Case report

Dating of spinal fractures by bone scan: A case report

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During the failure of the aircraft main gear box, it became necessary to force land a helicopter. The impact forces were very heavy, causing extensive damage to the helicopter. Spinal X ray of one of the pilots revealed compression fractures of D_6 and D_7. CT scan confirmed a wedge compression, but the pilot by then was totally asymptomatic. A bone scan was done which established that they were old fractures probably during an earlier ejection. The bone scan thus helped to reflight an aircrew who would otherwise have been put 'down' for a considerable time. The advantages of a bone scan and specific indications are discussed.

Keywords: Ejection, spinal fracture, bone scan.

A Chetak helicopter took off on 24 Oct 97 at 1525 h from one of the Flying Training Establishments for an instructional Triangular Pilot Navigation Dual sortie. The capitan was Flt Cdr himself, a 36 year old A2 Master Green QFI and the pupil, a semester II trainee officer. The flight was uneventful for the first 40 minutes. Short of the second point, the crew heard a bang from behind and above the cockpit. This was followed by a grinding noise and the helicopter started to vibrate. Correctly diagnosing the emergency as Main Gear Box failure, the capitan lowered the collective immediately for a descent and gave a May Day call. The helicopter crash landed in a field 81 Km North of base and toppled to its left. Both the pilots crawled out of the helicopter safely and were air evacuated to the base.

The pupil officer was absolutely asymptomatic and normal on examination. The capitan, who is the subject of our interest mentioned pain at the base of the spine on sitting in a chair. However, he had no other complaints. On examination of his back, there was no swelling or deformity and no bony tenderness. Movements were full and painless. There was no muscular spasm and normal posture and gait were maintained. As per standard policy on the subject, both the pilots were subjected to X-ray examination of the whole spine and were also seen by the Orthopaedic Surgeon. X-rays of the pupil officer were normal and he was declared fit for flying after a week's observation.

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X-rays of the QFI however, showed compression fracture of D6 and 7 vertebrae. There was no paraspinal mass or any reduction of joint space. Otherwise, he had become absolutely asymptomatic and the pain in his coccygeal region had disappeared within two days. He was advised to avoid undue exertion and forward bending, while a CT scan of the spine was ordered. The CT was carried out in a civil centre on 04 Nov 97 and confirmed a wedge compression of D6 and 7. There were no other associated injuries.

In view of the asymptomatic state and clinically normal status, the case was reviewed jointly by the Senior Advisor in Radiology and the Orthopaedic Surgeon and it was decided to carry out a Bone Scan to see if the wedge compression fractures were of recent onset or otherwise. An MDP Skeletal Scintigraphy was carried out in a civil centre on 07 Nov 97, which ruled out any fresh bony injury of the spine. A perusal of previous medical records revealed that the pilot had ejected from a MiG-21 aircraft in May 84, but the X-rays of skull, spine and all the limbs showed no fracture. An attempt was made to obtain x-ray films of that period, but these could not be traced. It was however recorded in the case sheet, that officer did have some tenderness in the D3 area of the spine. There was no record of repeating an x-ray examination of the spine, any time subsequently and the officer had remained asymptomatic.

It was therefore deduced that the compression fractures of D6 and 7 were old injuries which had been missed and had healed (1). The QFI was cleared for flying duties and kept under weekly check. X-rays of the spine were repeated after four weeks of the accident, on 22 Nov 97 and did not show any new findings. The pilot was taken off medical surveillance after this.

Discussion

Compression fractures of the spine are commonly encountered in pilots after an ejection or crash landing. Some of these fractures, however, may not be visible in the x-rays taken soon after the accident. Therefore, x-ray examination is repeated after four weeks. Cases detected to have a fracture, are hospitalised and later placed in low medical category and declared temporarily unfit for flying for a period of about three months. All such cases are re-evaluated at the Dept of human engineering at the Institute of Aerospace Medicine and are gradually returned to flying duties.

It is difficult and sometimes impossible, to differentiate between an old compression fracture of the spine and a recent one, by conventional radiography. This may cause a dilemma in deciding the disposal of some of these cases. A situation of this nature was encountered in the present case. However, it was possible with the help of a Bone Scan to rule out fresh bony injury and to ascribe the fractures to an ejection, sustained 13 years earlier. These appeared to have been missed in the x-rays taken at that time.

Conventional radiography and CT remain the primary imaging modalities for fractures. However, the bone content must change by minimum 30 to 50 percent for a change to be perceived in the x-rays. Bone is a highly vascular and complex organ. It has inorganic mineral matrix housing Osteoblasts which produce new cells and Osteoclasts which reshape the bone.

The strength of radionucleide bone scan lies in its ability to demonstrate physiological changes early. It has the ability to pickup metabolic alterations, as low as five to ten percent (2). The tracer is carried by the patient's arterial supply to the capillaries, where it exits from the

vascular compartment through the interstitial space and interacts with one of the constituents of the bone. The following compounds have been used:-

a) Strontium 85 - has high radiation dose and poor imaging characteristics.

b) Fluorine 18 - has short half life.

c) Technetium 99 - emits good quality rays, has half life of six hours. Radiation dose (max) is 900 m rads equivalent to an exposure for one x-ray of the spine.

Protocol

Methyl-di-phosphonate (MDP) Technetium 99 (Tc 99) is injected I/V at the elbow, after the patient has been positioned below the gamma camera. The dose is 15-20 m Curie, as per body weight. Three phase imaging (3) is carried out to get significant information, as given below:-

a) Flow Phase: Within three to five seconds of injection of the bolus, pathways are seen on the computerised TV screen, demonstrating areas of increased or decreased blood flow.

b) Blood Pool Phase: It is seen between five to ten minutes after injection and shows the extent of soft tissue and bone hyperaemia.

c) Delayed Scan: Is carried out after two hours and gives important information. Most of the Tc is cleared out in the urinary tract by this time and only the lesions are visualised. Anterior and posterior scans are taken to see the multiplicity of the lesions.

SPECT

Gamma camera rotates 360 degrees in which 128 images are taken, just as in CT or MR imaging.

Bone Scan in Trauma Cases

Bone scan does not give the best anatomical pictures, as compared to an x-ray or CT. Hyperaemia sets in within a few hours around the site of trauma and osteoblastic activity starts within 24 hours. Radionucleide Bone Scan becomes positive in the delayed scan phase after 24-48 hours. All the three phases remain hot (positive) for the next several weeks and remain so, as long as callus is being formed and there is increased blood flow. From second month onwards, only the delayed scan phases are positive. Therefore, Radionucleide Bone Scan is not recommended as a primary investigation, however it is very useful when the patient is symptomatic, but the x-rays are negative, for an early diagnosis and treatment of fractures. It is also of special use, as in our case, to rule out bony injury for the purpose of reflighting a pilot at the earliest, after an ejection or a crash landing.

In case of polytrauma, a bone scan may be carried out to exclude multiplicity. Instead of carrying out x-rays of the whole body, x-rays of only the hot areas seen on Bone Scan, need be taken. Fractures of sites which are not seen well on x-rays such as ala of sacrum, anterior ends of ribs, sternum and base of skull can be detected easily by a bone scan.

Recommendations

It is recommended that the present policy on disposal of cases after ejection or crash landing

may be modified suitably to include a radionucleide bone scan after 24 hours of the accident. This will obviate the requirement of repeating x-ray examination of the spine after four weeks, presently in vogue. At present a bone scan costs Rs. 1,500/-, but may turn out be economical in the long run. It would help in institution of definitive treatment or reflighting of the aircrew, at the earliest after an ejection or crash landing.

References

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