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Cervical spinal cord injury during cerebral angiography with MRI confirmation: case report

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Abstract We report the first case of MRI-documented cervical spinal cord injury during cerebral angiography. A 54-year-old woman underwent an angiogram for subarachnoid hemorrhage. Her head was secured in a plastic head-holder. At the end of the procedure, she was found to have a left hemiparesis. MRI revealed high signal in the cervical spinal cord. The etiology may have been mechanical due to patient positioning, or toxic, from contrast medium injection in the vessels feeding the spinal cord, or a combination of both.

Key words Angiography, cerebral · Spinal cord, injury · Magnetic resonance imaging \sg

Introduction

Complications of cerebral angiography are generally classified as local, due to injury to the arteries, nerves or surrounding structures at the injection site; systemic, due to reactions to the contrast medium; neurological, due to subintimal dissection, embolization of atherosclerotic plaques or air; and neurotoxic and others [1, 2].

Myelopathy has been reported when the contrast medium was injected inadvertently into the spinal cord feeders during aortography, bronchial and intercostal arteries angiography, and spinal angiography [3–12]. There have been three cases of myelopathy following cerebral angiography, all in the pre-MRI era, and due to contrast medium injection into the spinal cord arteries [13–15].

We report the first case of MRI-documented cervical cord injury following cerebral angiography.

Case report

A 54-year-old woman presented with acute headache and neck stiffness. She reported neck pain and bilateral hand weakness a few weeks prior to the event. Her past medical history included hypertension.

The patient was admitted after CT revealed diffuse subarachnoid hemorrhage and hydrocephalus. A cerebral angiogram was normal. MRI of the neck revealed cervical spondylosis at the C4–5, C5–6 and C6–7 levels, with canal stenosis (Fig. 1). After two weeks of observation the patient was discharged.

Two months later she underwent a repeat cerebral angiogram as an outpatient. On arrival she was anxious and hypertensive. She was premedicated with intravenous diazepam. Sublingual nifedipine and intravenous labetalol were used to control her blood pressure. Her head was secured and taped in a plastic head-holder. The right common femoral artery was cannulated using the Seldinger technique and a 6 F sheath was inserted. Using a 5.5 F catheter, selective catheterization and angiography of both internal

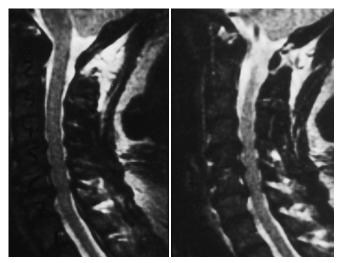


Fig. 1 Sagittal T2-weighted image of cervical spine before angiography revealing spinal stenosis at C4 to 7

carotid and the left vertebral arteries was performed. A total of 150 cc of contrast medium (Hexabrix and Conray 60) was used.

The patient received additional intravenous labetalol during the procedure to control her blood pressure, with minimal success: despite a total of 110 mg of labetalol, the diastolic blood pressure persisted in the 100–130 mm Hg range.

About 45 min after the beginning of the procedure, the patient started complaining of neck and back pain and heaviness in both arms, which we attributed to anxiety. She received an additional dose of diazepam and the procedure was continued. At the completion of the procedure, the patient was found to have a left hemiparesis, more marked in the arm, involving mainly the triceps and the intrinsic muscles of the hand.

CT showed no evidence of ischemic or hemorrhagic stroke. Two days later, cerebral and cervical spine MRI was obtained.

There was no evidence of intracranial damage, but a lesion was seen in the cervical spinal cord between C3 and C7 with high signal intensity on T2, consistent with edema (Fig. 2).

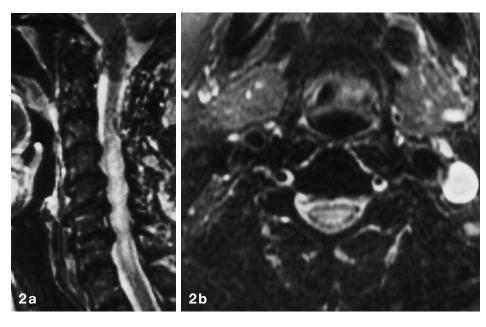
The patient improved neurologically over the following days and was discharged to a rehabilitation facility after 1 week. Six weeks later, following complete neurological recovery, she underwent a decompressive cervical laminectomy with a very good outcome.

Discussion

In series published during the past two decades, the rate of persistent neurological complications of cerebral angiography varies between 0% and 5.7%, most series reporting a rate lower than 1% [2, 16, 17].

In a review in 1966, Killen and Foster [18] proposed three mechanisms of injury to the spinal cord during angiography: direct injection of contrast medium into the subarachnoid space; occlusion of critical spinal arteries by aortic dissection; and neurotoxicity of the contrast medium; they found the last of these to be responsible of the majority of complications (54 of 60 cases). The exact mechanism by which contrast medium is toxis to neural tissue is not well known. Multiple factors seem to interact, including disruption of the bloodbrain barrier by hyperosmolar agents, vasomotor changes, sludging of blood flow, and alteration of the coagulation pathways [14, 19]. We have traced only three cases of myelopathy following cerebral angiography, all during the pre-MRI era [13–15]. In two the myelopathy occurred following injection of contrast medium into the thyrocervical trunk [14, 15], the third following injection into the left subclavian artery [13]. The contrast media used were Renografin-60 (methylglucamine and

Fig. 2 a Sagittal T2-weighted image 2 days after the angiogram. Diffuse increase in signal intensity in the cord is seen at the stenotic level. This is confirmed by an axial image (b)



sodium diatrizoate) [14], 60 % methylglucamine iothalamate [15] and tri-iodide acetylaminobenzoate of methylglucamine [13].

More than one mechanism can be invoked to explain the cord injury in our patient, including contrast medium toxicity and mechanical compression; a combination is a possibility. Although the left vertebral artery was injected, contrast medium was not injected into the thyrocervical trunk, but might have reached the spinal cord through the anterior spinal artery. The concomittant presence of cervical spondylosis, and high signal in the spinal cord within the spondylotic area point to neck positioning as a possible etiology. Two other factors favor positioning as being responsible: the head was taped in an uncomfortable position, and the patient's complaints were addressed by giving more sedatives, which could decrease the protective mechanism of the tone of the paraspinal muscles.

Positioning of the head has not been reported as a mechanism of spinal cord injury in patients undergoing cerebral angiography, but it is a well known complication of neck positioning and manipulation during surgical procedures, including acoustic neurinoma resection in the sitting position [20], posterior cervical laminectomy

[21], and hyperlordotic positioning for lumbar surgery [22]. Spinal cord injury can also occur in patients with cervical spondylosis during induction of anesthesia [23]. In these cases, drug-induced muscle paralysis causes increased mobility of the cervical spine, which may lead to cervical cord injury when the neck is extended for intubation, due to anterior compression by bony spurs and posterior compression by infolding of the ligamentum flavum [24]. Myelopathy will be due to either direct cord compression and/or ischemia by compression of the neural vascular structures; these are the same mechanisms that are thought to underlie the pathogenesis of spinal cord disorders associated with cervical spondylosis [25]. In awake patients the paraspinal muscle tone prevents extremes of position and subsequent spinal cord injury. This protective mechanism is lost during general anesthesia when muscle relaxants are used [23], and or in trauma [26]. In our case, sedation and securing the head in an uncomfortable position may have overcome the protective mechanisms and caused the spinal cord injury. The mechanical compression of the spinal cord and its vessels might have slowed the circulation and favored the toxic effect of the contrast medium.

References

- Kerber CW, Cromwell LD, Drayer BP, Bank WO (1978) Cerebral ischemia. I. Current angiographic techniques, complications and safety. AJR 130: 1097–1103
- Mani RL, Eisenberg RL, McDonald EJ, Pollock JA, Mani JR (1978) Complications of catheter cerebral arteriography: analysis of 5000 procedures. I. Criteria and incidence. AJR 131:861–865
- Boyardsky S (1954) Paraplegia following translumbar aortography. JAMA 156: 599– 602
- Brust AA, Howard JM, Bryant MR, Godwin JT (1959): Coarctation of the abdominal aorta with stenosis of the renal arteries and hypertension. Clinical and pathologic study of two cases and review of the literature. Am J Med 27: 793–802
- Cornell SH (1969) Spasticity of the lower extremities following abdominal aortography. Radiology 93: 377–379
- DiChiro G, Wener M (1973) Angiography of the spinal cord. A review of contemporary techniques and applications. J Neurosurg 39: 1–29
- DiChiro G (1974) Unintentional spinal cord arteriography: a warning. Radiology 85: 663–665
- 8. Fiegelson HH, Ravin HA (1965) Transverse myelitis following selective bronchial arteriography. Radiology 85: 663–665
- Foex P, Lambert H, Mentha C (1964) Les complications médullaires graves de l'aortographie abdominale. Arch Mal Coeur 57: 142–157

- Grossman LA, Kirtley JA (1958) Paraplegia after translumbar aortography. JAMA 166: 1035–1037
- Kardijev V, Symeonov A, Chankov I (1974) Etiology, pathogenesis and prevention of spinal cord lesions in selective angiography of the bronchial and intercostal arteries. Radiology 112: 81–83
- 12. Killen DA, Foster JH (1960) Spinal cord injury as a complication of aortography. Ann Surg 152: 211–230
- Ederli A, Sassaroli S, Spaccareli G (1962) Vertebral angiography as a cause of necrosis of the cervical cord. Br J Radiol 35: 261–264
- Ramirez-Lassepas M, McClelland RR, Snyder BD, Snyder BD, Marsh DG (1977) Cervical myelopathy complicating cerebral angiography. Report of a case and review of the literature. Neurology 27: 834–837
- Takahashi M, Wilson G, Hanafee W (1969) Diagnostic value of catheter vertebral angiography. Review of 250 examinations. Acta Radiol 9: 494–502
- Moniz E (1927) L'encéphalographie arterielle, son importance dans la localisation des tumeurs cérébrales. Rev Neurol 342: 72–90
- 17. Hankey GJ, Warlow CP, Sellar RJ (1990) Cerebral angiographic risk in mild cerebrovascular disease. Stroke 21: 209–222
- Hellman DB, Roubenoff R, Healy RA, Wang H (1992) Central nervous system angiography: safety and predictors of a positive results in 125 consecutive patients evaluated for possible vasculitis. J Rheumatol 19: 568–572

- Killen DA, Foster JH (1996) Spinal cord injury as a complication of contrast angiography. Surgery 59: 969–981
- Hitselberger WE, House WF (1980) A warning regarding the sitting position for acoustic tumour surgery. Arch Otolaryngol 106: 69
- Lesoin F, Bousakao N, Clarisse J, Rousseaux M, Jomin M (1985) Results of surgical treatment of radiculomyelopathy caused by cervical arthrosis based on 1000 operations. Surg Neurol 23: 350–355
- Choudhury AR, Taylor JC, Withaker R (1979) Paraplegia complicating lumbar disc surgery. J Roy Coll Surg Edin 24: 167–169
- Horwitz NH, Rizzoli HV (1987) Laminectomy: General complications. In Horwitz NH, Rizzoli HV (eds) Postoperative complications of extracranial neurological surgery. Williams and Wilkins, Baltimore, pp 3–29
- 24. Greenberg MS (1994) Handbook of neurosurgery. Greenberg Graphics, Lakeland, Florida, Third edition, p 579
- 25. Nurick S (1972) The pathogenesis of the spinal cord disorder associated with cervical spondylosis. Brain 95: 87–100
- Brain WR, Northfield D, Wilkinson M (1952) The neurological manifestations of cervical spondylosis. Brain 75: 187–225