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Case report

Paraplegia complicating embolization for bleeding intercostal artery in penetrating trauma

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ABSTRACT

Study design: Case report.
Background and importance: Transcatheter arterial embolization is an interventional radiological procedure that is increasingly used to stop bleeding particularly in trauma. As previous reports allude to paraplegia complicating this procedure in blunt trauma, we describe a complication of this procedure following penetrating trauma to the posterior trunk.
Clinical presentation: A 21 year old male sustained a stab wound to the back with profuse bleeding. CT angiography showed a bleeding paraspinal branch of the 10th intercostal artery, for which he had intercostal embolization using Embozene® 500 μm. Although hemostasis was achieved immediately, the patient developed weakness in both lower limbs shortly after the procedure and rapidly progressed to complete cord injury with sensory level at T10.
Conclusion: Transcatheter embolization of the intercostal artery, though safe and effective, may be accompanied by a complete and permanent spinal cord injury. It is probably best avoided where it would involve embolizing vessels close to the origin of the artery of Adamkiewicz (T8–T11) and situations where it will involve embolizing the vessel in proximity to its origin in the midline. In the haemodynamically stable patient with penetrating injury, other options including wound exploration should be considered.

1. Introduction

Interventional radiology involves the performance of invasive diagnostic and therapeutic procedures under image guidance [1]. The range of clinical applications of this modality of treatment is wide and constantly increasing. It has been applied in the treatment of vascular, hepatobiliary, genitourinary, musculoskeletal, pulmonary and central nervous system pathologies [2]. Vascular procedures involve stent grafting, balloon dilatation or embolization. Embolization, is also used in the treatment of arterio-venous malformations and tumours, is being increasingly used in the management of trauma [3]. It affords the achievement of haemostasis especially in patients who are haemodynamically unstable from haemorrhage, without the associated morbidity and mortality of open surgery. It has been employed in the management of splenic injuries, hepatic artery tears and traumatic retroperitoneal haematoma due to pelvic injuries. This role has expanded increasingly to include also, the embolization of the intercostal/lumbar artery in bleeding [4].

Although relatively safe, the procedure of embolization is not without complications. These may include contrast allergy, anaphylactic reaction and distal ischaemia. We present a 21 year old male who developed paraplegia following intercostal artery embolism for a bleeding paraspinal branch of the 10th left intercostals following a stab wound to the back. The literature is replete with spinal cord ischaemia and paraplegia following intercostal artery embolization for haemoptysis in bronchial bleeding in lung disease [5]. There are also accounts of embolization for bleeding intercostal or lumbar artery in blunt trauma and iatrogenic injuries [6]. To the best of our knowledge, no previous report has been made of paraplegia due to embolization of the intercostal artery for bleeding in penetrating trauma.

2. Case presentation

The patient is a 21 year old male who was previously in good health until the day of presentation when he was stabbed in the back by unknown persons. He bled profusely from the wound and was immediately taken to a nearby hospital. On admission, he was

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in pain, was ambulant and haemodynamically stable. Examination revealed two stab wounds on the left side of the body. The first was located over the lower left posterior triangle of the neck. It was a transverse, 5 cm long superficial laceration. The second was a deeper wound in the mid posterior trunk, on the left. It was 2 cm lateral to the midline with a track that extended deep into the paraspinal muscles and was bleeding actively. There was no neurological deficit. The neck wound was explored, debrided and dressed while the posterior trunk wound was debrided, irrigated and packed with gauze. His haemoglobin was 14.8 mg/dl (initially), WBC was 6670/mm^3, the platelet count was 270,000/mm^3 and the chest X-ray was normal. He was given tetanus prophylaxis, antibiotics, analgesics and admitted for observation.

While on admission, the trunk wound continued to bleed necessitating a CT angiography. It showed evidence of bleeding in the posterior left chest wall beneath the wound packing. There was no haemo- or pneumothorax and the thoracoabdominal viscera were normal. The tracks of both stab wounds were identified. The nuchal was subcutaneous while the trunkal entered into, but did not extend beyond the paraspinal muscles on the left. CT angiography of the chest, abdomen and pelvis using Ultravist® showed minimal extravasation of contrast (blush sign) localized to the level of T10 indicative of active arterial haemorrhage (Fig. 1). *Telebrix® gastric swallow did not yield further contributing information*. He was taken to the angiography suite for a super selective embolization of the 10th left intercostal artery using Embozene® 500 μm (Fig. 2). Repeat angiography post embolization confirmed cessation of bleeding. Access for the procedure was gained via the right femoral artery at the groin and the catheter was left in palace after the procedure as a precautionary measure, should there be re-bleeding and a need for a repeat embolization.

Although the patient's condition immediately following the procedure appeared satisfactory, he shortly thereafter complained of weakness in both lower limbs. Examination revealed reduced power with 0/5 on the left and 1/5 on the right. Initially, there was no sensory loss, the bulbocavernosus reflex was present, the anal tone was normal, and the patient maintained urinary continence. Shortly afterwards, he deteriorated and developed complete bilateral lower limb paralysis. There was still preservation of sensation and bulbocavernosus reflex but the anal sphincter tone became lax. This prompted a diagnosis of anterior spinal artery syndrome suspected to be due to inadvertent embolization of the left 10th intercostal artery, with possible occlusion of the artery of Adamkiewicz. He was immediately commenced on high dose methylprednisolone and was referred to our centre for MRI of the spinal cord.

Physical examination on presentation to our facility the next day confirmed complete motor paralysis of both lower limbs with

Fig. 1. CT angiography showing blush sign.

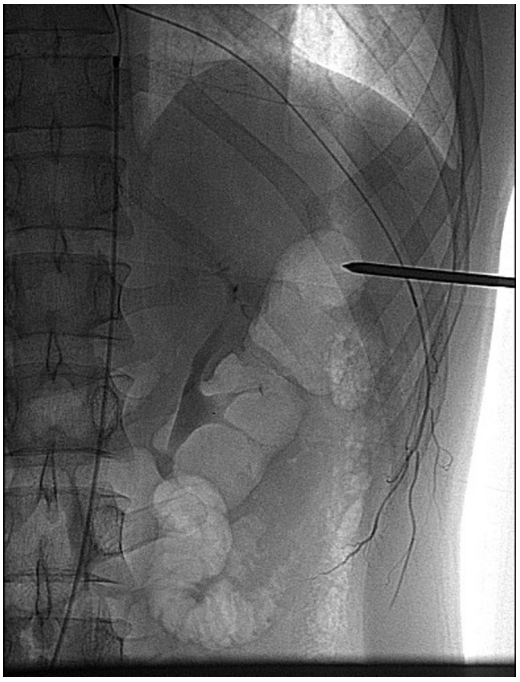

Fig. 2. CT angiography showing T10 inter costal artery before embolization.

sensory preservation. MRI of the spine showed features of cord oedema in the T8–T10 segment involving predominantly the anterior 2/3rd of the cord with a minimal syrinx in the region of T6/7, all consistent with a diagnosis of cord ischaemia. There was no haematoma within or around the spinal cord.

The diagnosis of anterior spinal artery syndrome following a left 10th intercostal artery embolization was upheld. The patient was continued on steroids, commenced on Clexane® anticoagulation and admitted into the neuro-intensive care unit. By the next day, the patient had further deteriorated, with development of loss of sensation and a sensory at the level of T10. The bulbocavernosus reflex was present, the anal tone was lax but the patient had lost urinary sphincter control resulting in incontinence, which necessitated the passing of a urethral catheter. At this point, diagnosis of complete spinal cord injury was made. The methyl prednisolone was discontinued after 48 h. Four days after admission into our centre, the neurological condition remained the same. He was counselled on the prognosis, discharged and referred for rehabilitation. Three months later, there remained no neurological improvement.

3. Discussion

Paraplegia resulting from spinal cord infarction has been reported following procedures on the abdominal aorta. It is a complication of both abdominal aortic aneurysm and its surgery [7,8]. It has also been increasingly seen with the advent of interventional radiology with transcather arterial embolization of vessels for various pathologies [9,10]. The mechanism of infarction is thought to be due to the occlusion of the great radiculomedullary artery of Adamkiewicz which supplies a major contribution to the anterior spinal artery in the lower thoracic and lumber levels [11,12].

The blood supply of the spinal cord is derived from the paired posterior and single anterior spinal arteries, both branches of the vertebral artery at the base of the skull. The paired tributaries of the anterior spinal artery unite to form a single trunk, which descends in the anterior groove of the spinal cord.

The posterior intercostal artery arises from the thoracic aorta dorsally, gives off the intercostal artery proper and continues as the dorsal branch. The dorsal branch gives off the paraspinal branch and continues as the spinal branch. The spinal branch gives off the osseous branch and continues as the radicular branch. The radicular branch then divides into the anterior and the posterior radicular arteries. The anterior passes along the ventral root to enter the anterior spinal artery while the posterior goes along the dorsal root to join the posterior spinal artery and thus supply the posterior (sensory) part of the spinal cord. In up to 70% on cases there is a large anterior radicular branch of intercostal artery arising from the T10 to T 12 segments on the left. It makes a hairpin bends as it enters the anterior spinal artery and thus provides a major source of blood supply to especially the anterior part of the cord below this level. This is the great radiculomedullary artery of Adamkiewicz or arteria radicularis magna (ARM) [11]. In the lower thoracic and lumbar regions, this artery supplies the anterior half of the spinal cord which conveys the descending motor fibres to the lower limbs. Occlusion of the artery of Adamkiewicz therefore typically presents with predominantly motor affectation with relative sensory sparing – the anterior spinal artery syndrome [13].

Our patient presented with mainly motor paralysis of the lower limbs with initial sparing of sensation and sphincter function. This is typical of the presentation of the anterior spinal artery syndrome [13]. We speculate that this resulted from inadvertent occlusion of the artery of Adamkiewicz, resulting in cord ischaemia. This is very likely given that the procedure was carried out on T10 on the left, the point of origin of the ARM. In addition, the bleeding point was proximal, close to the origin of the posterior intercostal in the midline, therefore, its embolization could stand a higher chance of occluding the artery at its origin than would a more peripherally disposed one.

The progression to complete motor and sensory paralysis with loss of sphincter function suggests progression of spinal cord ischaemia and injury to involve the posterior cord. This rather is unusual and may indicate occlusion of the blood supply to the posterior cord. Clot extension with occlusion of the posterior radicular artery could partly explain this, though one would expect a contralateral sensory sparing. Another possibility is systemic hypo-perfusion and global cord ischaemia as may occur in shock although our patient did not manifest any feature of shock in his clinical progress. The presence of shock has been documented to worsen spinal cord injuries even in the absence of direct injury to the spinal cord [14].

Paraplegia following interventional radiology is not a commonly seen complication, but when it does occur, its consequences could be catastrophic. While there are few cases of partial or even complete recovery, many report a permanent and irreversible cord damage supervening [15,16]. Where recovery occurs, signs of improvement are usually observed within 2–4 weeks, and subsequent progress is incremental and may continue for up to 9 months. The initial improvement in function coincides with resolution of cord oedema and unmasking of an incomplete cord injury while subsequent improvement is due to muscle strengthening from physical therapy. In the absence of return of some neurological function within the initial 2–4 weeks, improvement becomes increasingly less likely. It follows that recovery is therefore more likely to be seen in those patients that had less severe cord injury at the outset [15]. Our patient manifested features of complete cord injury within 24 h and remained paraplegic with no features of recovery of cord function three months after the onset. The prognosis is therefore not very hopeful.

Various accounts in the literature allude to preventive measures to safeguard the artery of Adamkiewicz and thus prevent ischaemia before procedures on the aorta [17]. Attempts have been made to angiographically identify the artery of Adamkiewicz preoperatively in order to prevent paraplegia but the results have not been encouraging [12,18]. This is mainly in regard to abdominal aortic aneurysm repair but we are unable to find accounts of similar strategies in the context of interventional radiology in literature. There is a pervading opinion that spinal cord infarction resulting from interventional radiology although not common, is a random occurrence and therefore not amenable to proven preventive strategies [17].

In retrospect, we suggest that careful patient selection be adopted before electing for transcatheter arterial embolization of intercostal vessels in a patient with a penetrating wound such as ours. The procedure is probably best avoided or at least approached with caution when embolization involves branches arising from the 10th to 12th thoracic segments, and when branches to be occluded are close to the midline, to prevent inadvertent occlusion of the artery of Adamkiewicz since this is its area of origin. We also recommend that in the haemodynamically stable patient, other haemostatic options should be adopted including local exploration and direct ligation of the bleeding vessel, to prevent this catastrophic complication of an otherwise life saving, minimally invasive procedure.

Conflict of interest statement

The authors declare that they have no conflict of interest to declare.

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