ISBN 1478-4672

Spontaneous migration of intradural bullet during surgery - A case report and review of the literature

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Introduction and clinical presentation: Migratory nature of retained bullet in brain and spinal canal has been reported. However, we report here an unusual case of dramatic intraoperative intradural caudal and cranial migration of a retained bullet in the lumbar region, in a 20-year old male. The movement was presumably related to the positioning of the patient and caused by gravity.

Intervention: Radiographs of the lumbar spine had revealed a metallic bullet lying in the spinal canal at the level of L4/5 on the left side. The patient was symptomatic and surgical removal of the bullet was elected. The patient was positioned in prone position. A laminectomy of L4 was done with usual precautions but the bullet was not found as located on the preoperative radiographs. On intraoperative check X-ray the bullet was noted to have migrated to the L2 level. It was brought to the L3/4 level by tilting up the head-end of the operation table. Then the laminectomy was extended and the dura was opened and bullet was retrieved.

Conclusion: Our case study is the first to show that migration of the bullet in the spinal canal can occur as early as few hours after injury. It also highlights several important points during removal of the bullet: i) The surgeon must identify the exact location of the bullet after positioning the patient and should not rely on preoperative X-ray / other investigations only; ii) The surgeon may be able to bring the bullet to the desired level by changing inclination of the operation table, if migration of the bullet occurs during surgery; and iii) The bullet may need to be fixed while removing it, to prevent further migration.

Bullet migration • spinal canal • spinal injury • lumbar spine

Migratory nature of a retained bullet in the brain and spinal canal has been reported in the literature [1, 3, 4, 6, 8-17]. However, here we report a case of dramatic intradural cranio-caudal movement of a bullet in the lumbar region during its surgical removal. We have also reviewed the relevant literature regarding the migratory nature of bullets in the spinal canal and how such migration influences surgical judgment concerning their

removal.

Case presentation

A twenty-one year male admitted in the Emergency Department of the Post Graduate Institute of Medical Sciences (PGIMS), Rohtak. He had been shot in the back at a very close range by .32 caliber handgun. He had complaint of back pain and numbness of his left foot. On examination, there was an entry wound in the region of the L5 vertebra just to the right of the midline. Neurological examination showed no motor deficit. There was hypoaesthesia in the left L5 and S1 dermatomes to light touch. All deep tendon reflexes were intact and symmetrical. Tone of the anal sphincter was normal.

A routine radiograph of the lumbar spine showed a metallic bullet lying in the spinal canal in the region of L4/5 on left side (Fig. 1 & 2). Further imaging studies with CT scan could not be done as the machine was out of service. So a decision was made to remove the bullet without further investigations. A decision to remove the bullet was made because of the possibility of it later leading to infection and further neurological deficit or lead intoxication.

Under general anaesthesia the patient was positioned prone on bolsters. A midline incision was made and a slightly oblique bullet tract was identified which, to lead to the inferior border of the L4 lamina and interlaminar space at L4-5. There was a chip fracture of the inferior border of the L4 lamina and a rent was found in the ligamentum flavum between lumbar four and five vertebrae. A laminectomy of L4 was done with usual precautions but the bullet was not found as seen in the preoperative X-rays. The only abnormality seen was a cauterized area on the surface of the dura at the left L4 root level associated with edema of the nerve root. Therefore intraoperative plain radiographs of the lumbosacral region were obtained. To our surprise, the bullet had migrated to the level of the L2 vertebral body region, also rotating cranio-caudally in the process (Fig. 3).

In the hope of getting the bullet to the site of operative exposure, the head-end of the table was elevated for fifteen minutes and another radiograph was taken. This time the bullet had migrated to level of L3/4 (Fig. 4). Fur-

Fig. 1: Anteroposterior lumbar X-ray show the bullet lodged within spinal canal at the L4/5 level

Fig. 2: Lateral lumbar x-ray shows the bullet lodged within spinal canal at the L4 intervertebral disc level. Bullet lies with base upwards

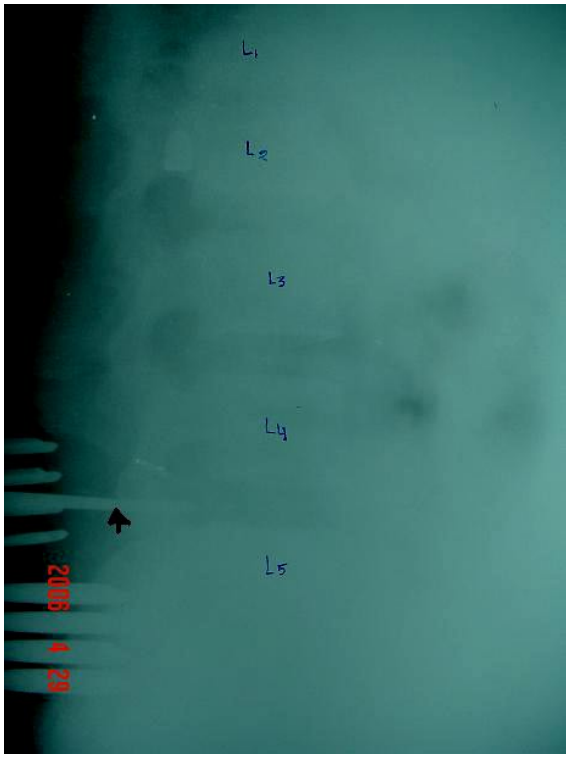

Fig. 3: Intraoperative lateral x-ray shows the bullet has migrated to L2 level. Marker (arrow) at L4/5 disc level. Spontaneous version of the bullet has occurred (base downwards)

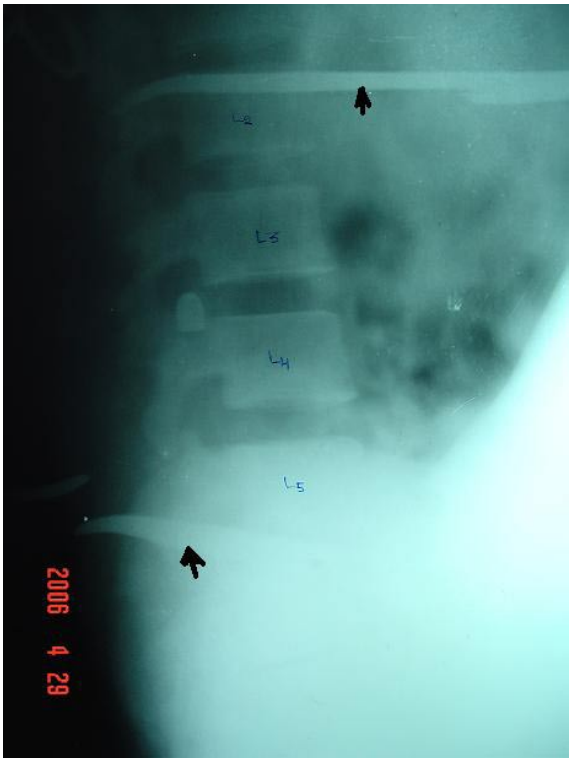

Fig. 4: Intraoperative lateral x-ray after 15 minutes of tilting the operation table. Bullet has migrated down to L3/4 level. Markers (arrows) were put to identify L2 and L5 vertebrae.

ther one-step laminectomy of L3 vertebra was done but the bullet could not be found the L3 region. However, with very gentle palpation the surgeon found it lying low in the region of the lower border of the L4 vertebra; it was highly mobile. It was fixed with two Penfield retractors to prevent further migration. Dura was incised and bullet was removed.

From the smooth shiny surface of bullet the ease of migration within the spinal fluid could be appreciated. The dura was stitched with locking sutures and the wound closed in layers. The patient was nursed in a prone position for two days. Post operatively there was no further neurological deterioration. The postoperative period was uneventful and the patient was covered with antibiotics and acetazolamide.

At six weeks of follow up, sensory deficit improved and the patient was mobilized on spinal brace.

Discussion

Migration of a bullet within the spinal canal is a rare condition and the migration may be associated with new neurological deficits. [1, 6, 10-14, 16, 17]. Karim et al., reported migration of a bullet from T11-T12 to L4-L5 level, causing pain and motor deficit. The patient recovered following the removal of the bullet [11]. Similarly Avci et al., reported delayed neurological symptoms from spontaneous migration of a bullet in the spinal canal from S1 to L4 level [1]. This movement was against gravity. The bullet was removed by laminectomy and removal resulted in complete neurological recovery. In both these cases the bullet had entered through the abdomen and initially the patients were neurologically intact but later developed neurological symptoms with the subsequent migration of the bullet. Soges et al., also described a similar intrathecal migratory missile presenting with delayed radicular symptoms [14].

Avci et al., proposed that cranial migration may be caused by prone position of patient during laminectomy, which brings the spinal canal at L3 and L4 to the lowest level

[1]. In our case too, positioning during surgery might have helped in migration of the bullet from L4 / 5 to L2, the lowest level.

As the spinal cord expands at T10, it has been thought that migration of bullet in spinal canal above this level does not occur [12]. Otkem et al., however reported a bullet traversing the length of spinal canal [13].

Kafadar et al., reported a penetrating gunshot injury at L1 with migration within the spinal canal to S2. MRI revealed haemorrhagic areas in the conus medullaris and L1 corpus. Lumbar MRI was used safely in this case without any change in neurological status or patient discomfort. Removal of bullet was performed and his neurological status improved [10].

Gupta et al., reported a wandering bullet in the subarchnoid space, which entered the thecal sac via the right side of the chest [6]. The patient's neurological status was intact initially. However, he developed radicular symptoms with foot drop and urinary retention on the third day.

Tekavcic et al., reported penetrating gunshot injury to the cervical spine with retention of the missile in the spinal canal at T10 level. He had complete paraplegia, fracture of the C5 arch, metallic fragments in the spinal canal and the bullet was trapped at the T10 level. Laminectomies at C6-C7 and T9-T10 were performed to remove metallic fragments [17].

Migration of a bullet with subsequent meningitis has been reported by Tanguy et al. [16]. Initial X-ray showed the bullet at C7 but, later it migrated to the sacral region. The patient was asymptomatic when discharged but three months later developed meningococcal meningitis. Bullet was removed through laminectomy. It was noted to be moving with respiration. However, cultures of bullet and CSF were negative. Bullet migration in brain during removal has also been reported [8]. Bullet migration from paraspinal muscles and intervertebral disc space to spinal canal has also been reported [3, 9].

The role of laminectomy in spinal cord injury from gunshot depends on the neurological status of patient, and the location of bullet. In incomplete injury, the role of laminectomy is controversial. Since the prognosis for recovery depended on the initial neural deficit, laminectomy had no beneficial effect in complete or incomplete injuries in the study of Heiden et al. [7]. Stauffer et al., reported incidence of wound infection and spinal fistulae to be 10% of such patients who had underwent laminectomies. Spinal instability also complicated the patients who had multiple level laminectomies [15].

If the bullet is not removed, retention of metallic foreign bodies in the spinal canal can lead to neurotoxicity and impairment. Copper and lead fragments consistently caused a substantial area of neural injury within the spinal cord. In animal studies, copper fragments caused local neural toxicity in spinal cord areas in as much as 10%, suggesting that this may be a scientific rationale for removal of copper fragments lodged in the spinal cord even in the absence of neurological deficit [18].

Furthermore, Doll et al., showed that a retained intraspinal bullet at the C5 level in a patient with complete tetraplegia caused chronic inflammation due to metal breakdown products [4]. This led to increasing pain and the formation of a syringiform cyst.

Retention of bullets in spinal canal carries a risk of acute lead poisoning. There are reports of plumbism with bullets retained in the intervertebral disc space and spinal canal [5]. This occurred with partial bullet fragment resorption (2,19). However, other authors have reported that lead intoxication is rare and do not require of removal retained fragments in asymptomatic patients (20).

Action of gravity in migration of bullets is important. Since the weight of the bullet is greater than that of spinal fluid, tilting the head end up for fifteen minutes brought the bullet from L2 to L3/4 in the present case.

The other factors, which could contribute to migration are pulsation of cord, ferromagnetism, and local softening of tissue around the bullet. We postulate that surgical manipulation might be an additional factor contributing to bullet migration in the present case, as the bullet was observed to be highly mobile and had to be fixed with Penfield retractors before its removal.

Rotation of the bullet was probably caused by its shape and its assymetrical weight distribution with its posterior portion being heavier than its anterior portion.

Conclusions

The case we presented is the first to show that migration of the bullet in the spinal canal can occur as early as a few hours after injury. It also demonstrates several important points during removal of the bullet: i) Surgeon must identify the exact location of bullet after positioning the patient and should not rely on preoperative X-ray / other investigations only; ii) surgeon may be able to bring the bullet to the desired level by changing inclination of the operation table if migration of the bullet occurs during surgery; and iii) bullet may need to be fixed while removing it, in order to prevent further migration.

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Commentary

This case report provides evidence for the use of very practical techniques to deal with a problem which is frequently encountered both in military circumstances and in the trauma facilities of large urban areas.

The traditional doctrines involved in the surgical treatment of bullet injuries have, for the most part, followed the principle that removal of the bullet is secondary to the repair of the damage (and the associated bleeding) caused by the passage of the projectile, and that, in most cases, retention of the bullet (or fragments thereof), is not considered to be a significant adverse occurrence.

There is, however, increasing evidence that lead bullets, especially those retained in areas where the pH of the tissue tends towards the acidic side, can, over time, be degraded chemically, and the resultant lead compounds can be absorbed into the system to the point of causing lead intoxication, or Plumbism (1). This is particularly relevant in cases where the lead fragments are present in joints, where the synovial fluid carries an acidic pH. Reports of increase in blood lead levels in such cases, however, are rare, this mainly due to the fact that such increases are not usually looked for unless specific symptomatology develops. In fact, there are only about 100 such cases reported in the medical literature (2). In some of these cases, the influence of toxic lead levels was discovered only after other causes were systematically ruled out (3).

In the instance of this case report, the patient was suffering from symptoms related to the mass effect of the retained bullet, and removal was undertaken for the purpose of relieving the mechanical effects of the retained projectile.

The authors are to be congratulated on their practical and effective approach to a serious problem.

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Date submitted: 17 September 2006
Date accepted: 6 February 2007
Date published: 28 February 2007