disturbing is that 8.7% of these anticipated normal X-rays showed a positive feature. It would appear that the X-ray is used to a certain extent as a 'safety net', picking up cases that the accident and emergency doctor has himself missed.

The philosophy of 'opt on the safe side' is once more displayed when the accident and emergency doctor's X-ray interpretation is compared to the radiologist's report. Eighty-six (26.1%) of 330 films thought abnormal by the accident and emergency doctors were normal, and 42 (5.5%) of 767 films thought normal by accident and emergency doctors were abnormal. This is also worrying and may have serious consequences (De Lacey *et al.*, 1980).

In conclusion the Sheffield study shows three things. Firstly, that accident and emergency doctors, particularly when inexperienced, are not wholly accurate in predicting and interpreting emergency radiographs; secondly, that these doctors err very much on the side of caution; thirdly, that few X-rays are requested for non-clinical medico-legal reasons. Continued teaching and ready advice is essential from the growing number of trained accident and emergency specialists, so that the 'safety net' alluded to previously may be pitched at a more reasonable level.

ACKNOWLEDGEMENTS

Our sincere thanks are due to Dr C. M. Illingworth and Mrs K. M. Taylor (Consultants in Accident and Emergency Medicine) and Dr N. A. Barrington, Dr R. K. Levick and Dr M. Collins (Consultant Radiologists) for their help and constructive criticism at every stage in this study.

REFERENCES

- Bell R. S. & Loop J. W. (1971) The utility and futility of radiographic skull examination for trauma. *New England Journal of Medicine* **284**, 5, 236-9.
- De Lacey G. (1976) Clinical and economic aspects of the use of X-rays in the accident and emergency department. *Proceedings of the Royal Society of Medicine* **69**, 758-9.
- De Lacey G., Barker A., Wignall B., Reidy J. & Harper J. (1979a) Reasons for requesting radiographs in an accident and emergency department. *British Medical Journal* **1**, 1595-7.
- De Lacey G. & Bradbrooke S. (1979b) Rationalising requests for X-ray examination of acute ankle injuries. *British Medical Journal* **1**, 1597-8.
- De Lacey G., Barker A., Harper J. & Wignall B. (1980) An assessment of the clinical effects of reporting accident and emergency radiographs. *British Journal of Radiology* **53**, 304-9.
- Evans K. T. (1977) The radiologist's dilemma. *British Journal of Radiology* **50**, 299-301.
- Gibson T. C. (1983) Skull X-rays in minor head injury. *Scottish Medical Journal* **28**, 132-7.

- Mendelow A. D., Campbell D. A., Jeffrey R. R., Miller J. D., Hessett C., Bryden J. & Jennett B. (1982) Admission after mild head injury: benefits and costs. *British Medical Journal* **285**, 1530-2.
- Mendelow A. D., Teasdale G., Jennett B., Bryden J., Hessett C. & Murray G. (1983) Risks of intracranial haematoma in head injured patients. *British Medical Journal* **287**, 1173-6.
- Pilling H. H. (1976) A coroner's view of routine radiology. *Proceedings of the Royal Society of Medicine* **69**, 760-2.
- Raison J. C. A. (1976) Radiological resources. *Proceedings of the Royal Society of Medicine* **69**, 755-6.

Received 14 February 1984; editorial comments to authors 19 March 1984; accepted for publication 16 April 1984