Historical Note on Carotid Disease and Ligation

J.M.S. Pearce

Emeritus Consultant Neurologist, Department of Neurology, Hull Royal Infirmary, Hull, UK

This appoplexi as I take it? is a kind of lethergie [...] a kind of sleeping in the blood, a horson tingling.
King Henry IV, Part II
Shakespeare

Six years before Thomas Willis (1621–1675) described the cerebral arterial circle (fig. 1), the first link between carotid disease (Greek: *karotide*, to stupefy) and disordered brain circulation was probably made by the Swiss physician Johann Jakob Wepfer (1620–1695) who led the Schaffhausen School of Medicine. Wepfer, known as ‘The Hippocrates of Helvetia’, described the polygon of arteries at the base of the brain. He is best remembered for his *Historiae Apoplecticorum* (1658), where he described haemorrhagic apoplexy [1, 2]. He also described carotid thrombosis in a patient with a completely occluded calcified right internal carotid artery [3, 4].

Thomas Willis then described in 1664 in *Cerebri Anatome* (illustrated by Christopher Wren) a man who died of a mesenteric tumour, who in life had no neurological symptoms, but:

When his skull was opened we noted amongst the usual intracranial findings, the right carotid artery, in its intracranial part, bony or even hard, its lumen being almost totally occluded; so that the influx of the blood being denied by this route, it seemed remarkable that this person had not died previously of an apoplexy [5].

A hundred years later, van Swieten (1700–1772), far ahead of his time, postulated cerebral embolism arising in the heart and great vessels [6, 7]:

These polyyps [emboli] occasionally attach themselves as excrescences [...] were they thrown into the carotid or vertebral ar-

teries, could disturb – or if they completely blocked all approach of arterial blood to the brain – utterly abolish all functions of the brain.

But he gave no distinctive report of carotid strokes.

Giovanni Battista Morgagni (1682–1771) in his *De Sedibus* (1761) showed extravasation of blood caused damage and laceration to the brain and cavities resulting in apoplexy [8]. Morgagni recognised the cerebral lesion as causing contralateral palsy. This was the first clear account of cerebral haemorrhage causing apoplectic stroke in distinction from earlier notions that apoplexy caused a vague deprivation of motion and impairment of consciousness.

Until the late 1950s, undergraduate teaching told that a sudden hemiplegic stroke was commonly owing to thrombosis of the middle cerebral arteries or its lenticulostriate branches. Accounts of lesions in the carotid artery causing strokes with cerebral infarction, and retinal emboli had to await the latter half of the 20th century – notably in the work of C. Miller Fisher (1913–2012) [9, 10]. His 1951 article read:

Unexplained cerebral embolism may arise from thrombotic material lying in the carotid sinus [...] It is even conceivable that some day vascular surgery will find a way to by-pass the occluded portion of the artery during the period of ominous fleeting symptoms.

Fig. 1. Circle of Willis from *Cerebri Anatome*, 1681.

The first successful operation for carotid stenosis was performed in 1954. Sir George Pickering (1904–1980) of St Mary's Hospital showed severe stenosis in the carotid arteriogram of a 66-year-old woman with multiple transient right hemipareses and left amaurosis, and suggested to Rob and Eastcott that they surgically correct the block [11]. A year earlier, DeBakey had performed a similar endarterectomy [12] with success and survival for 19 years. These stenoses or occlusions provide links with surgical ligation of the carotid arteries.

Carotid Ligation

The development of modern carotid surgery to reduce the risks of trauma, occlusion and embolization into the cerebral circulation evolved gradually. This paper highlights the early contributions, particularly carotid ligation usually performed to attenuate traumatic haemorrhage and aneurysms. Warner's experience is illustrated and anticipates the better known accounts of Hebenstreit, Abernethy, Cooper, and Fleming.

Because of the obvious hazard of a stroke, for a long time surgeons avoided operations on the common and internal carotids. However, Jean-Louis Petit (1674–1750; who performed the first mastectomy and invented the screw tourniquet), discovered in the 18th century that

this was not inevitable. His patient had an aneurysm of the bifurcation of the right common carotid artery that resolved spontaneously; he was surprised to find at autopsy 7 years later that the vessel was completely occluded by a thrombus, yet no stroke had materialised [13].

It is often reported that Ambroise Paré (1510–90) [14–16] performed the first carotid ligation [17] in 1552 by which he controlled the haemorrhage from an épée wound and thus saved the life of a French soldier though he developed aphasia and hemiplegia. Interestingly, Paré also noted in chapter XI, 'Why, when the braine is hurt by a wound of the head, there may follow a Convulsion of the opposite part?' [14]. Hebenstreit of Germany, in his translation of Benjamin Bell's *Surgery* in 1793, recalled how he had injured a carotid artery during surgery for a scirrhus tumour; he controlled the bleeding by carotid ligation, and the patient survived for many years [18]. This is often claimed to be the first recorded case of ligation of the carotid [19].

John Abernethy (1764–1831), pupil of John Hunter (1728–1793), reported an incident [20], probably in 1798, when he ligated the common carotid to stop the bleeding of a man gored by the horn of a cow; however, the man died 30 h later, and Abernethy, famed for his eccentricity and rudeness of his manners, abandoned the procedure. This case too is claimed as the first ligation for injuries of the neck [21].

On October 17, 1803, David Fleming, a naval surgeon aboard HMS *Tonnant*, an 80-gun ship of the line of the French Navy, attended Mark Jackson, a servant who had attempted suicide by cutting his throat. Fleming cut down on the artery proximal to the rupture and ligated it. The patient made an uninterrupted recovery (reported in 1817 by Richard Warren Coley [22], an assistant surgeon on HMS *Tonnant*). This was claimed as the 'first' authentic successful case of ligation of the carotid artery on record [23].

Benjamin Travers (1783–1858) diagnosed and treated a carotidocavernous fistula by daring to ligate the common carotid artery in 1811 [24], having allegedly witnessed Astley Cooper's (1857–1916) 'first' carotid ligation for a cervical aneurysm in 1805. Although Cooper's patient succumbed to sepsis with a hemiplegia 3 weeks later, he successfully treated a further case in 1808 [25, 26]. In 1885, Victor Horsley successfully ligated the carotid for intracranial aneurysm [27].

One of the earliest and remarkable carotid ligations is often overlooked. Joseph Warner, surgeon to Guy's Hospital, removed a massive 4-pound 'steatoma' (lipoma) in 1775 and probably tied the carotid artery. His description

Fig. 2. Joseph Warner: *Cases in Surgery*.

Fig. 3. Joseph Warner. Painting by Samuel Medley (portrait in the Hunterian museum, Royal College of Surgeons of England).

[28]: 'There was but one Vessel which required tying' is reproduced without further comment in figure 2. This account clearly antedates those of Hebenstreit, Abernethy, and Fleming.

Joseph Warner (1717–1801; fig. 3), was the son of Ash-ton Warner, a politician in Antigua. Warner was educated at Westminster School. He was apprenticed to Samuel Sharp at Guy's Hospital in 1734 and assisted him as a lecturer in anatomy in 1741 after obtaining his diploma. In 1745, he was appointed to Guy's Hospital, then served under the Duke of Cumberland in the 1745 Rebellion. Warner held the unique distinction of being a member of all three surgical institutions in London, since he was a Barber-Surgeon, twice Master of the Company of Surgeons in 1755 and 1784, and the first member of the College of Surgeons in 1800.

His distinction was recognised by election as a Fellow of the Royal Society on December 6, 1750; and on April 5, 1764, he was chosen as a member of the court of the

Company of Surgeons which in 1800 was granted a Royal Charter to become in 1843 The Royal College of Surgeons of England. Warner was one of the first Fellows who, like Paré and Abernethy, insisted ‘a good surgeon avoided operating if possible, and cured, instead, by regimen and medicines’ [29].

D’Arcy Power remarked that he contributed little to the literature of surgery [30], yet his writings [28, 31] illuminate contemporary surgery in London. His respected

Cases in Surgery [32] recorded the whole range of surgery, including an account of the agaric of the oak stopping bleeding ‘after some of the most capital operations’ (1754) [28]. A dispute with John Hunter about surgical teaching is recorded in Wilks and Bettany’s *A Biographical History of Guy’s Hospital* (1892) [33].

Warner died at his house in Hatton Street, London, on July 24, 1801 [30]. A life-size half-length portrait by Samuel Medley is in the Royal College of Surgeons of England.

References

- Wepfer JJ: *Observationes anatomicae, ex cadaveribus eorum quos sistulit apoplexia cum exercitatione de ejus loco affect.* Schaffhausen, Sutter, 1658.
- Pearce JMS: Johann Jakob Wepfer (1620–1695) and cerebral haemorrhage. *J Neurol Neurosurg Psychiatry* 1997;62:387.
- Gurdjian ES, Gurdjian ES: History of occlusive cerebrovascular disease. I. From Wepfer to Moniz. *Arch Neurol* 1979;36:340–343.
- Pearce JMS: Johannes Jacob Wepfer (1620–1695); in Aminoff MJ, Daroff RB (eds): *Encyclopedia of the Neurological Sciences*, ed 2. San Diego, Elsevier, 2014, section 1022, in press.
- Hughes JT: Thomas Willis (1621–1675). His Life and Work (Eponymists in Medicine). London, Royal Society of Medicine, 1991, pp 68–69.
- van Swieten G: Of the Apoplexy, Palsy and Epilepsy. Commentaries on the Aphorisms of Dr. Herman Boerhaave. London, John & Paul Knapton, 1754, vol 10.
- Pearce JMS: van Swieten’s concept of cerebral embolic stroke. *J Neurol Neurosurg Psychiatry* 2002;73:153.
- Morgagni GB: *De sedibus et causis morborum per anatomen indagatis, libri quinque.* Vienna, Remondiana, 1761.
- Fisher CM: Occlusion of the internal carotid artery. *Arch Neurol Psychiatry* 1951;69:346–377.
- Fisher CM: Observations of the fundus oculi in transient monocular blindness. *Neurology* 1959;9:333–347.
- Eastcott HHG, Pickering GW, Rob CG: Reconstruction of internal carotid artery in a patient with intermittent attacks of hemiplegia. *Lancet* 1954;2:994–996.
- DeBaakey ME, Crawford ES, Cooley DA, Morris GC Jr, Garret HE, Fields WS: Cerebral arterial insufficiency: one to 11-year results following arterial reconstructive operation. *Ann Surg* 1965;161:921–945.
- Petit JL: *Chirurg Mem de l’Acad Roy des Sciences.* Paris, Royal Academy of Science, 1765.
- Paré A, Johnson T: *The Workes of That Famous Chirurgion Ambrose Parey.* Translated out of Latine and Compared with the French, English, ed 4. London, Clarke, 1678.
- Paré A: *Oeuvres completes.* Lyons, Rigaud, 1652.
- Wangensteen OH, Wangenstein SD, Klinger CF: Ambroise Paré and Dominique Larrey, great French military surgeons of the 16th and 19th centuries. *Bull Hist Med* 1972;46:207–234.
- Robicsek F: The medical history of extracranial cerebrovascular disease; in Robicsek F (ed): *Extracranial Cerebrovascular Disease.* New York, Macmillan, 1986, pp 5–18.
- Hebenstreit EBG: *Zusätze zu Benjamin Bells Abhandlung von den Geschwüren und deren Behandlung.* Leipzig, Weidmann, 1793.
- Norton JA, Barie PS, Bollinger RR, Chang AE, Lowry SF, Mulvihill SJ, Pass HI, Thompson RW: *Surgery: Basic Science and Clinical Evidence.* Berlin, Springer 2009, p 1307.
- Abernethy J: *Observations on Injuries of the Head and on Miscellaneous Subjects.* Philadelphia, Dobson, 1811, p 162.
- Miller JD, Jawad K, Jennett B: Safety of carotid ligation and its role in the management of intracranial aneurysms *J Neurol Neurosurg Psychiatry* 1977;40:64–72.
- Coley RW: Case of rupture of the carotid artery, and wounds of several of its branches, successfully treated by tying the common trunk of the carotid itself. *Med Chir J Rev* 1817;3:1–4.
- Thompson JE: The evolution of surgery for the treatment and prevention of stroke. The Willis lecture. *Stroke* 1996;27:1427–1434.
- Travers B: A case of aneurysm of anastomosis in the orbit by ligation of the common carotid artery. *Med Clin Transact* 1811;2:1–16.
- Cooper A: A case of aneurism of the carotid artery. *Medico-Chir Transact* 1809;1:1.
- Cooper A: Account of the first successful operation performed on the common carotid artery for aneurysm in the year 1808 with post-mortem examination in 1821. *Guy’s Hosp Rep* 1836;1:53–59.
- Drake CG: Earlier times in aneurysm surgery. *Clin Neurosurg* 1985;32:41–50.
- Warner J: *Cases in Surgery; with Introductions, Operations and Remarks*, ed 4. London, Johnson, 1784, pp 41–42.
- Lawrence SC: *Charitable Knowledge: Hospital Pupils and Practitioners in Eighteenth Century London.* Cambridge, Cambridge University Press, 1966, p 305.
- Power D’A, Bevan M: *Dictionary of National Biography.* Oxford, Oxford University Press, 2004. <http://www.oxforddnb.com/view/article/28762> (accessed 31 July 2013).
- Warner J: *A Description of the Human Eye, and Its Adjacent Parts Together with Their Principal Diseases, and the Methods Proposed for Relieving Them.* London, Davis, 1773.
- Warner J: *Cases in Surgery, with Remarks: To Which Is Added, an Account of the Preparation and Effects of the Agaric of the Oak in Stopping of Bleedings*, ed 2. London, Tonson and Draper, 1754.
- Wilks S, Bettany GT: *A Biographical History of Guy’s Hospital.* London, Ward, Lock, Bowden & Co, 1892.