

## Perforating injury of the neck and vertebral artery trauma

M. L. FARRELL, R. F. GRAY, F.R.C.S. (Cambridge)

### Abstract

A 10-year-old schoolboy presented with a penetrating wound to the neck after a children's slide accident. A CT scan and endoscopy showed a traumatic oesophageal-cutaneous fistula. Neurologically the child deteriorated over a period of 34 hours and finally succumbed to a respiratory arrest.

Post-mortem findings showed a hypoplastic right vertebral artery. In the left suboccipital triangle a venous clot had blocked the dominant artery thus leading to cerebellar and brainstem infarction.

This extraluminal compression leading to obstruction of an otherwise non traumatized vertebral artery is unique in the literature.

### Case report

A 10-year-old boy was received in Casualty approximately one hour after a playground injury where he sustained a penetrating wound to the neck.

#### Cause of injury

The injury was due to a splinter of wood  $9.5 \times 1.5$  cm (Fig. 1) from a children's slide coming loose and impaling the anterior lower cervical region when the child went head first down the slide. His elder brother had gone down before him for safety and had sat on the end of the slide. A small amount of movement in the foundation supports allowed his weight to tip the splinter's leading edge into his brother's path (Fig. 2). The splinter entering the neck probably led to forced cervical extension and head rotation.

On presentation, the child was able to walk, was alert and oriented with no cardiovascular or neurological deficit. A small wound  $1.5 \times 0.5$  cm (Fig. 3) in the suprasternal notch, squirted water when the child was asked to drink. Surgical emphysema was present in the lower neck. This was confirmed by cervical spine X-ray and chest X-ray. There was no evidence of cervical fracture.

Subsequently the neurological condition deteriorated with the child becoming drowsy, (Glasgow Coma Scale—14), and developing slight weakness in the left arm. CT scans of the head and neck revealed no intracranial pathology but a traumatic track in the anterior neck and an air-filled cavity to the right of the oesophagus were noted. (Fig. 4).

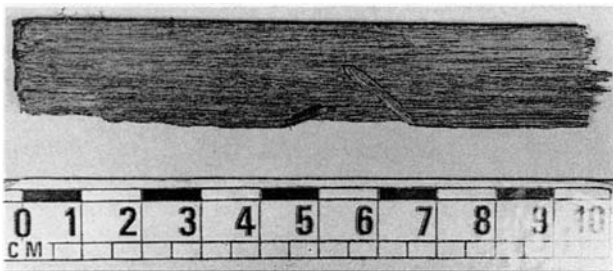


FIG. 1

Wooden splinter which penetrated the neck.

#### Endoscopic findings

Emergency endoscopy revealed a normal larynx, trachea and bronchial tree and a vertical laceration of 1.5 cm in the anterior oesophageal wall communicating with the neck skin and smaller mid-line laceration 1 cm long in the posterior wall. A nasogastric tube was inserted under direct vision, intravenous antibiotics and hourly neurological observations were commenced.

#### Neurological signs

Twenty-four hours after admission the child's neurological status was fluctuant between coherent conversation and a Glasgow Coma Scale of 12—opening eyes on strong physical stimulation, moving all limbs to strong verbal command, and coherent monosyllables. The neurological signs were a left VIth cranial nerve palsy, left leg hyperreflexia and bilateral upgoing plantar reflexes.

A diagnosis of a recent onset ischaemic brainstem lesion was made which was thought to be due to vertebral artery injury. Angiography was considered but rejected due to the risks that it may have led to further neurological deterioration. The technical surgical difficulty of operating on the vertebral artery is well known.

#### Respiratory arrest

Thirty-four hours after admission the child had a respiratory arrest. Both pupils had become fixed and dilated with no reflex eye movement and limbs were unresponsive to painful stimuli. An urgent CT scan confirmed the diagnosis of a large infarct of the left cerebellum and brainstem with displacement of the fourth ventricle (Fig. 5). The child did not recover.

#### Post-mortem report

A post-mortem report confirmed the CT scan signs and also the oesophageal rupture. However the child was found to have a left vertebral artery which was almost the same calibre as the basilar artery with only a vestigial right vertebral artery (Fig. 6).

The left vertebral artery was surrounded by a blood clot where it loops backwards and medially around the lateral mass of the atlas prior to piercing the atlanto-occipital membrane. Histologi-



FIG. 3

Neck wound in the suprasternal notch (white arrow) which squirted water upon patient swallowing.

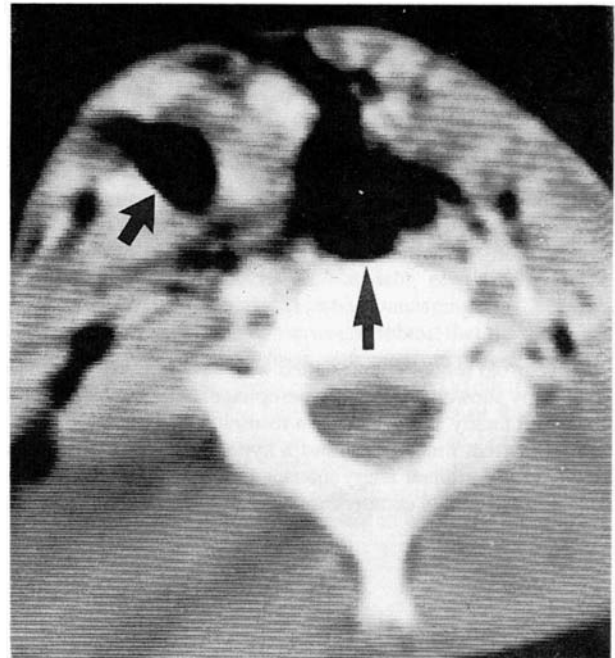


FIG. 4

Axial CT scans through the cervical region showing an air-filled cavity (wide arrow) to the right of the oesophagus (thin arrow), with a traumatic opening anteriorly. There is surround surgical emphysema.

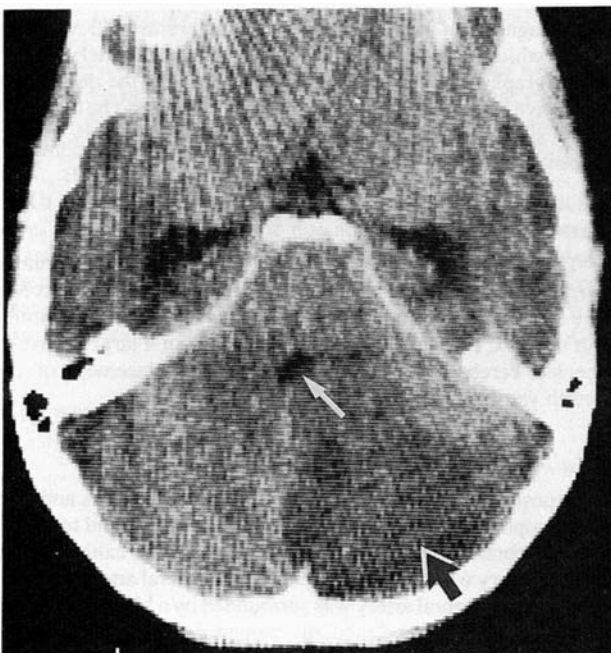


FIG. 5

Axial CT scans of the head showing a left cerebellar infarct (large arrow) with displacement of the fourth ventricle (small arrow).

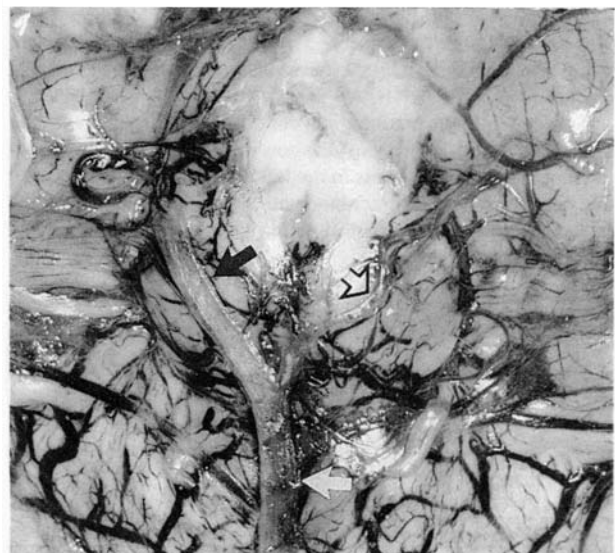


FIG. 6

Spinal cord sectioned just below the medulla. A hypoplastic right vertebral artery (open black arrow) is seen opposite a large calibre left vertebral artery (black arrow). The lumen of the left vessel is similar in size to the distal basilar artery (white arrow).

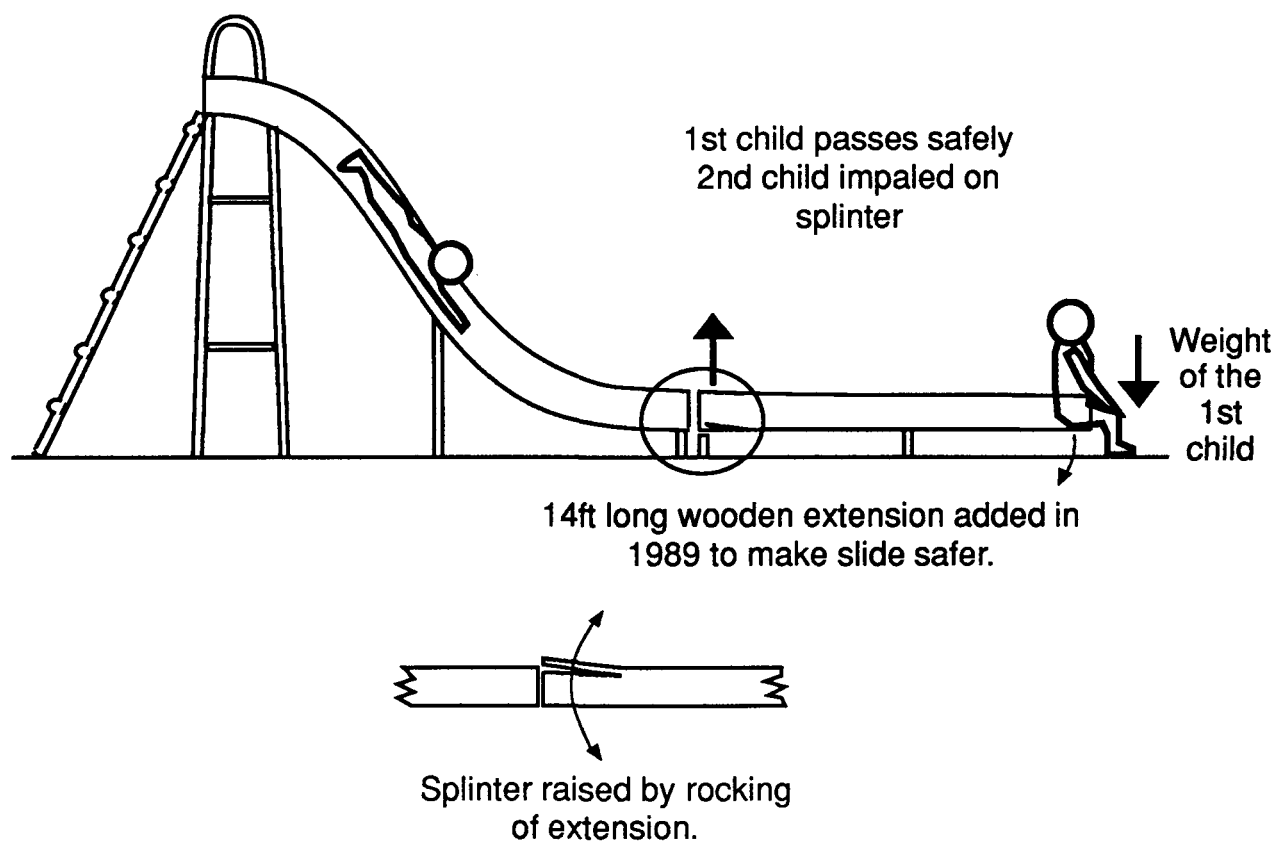


FIG. 2

Playground incident. Impact probably led to reflex head rotation and cervical extension.

cal findings revealed no injury of the vertebral artery (Fig. 7), but recent thrombosis in the neighbouring vertebral veins (Fig. 8). It appears that there was pressure upon the left vertebral artery in this part of its course which has disastrous consequences.

### Discussion

Any patient presenting with trauma to the neck must be observed for signs of neurological deterioration suggesting vascular injury. In this case damage to the peri-arterial veins at the base of the skull occurred at the moment of impact with a penetrating splinter.

The CT scan was non-contributory to the diagnosis and although angiography is seen as the gold standard for vertebral artery injury, (Bradac *et al.*, 1981; Gouleke and Sclafani, 1987), it was deemed too hazardous in the face of a deteriorating patient with a brainstem lesion.

High resolution real time B-mode imaging with Doppler has little place in the diagnosis of distal vertebral artery injury (Bendick, 1990). Magnetic resonance imaging with contrast is beginning to appear promising in regard to investigations of vascular trauma and neurological sequelae (Quint and Spickler, 1980), although it is still too early to tell what its role will become.

As the localization and type of vascular pathology was unknown anticoagulant therapy (Levy *et al.*, 1980; Six *et al.*, 1981; Goldstein, 1982; Hart and Easton, 1982; Katirji *et al.*, 1985; Chedid *et al.*, 1989) and neurosurgical vascular intervention were thought inappropriate.

The literature describes many cases where head rotation and neck extension has led to cerebellar or brainstem pathology including such minor episodes as swimming, (Tramo *et al.*, 1985), reversing the car (Sherman *et al.*, 1981), painting the ceiling (Okasawa and Nibblelink, 1974) and sleeping (Hope *et al.*, 1983). However this case is unusual in that there was no identified intrinsic vertebral artery pathology.

Hypoplasia of the contralateral vertebral artery which can occur in up to 15 per cent of patients (Thomas *et al.*, 1956), meant only a small chance of recovery.

### Conclusion

It is possible to speculate that operative intervention would have saved this young man's life. The policy of management was conservative because of uncertainty as to the cause of the deterioration. However even if it had become known in good time that the basilar artery circulation was compromised it is difficult to know which operative procedure would have been effective.

### References

- Bendick, P. J. (1990) Haemodynamic evaluation of vertebral arteries by duplex ultrasound. *Surgical Clinics of North America*, **70**: 234–244.
- Bradac, G. B., Kaernback, A., Bolk-Weischedel, D. (1981) Spontaneous dissecting aneurysm of the cervical vertebral arteries. Report of six cases and review of the literature. *Neuroradiology*, **21**: 149–159.
- Chedid, M. K., Deeb, Z. L., Rothfus, W. E., Abl, A. A., Sherman, R. L., Maroon, J. C. (1989) Major cerebral vessels injury caused by a seat belt injury; case report. *Journal of Trauma*, **29**: 1601–1603.
- Goldstein, S. J. (1982) Dissecting haematoma of the cervical vertebral artery. *Journal of Neurosurgery*, **56**: 451–454.
- Gouleke, P., Sclafani, S. (1987) Vertebral artery injury—diagnosis and management. *Journal of Trauma*, **27**: 856–865.
- Hart, R. J., Easton, D. J. (1982) Dissection of cervical and cerebral arteries. *Neurological Clinics*, **1**: 451–454.
- Hope, E. E., Bodensteimer, J. B., Barnes, P. (1983) Cerebral infarction related to neck position in an adolescent. *Paediatrics*, **72**: 335–337.
- Katirji, M. B., Reinmuth, D. M., Latchaw, R. E. (1985) Stroke due to vertebral artery injury. *Archives of Neurology*, **42**: 242–248.

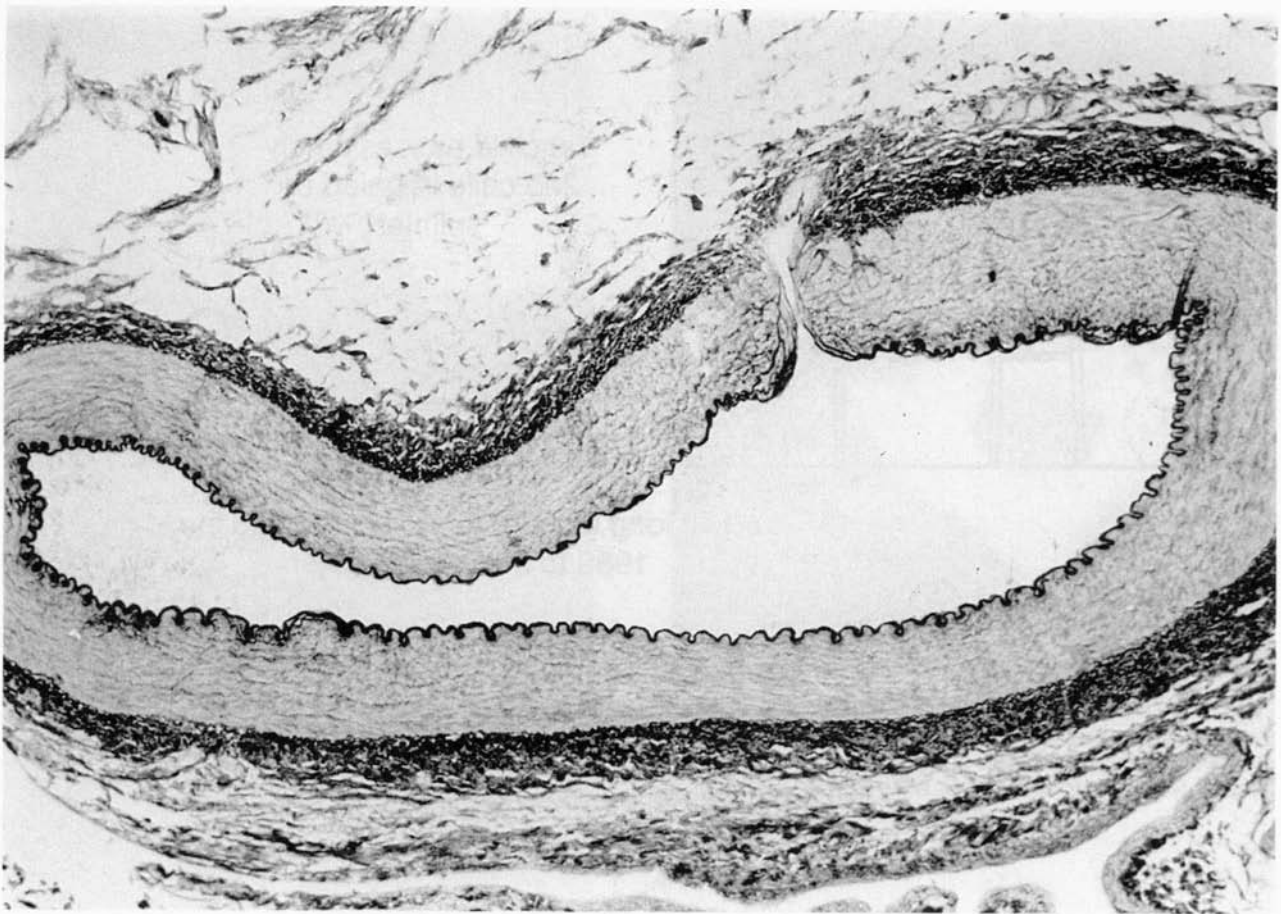


FIG. 7

The left vertebral artery clearly showing intact vessel walls.



FIG. 8

Left vertebral artery (thin arrow) compressed by extraluminal thrombosis (wide arrow), arising from paravertebral veins.

- Levy, R. L., Dugan, T. M., Bernat, J. L., Keating, J. (1980) Lateral medullary syndrome after neck injury. *Neurology*, **30**: 788–790.
- Okasawa, S., Nibblelink, D. (1974) Vertebral artery occlusion following hyperextension and rotation of the head. *Stroke*, **5**: 640–642.
- Quint, D. J., Spickler, E. M. (1990) Magnetic resonance demonstration of vertebral artery dissection. Report of two cases. *Journal of Neurosurgery*, **72**: 964–967.
- Six, E. G., Stringer, W. L., Cowley, A. R., Davis, C. H. (1981) Post-traumatic bilateral vertebral artery occlusion: a case report. *Journal of Neurosurgery*, **54**: 814–817.
- Sherman, D., Hart, R., Easton, J. (1981) Abrupt changes in head position and cerebral infarction. *Stroke*, **12**: 2–6.
- Thomas, G. I., Anderson, K. N., Hain, R. F. (1956) The significance of anomalous vertebral basilar artery communications in operations on the heart and great vessels. *Surgery*, **46**: 747–757.
- Tramo, M. J., Hainline, B., Petito, F., Lee, B., Caronna, J. (1985) Vertebral artery injury and cerebellar stroke while swimming. Case report. *Stroke*, **16**: 1039–1042. Address for correspondence: Dr M. L. Farrell, ENT Registrar, Royal North Shore Hospital, St Leonards, NSW 2065, Australia.

**Key words:** Neck; Wounds, penetrating; Vertebral artery.