

Radiography in the home

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SUMMARY. Modern portable x-ray units are light enough to be easily carried to the ill patient in his home; their output is sufficient for radiographs containing useful diagnostic information to be made of the chest, hip, and other regions, especially if a grid is employed. The skull is considered to be beyond the range of this method of examination, because of the long exposure times required, but gross lesions can be demonstrated in the oesophagus and stomach if barium is given. The radiation hazard is not considered to be a contraindication if appropriate precautions are taken.

Introduction

With increasingly powerful and complex apparatus becoming available in hospital x-ray departments, allowing very sophisticated radiological techniques to be carried out, it is possible to forget that diagnostic information of great value in the management of a patient can be obtained using simple, cheap x-ray apparatus, which is easily taken to the patient in his home. Because modern apparatus has become so portable, I thought it appropriate to review some of the uses and limitations of this type of examination.

Choice of apparatus

The apparatus should be as light as possible yet sufficiently robust to withstand rough handling during its journey to and from the bedside. Several types of apparatus are currently available, all offering a comparatively high output/weight factor. In addition to moderate weight, small size is important, so that the radiologist can carry the x-ray set, cassettes, protective apron, and even contrast medium all at once so as to avoid repeated journeys to the bedside. Repeated journeys through awkwardly-shaped heavily-furnished houses can convert an otherwise simple examination into a tedious time-consuming exercise.

The importance of the one-trip visit means that the use of a supporting stand is undesirable. If the apparatus is mounted within a rectangular box, with an aperture for the rays to emerge, the varying dimensions of the box will allow a stand to be dispensed with, some improvisation with bedside tables and chairs being sufficient to allow almost all examinations to be carried out. If the operative is suitably attired in a lead rubber apron the box may even be hand held. This extends the use of the examination even further, and assists the radiologist to obtain true projections with aged or ailing patients who have difficulty in maintaining a set position, and with infants and young children.

The comparatively low power of these portable sets allows them to operate satisfactorily from five ampere 230 volt socket. Provision of an earth lead is desirable, but not essential if the tube is mounted within a wooden box. A range of plug adaptors and an extension cable enable all variations in type and position of socket outlet to be accommodated and other ancillary apparatus of frequent use are a tape-measure, neon-screwdriver and a right/left film marker.

Radiation hazard

It can be assumed that during manufacture the sets are suitably shielded so as not to allow any escape of radiation other than in the desired direction; it is as well, however, to check this aspect periodically. Irradiation of the operator comes about not from the set, but from back-scatter, chiefly from the patient himself. The use of a cone is desirable to limit the size of the field being irradiated, and the operator should maintain as great a distance between himself and the patient as possible. If these measures are carried out, and a lead rubber apron of 0.25 mm. lead equivalent (or more) is worn, the radiologist receives no more irradiation than he does during screening sessions. The sets usually have an inherent filtration of two millimetres aluminium, and the radiation hazard to the patient needs to be no greater than with departmental apparatus.

Technique

The chief limiting factor is the fixed low output of the x-ray tube (about 15mA), which can be overcome only by increasing exposure times and keeping the tube-film distance as short as possible. Thick portions of the body and fat patients generally need special consideration if adequate film-blackening is to be obtained. Further, those portions of the body which require grid (or bucky) techniques continue to need them with portable apparatus, with their attendant higher exposures. Exposure times of 0.5 seconds or longer are needed for examinations of the hip, abdomen, and lumbar spine, and the hand-held tube will then need additional support to preserve immobility.

Many procedures require the use of a grid. A high grid-ratio is not necessary and focused fine-line grids are difficult to use. A loose non-focused grid with a ratio of 6:1 gives good results, provided that care is taken to turn the grid so that if the incident ray is not normal to the grid the primary rays pass between the grid septa, rather than across them.

Some sets offer a choice of kilovoltage e.g. 60/75. The higher of these is almost invariably used, because it appreciably shortens exposure times.

Film-processing

Radiography in the home has many variable factors which are beyond the control of the operator; for example, an unco-operative patient, inadequate assistance, and fluctuating mains voltage. While superficially it might be thought that films should, therefore, be hand processed so that film density can be controlled by the development time, in fact this introduces yet a further variable. It is suggested, therefore, that strict discipline be exercised, and machine processing always carried out. The operator soon learns optimum exposure times, and benefits from better film quality as well as rapid access to dry films.

Applications

Chest

The most commonly requested examination in an industrial community is that of the chest. If the patient can sit astride a chair, or on the edge of the bed, a posterior/anterior (PA) film is taken, with a tube-film distance of approximately one and a half metres. Two PA films are taken, the second one having a 50 per cent increase in exposure giving a 'penetrated' view particularly useful where there is a large pleural effusion. The film is usually held in front of the patient by a relative, but may be propped on cushions between the patient and the chair back if assistance is not available. If the patient cannot leave his bed he is propped up on pillows, and AP films taken. A lateral view is always taken, its side being determined by the symptoms or clinical signs and a shorter tube-film distance used, generally about one metre. PA exposure times range from 0.1 sec. to 0.3 sec., and for lateral views 0.3-0.5 sec. is needed.

Limbs

Detection of skeletal injury is the second most common reason for examination. A suspected hip fracture in an elderly patient is thus a fairly frequent indication for examination. A loose grid or grid cassette is used, and AP and inclined-up AP films taken. With tube film distances of 80–100 cm. exposure times necessary are between 0.4 and 0.8 sec. Lateral films are rarely taken, the 30° angled-up AP view giving a useful alternative to the conventional AP projection with a good display of the pubic rami (Shaw, 1973).

Lower limb joints other than the hip are easily examined, and the small tissue bulk generally allows non-screen films to be used with exposure of 0.5–1.0 sec. Screen films provide adequate films for the diagnosis or exclusion of bony injury, and their use allows exposures to be reduced to 0.02–0.04 sec.

Spine

Examination of the lumbar spine is sometimes requested in patients immobilised by pain or stiffness, and presents a considerable challenge in a patient of average or above average build. Where possible the patient is laid on the floor and the tube held above him by two assistants. Grid films are necessary and exposures of up to two seconds are occasionally needed for lateral views.

Abdomen

Examination of the abdomen with or without the use of contrast media can be accomplished successfully with the aid of a grid. The stomach can be examined for gross abnormalities if barium is given, the patient being turned prone, supine, and oblique as in a conventional ward barium meal (Cantwell, 1960). Obstructive lesions in the oesophagus can also be demonstrated, the obstruction removing the critical timing otherwise needed in a barium swallow.

Skull

Examination of the skull is the least satisfactory examination with portable apparatus. Very long exposures are needed, and the patient requiring this type of examination is unlikely to be able to remain still for two to three seconds. The detection of skull and facial fractures is, therefore, difficult, if not impossible, and the procedure should be avoided where possible.

Discussion

Radiodiagnostic precision has advanced greatly in recent years, partly because of developments in contrast media, and partly because of improved apparatus. No excuse should be necessary, therefore, for an extension of radiodiagnosis not in quality but in quantity, or location, and it is quite reasonable that ill patients should benefit from the smaller size of modern apparatus by having it taken to them in their home.

The range of conditions which can be diagnosed by simple radiographic procedures is almost endless. Even if the examination is confined to the chest, where the results are consistently successful, much diagnostic help can be given to the practitioner, particularly in detecting complications of pulmonary infection or underlying neoplasm, in assessing the relative importance of congestive failure and pulmonary infection, and detecting the cause of chest pain and haemoptysis.

Extending the technique to the hip joint gives benefit to a very distressed group of patients, the elderly, infirm, and immobile ones for whom a trip to hospital for a diagnostic examination would be a major undertaking, as well as a burden on ambulance and other social services, especially in those who do not have a fracture. Good quality

radiographs can be obtained with very little practice, and exclusion or diagnosis of fractures around the hip carried out accurately.

The procedure can be criticised on the grounds that it is difficult to minimise the radiation hazard to both patient and the operator and his assistants. Where possible cones are used, and gonad shields can be used with young patients. The operator himself is exposed to a possible hazard, and it is up to him to keep this to a minimum. With a horizontal ray—as in chest examinations—he stands behind the x-ray beam, and the shield around the tube gives adequate protection if the operator wears a standard lead rubber apron. Where a vertical beam is employed, as in the hip, the cone should always be used, and the operator should wear a thick protective apron, preferably 0.5 mm lead equivalent. Film badge measurements have not shown any appreciable increase in radiation dosage with these precautions.

The domiciliary radiograph offers a significant improvement in the medical care of patients in their homes. In a country with an advanced health care system such as the National Health Service the important question is whether the arrangements for such a domiciliary service are adequate and appropriate.

Acknowledgement

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EVALUATION IN A HOME-CARE PROGRAMME

The home care programme of the Nassau County Department of Health is described and evaluated. Available services are team nursing, physical therapy, occupational therapy, speech therapy, medical social work and rental of medical equipment. The number of patients to whom care was given in the programme from July 1966 to June 1968 was 2,383.

Various approaches to evaluation of a home care service are given and examples are demonstrated. In particular, the Barthel Index was applied to examine its usefulness in a service of this kind. This functional index scores the physical capacity of the individual and his degree of independence. The functions assessed are those of walking on a level surface, ascending and descending stairs, getting on and off a toilet, moving from a bed to a chair and return, bathing, personal toilet, dressing, feeding and continence. Since the patient's mental condition and its effect on total functioning is not included in the Barthel index, a simple "mental index" was devised. Three areas were chosen to represent overall mental functioning: cognition, orientation and mood. Sixty-seven patients were chosen for evaluation by the combined indexes.

Reliability of the index was confirmed and the evaluation tool was used to review certain aspects of the Home Care Programme. Consideration was given to physical and mental functioning, diagnosis, length of time on the programme and extensiveness of care as represented by the number of home visits. The functional index, with the addition of a mental score, was found to be of use in classifying patients and seems to be of sufficient value to warrant further exploration in appraising patient programmes and appropriateness of distribution of services.

REFERENCE

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