

A hundred years of lumbar puncture: 1891–1991

The centenary of the introduction of lumbar puncture in 1891 provides an appropriate occasion to recall the story of the discovery of the cerebrospinal fluid.

The ancient Egyptians were familiar with the meninges which were referred to in the Ebers papyrus (c 1500 BC), but the first record of the presence of a watery liquid in and around the brain dates back to classical Greek times. Hippocrates (470–400 BC) recognised hydrocephalus ('water on the brain') and Galen (129–199 AD) observed that the cerebral ventricles were filled with an aqueous humour. This was later confirmed by Vesalius (1514–64) in his *De humani corporis fabrica* (1543), and in 1677 Francis Glisson (1597–1677), President of the Royal College of Physicians of London, described with greater precision a watery liquid on the surface of the brain, occupying the space between the dura and pia mater [1,2].

The first mention of a similar watery liquid around the spinal cord was made in 1692 when Valsalva (1666–1723) cut through a dog's spinal cord and noted a clear water-like liquid which he described as resembling synovial fluid [3]. Then, in 1764, Domenico Cotugno published his classic account of the cerebrospinal fluid in man.

Domenico Cotugno (1736–1822)

Domenico Felice Cotugno, also known as Domenicus Cotunnus (Fig. 1) was born in Ruvo di Puglia, in southern Italy. He was educated at the University of Naples where he was appointed, at the age of 30, to the Chair of Anatomy. He was soon the leading physician in Naples and became Dean of the School of Medicine, Rector of the University, and Principal of the Royal Academy of Sciences [4].

Cotugno was the author of two important anatomical works. In the first, *De aquaeductibus auris humanae internae* (1761), he demonstrated that the semicircular canals of the inner ear contained a clear watery liquid and not air as had been taught by Valsalva [5]. In the second, *De ischiade nervosa commentarius* (1764) (Fig. 2), he gave a classic description of sciatica ('Cotugno's disease') and of the cerebrospinal fluid ('liquor Cotogni') [6,7]. In this work, he clarified the anatomical basis of sciatica as an affection of the lower spinal nerves, and he demonstrated that the membranes enveloping the spinal cord contained a water-like fluid

which he described as similar to that found in the pericardium, cerebral ventricles, or the semicircular canals.

Cotugno explained why previous anatomists had not recognised the cerebrospinal fluid:

'The reason that anatomists have never yet observed this collection of water about the brain and in the spine is owing to the common preposterous method of dissecting; for when they are about to examine the brain, they commonly cut off the head from the neck; this means that the tube of the Dura Mater, which ascends by the spine of the neck, being cut through, all the water that is collected about the brain and the spinal marrow flows out and is foolishly lost. . .'

Cotugno's discovery of the cerebrospinal fluid in 1764 made no great immediate impact and it was not until its 'rediscovery' in the next century by François Magendie (1783–1855) that interest was reawakened and the anatomical and physiological features were better understood. In 1827, Magendie republished Cotugno's original work in Latin and accorded Cotugno complete priority for the discovery of the cerebrospinal fluid [8].

Little further progress was made until lumbar puncture was introduced in 1891 by Walter Essex Wynter in Britain and Heinrich Quincke in Germany, both quite independently seeking a means of reducing the cerebrospinal fluid pressure.

Walter Essex Wynter FRCP (1860–1945)

Walter Essex Wynter (Fig. 3) was the son of Dr Andrew Wynter (1819–76), a medical practitioner in Chiswick, near London, who became editor of the *British Medical Journal* (1855–61). Educated at Epsom College and the Middlesex Hospital, Essex Wynter qualified in 1883 and, although he had some surgical leanings (he was a great friend of Sir John Bland Sutton and obtained the FRCS in 1885), he pursued his career as physician and was appointed Assistant Physician to the Middlesex Hospital in 1891 and Physician in 1901. He grew his own tobacco and smoked heavily, and at the age of 70 peripheral vascular disease necessitated amputation of a leg [9,10].

It was while Essex Wynter was still a medical registrar at the Middlesex Hospital that he made his historic first attempts at lumbar puncture, which were reported in the *Lancet* of May 2, 1891 [11]. In this paper he described four cases of meningitis. Case 1 (treated February 1889) was a boy aged three whose

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Fig. 1. Domenico Cotugno (By courtesy of the Royal College of Physicians, London)

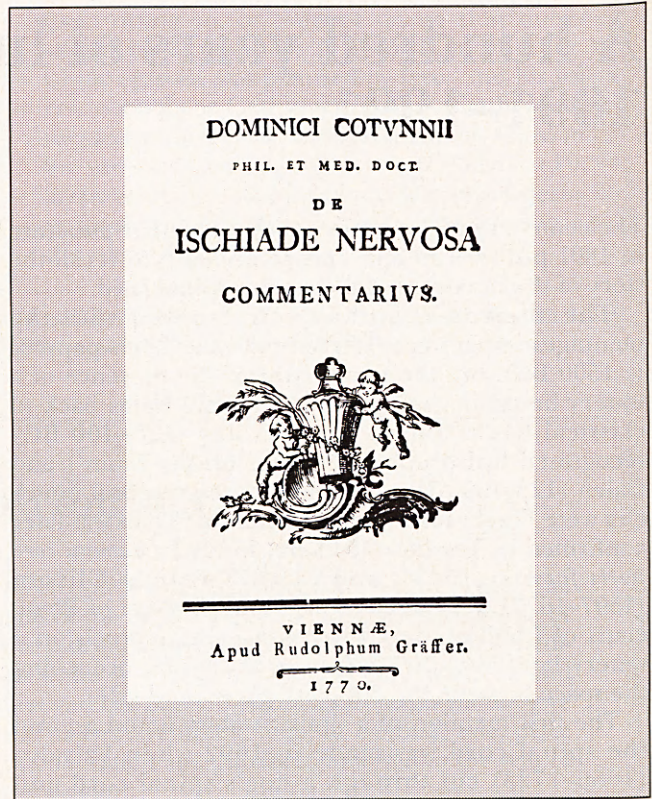


Fig. 2. Title page of Domenicus Cotunnii's 'De Ischiade Nervosa Commentarius' (1770) (By courtesy of the Royal Society of Medicine, London)

meningitis followed an ear infection. The other three were tuberculous. Case 2 (treated February 1890) was a girl aged 11. Case 3 was a boy aged 2. Case 4 (treated April 1891) was a girl aged 13 months.

Essex Wynter's technique was to make a small incision at the level of the second lumbar vertebra near the midline and cut down through the intervertebral space to reach the dura through which he introduced a Southey's tube to which was attached a rubber drainage tube. The procedure produced some temporary symptomatic relief, but all four patients died.

Southey's tubes were invented by Dr Reginald Southey, FRCP (1835–99), physician to St Bartholomew's Hospital. He was a nephew of the poet Robert Southey [12]. Southey's tubes were designed for subcutaneous insertion to drain gross cardio-renal oedema and were also inserted intraperitoneally to drain ascites (Fig. 4). It was one of these which Essex Wynter employed in his first lumbar puncture attempts during 1889–91.

Heinrich Quincke (1842–1922)

Heinrich Irenaeus Quincke (Fig. 5) was born in Frankfurt-an-der-Oder, the son of a successful Berlin physician. He studied medicine in Berlin, Würzburg and Heidelberg, and graduated in 1863. After serving as

Fig. 3. Walter Essex Wynter (By courtesy of the Royal College of Physicians, London)



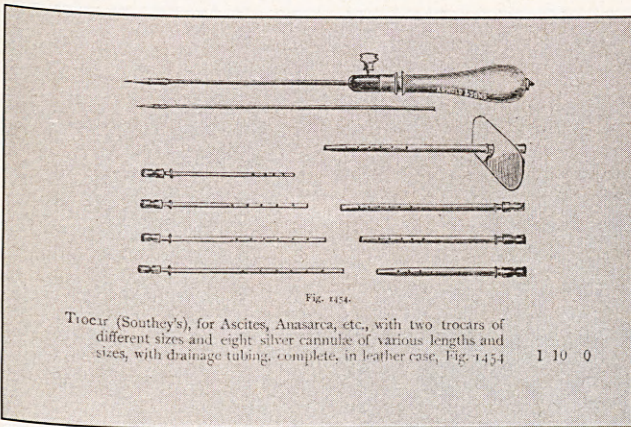


Fig. 4. Southey's tubes. Illustration from catalogue of Arnold & Sons, 1895. (By courtesy of the Science Museum, London)

assistant to Friedrich Theodor Frerichs (1819–85) at the Charité, Berlin, he was called to the chair of medicine in Berne in 1873 and, after 5 years, to the chair at Kiel which he occupied for 30 years (1878–1908) [13–15]. He made numerous contributions to clinical medicine, especially in gastrointestinal diseases; he pioneered surgery for lung abscess; and in 1882 he described angioneurotic oedema ('Quincke's oedema') [16].

Quincke is, however, chiefly remembered for the historic part he played in introducing lumbar puncture in 1891. His interest in the cerebrospinal fluid dated from the time of his assistantship to Frerichs at the Charité. In 1872, Quincke published a study of the physiology of the cerebrospinal fluid in dogs and rabbits, into whose subarachnoid space he injected red sulphide of mercury [17].

Nearly 20 years later, in Kiel, in an attempt to relieve the severe headache in hydrocephalus, he considered practical methods of reducing the cerebrospinal fluid pressure. In April 1891 (one month prior to the appearance of Essex Wynter's paper), Quincke presented an initial report to the Tenth Congress of Internal Medicine at Wiesbaden. In this communication, entitled *Ueber hydrocephalus* [18–20], he described three cases.

Case 1 (treated in 1888) was a boy aged 12 whose skull was trephined and the cerebral ventricle punctured on six occasions, but he died. Case 2 (treated December 1890) was a boy aged 1 year 9 months who was comatose, and in whom tuberculous meningitis was suspected. Quincke performed three lumbar punctures at 3-day intervals, using a needle not very different from those in use today. He wrote:

'... I punctured the subarachnoid space in the lumbar area, passing a very fine cannula 2 cm deep between the third and fourth lumbar spinal arches and drop by drop I drained a few cubic centimetres

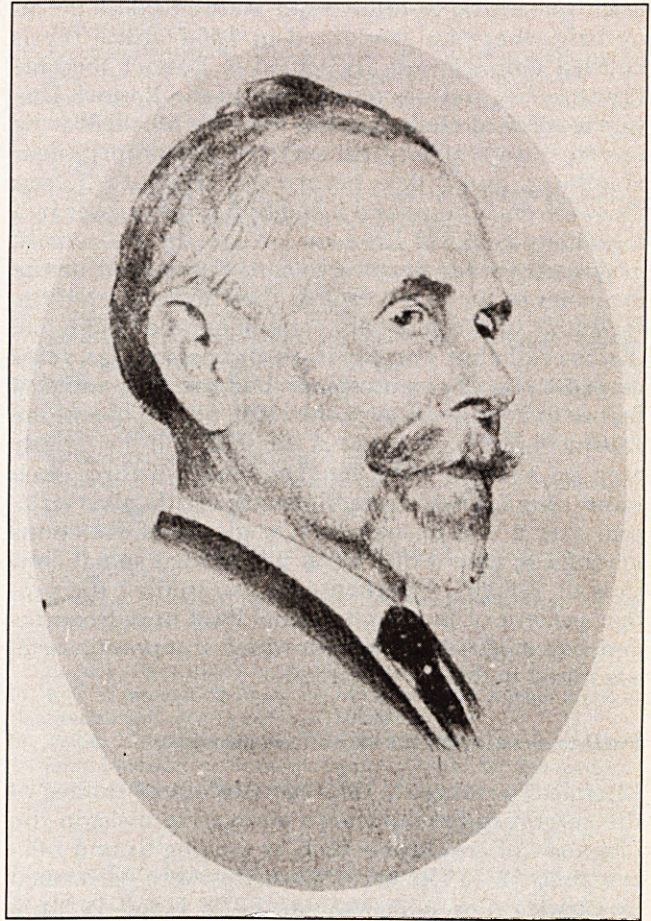


Fig. 5. Heinrich Quincke (By courtesy of the Royal College of Physicians, London)

of watery clear fluid . . . one could see clearly increases [in flow] with expiration and decreases with inspiration.'

The child recovered and the diagnosis was no doubt pneumonia associated with meningism. Case 3 (treated April 1891) was a man aged 25, with chronic hydrocephalus, whose headache was relieved by lumbar puncture.

Quincke persevered with the technique, so that in his paper entitled *Lumbalpunktion des Hydrocephalus*, published later that year on September 21, 1891, he was able to report on a series of ten cases (five children, five adults) and made reference to Essex Wynter's earlier paper of May 1891 [21].

Hans Queckenstedt (1876–1918)

Following its introduction in 1891 by Essex Wynter and Heinrich Quincke, lumbar puncture was increasingly employed and important studies of the cerebrospinal fluid were made by Queckenstedt.

Hans Heinrich Georg Queckenstedt (Fig. 6) was

born in Leipzig-Reudnitz and studied medicine in Leipzig where he graduated in 1904 with a thesis entitled *Carcinosarcom*. He settled in Rostock, became Privatdozent, and was on the staff of the Rostock University medical clinic. During the First World War he was in charge of medical services in Harburg, near Hamburg, and 2 days before the armistice he was thrown from a horse and killed by being run over by a munitions truck [22,15].

Queckenstedt became greatly interested in the dynamics of the cerebrospinal fluid and observed the variations in pressure with respiration and cough. He discovered that compression of the jugular veins caused a rise of cerebrospinal fluid pressure and that failure to do this was associated with obstruction of the subarachnoid space between the skull and the lumbar area. In 1916 he published his report of three such cases: case 1 due to hydatid disease of a lumbar vertebra; case 2 due to malignant angioma of the conus medullaris; case 3 due to an unspecified spinal cord tumour [23,20]. Queckenstedt also studied the protein content of the cerebrospinal fluid in polyneuritis and reported on 42 cases in which the protein level was raised in this condition [24].

Further developments of lumbar puncture

Chemical, cytological and bacteriological studies of the cerebrospinal fluid were pursued to assist in the diagnosis of conditions such as meningitis and neurosyphilis [25]. The earliest analyses were performed by Charles Alexander Morton, FRCS (1860–1929), a Bristol surgeon who, as early as October 1891, published a report on the cerebrospinal fluid findings in 14 cases, 11 of which were tuberculous meningitis [26]. Georges Froin (1874–1932) drew attention in 1903 to the features of the spinal block syndrome [27]. An important early monograph on the chemistry of the cerebrospinal fluid by William Mestrezat (1883–1928) appeared in 1911 [28].

In 1919, Walter Dandy (1886–1946) injected air via lumbar puncture and introduced pneumoencephalography [29]. In 1921, Jean Athanase Sicard (1872–1929) and Jacques Ernest Forestier (1890–?) injected a contrast medium, iodised oil (Lipiodol), via lumbar puncture, and ushered in myelography [30]. In 1920, James Bourne Ayer (1882–1963) first carried out cisternal puncture [31].

In addition to its diagnostic uses lumbar puncture also came to be employed therapeutically, and with the advent of antibiotics their administration by the intrathecal route was an important advance.

The first injection of local anaesthetic into the region of the lumbar spine was performed by James Leonard Corning (1855–1923), a New York neurologist. In 1885 he injected a cocaine preparation into the spinal subarachnoid space, but he did so unintentionally and without realising what he had done. He did not withdraw any cerebrospinal fluid and he cannot



Fig. 6. Hans Queckenstedt (By courtesy of the Royal College of Physicians, London)

therefore be credited with having purposively performed lumbar puncture before Essex Wynter and Heinrich Quincke [32, 33]. Priority for the introduction of spinal analgesia must be given to two surgeons, August Karl Gustav Bier (1861–1944) of Kiel (a colleague of Quincke) and Theodore Tuffier (1857–1929) of Paris, both of whom published their work quite independently in 1899 and expressed their indebtedness to Quincke [34,35]. Interestingly, both received an Honorary KBE from King George V for their help with the care of British troops in the First World War.

Finale

When, one hundred years ago, Essex Wynter and Heinrich Quincke took those first courageous steps and deliberately inserted a tube or needle into the spinal subarachnoid space in order to drain the cerebrospinal fluid, they could not have foreseen the enormously beneficial consequences of their action on our understanding of the nervous system and on clinical neurology, as well as on other disciplines such as anaesthesia and radiology. A century later, lumbar

puncture remains an important investigative and therapeutic procedure, and our debt to these pioneers is incalculable.

References

- 1 Bailey P. Introduction in: *The cerebrospinal fluid*, S Lups and A M F H Haan. Amsterdam: Elsevier, 1954.
- 2 Woollam DHM. The historical significance of the cerebrospinal fluid. *Medical History* 1957;**I**:91–114.
- 3 Bilancioni G. Valsalva scroproitore del liquide cefalo-arachidiano. *Policlinico* 1911;**18**:1045.
- 4 Viets HR. Domenico Cotugno: his description of the cerebrospinal fluid. *Bulletin Institute History of Medicine* 1935;**3**:701–38.
- 5 Cotugno D. *De aquaeductibus auris humanae internae*. Neapoli: Simoniana, 1761.
- 6 Cotugno D. *De Ischiade nervosa commentarius*. Neapoli: Simonios, 1764.
- 7 Cotunnus D. *A treatise on the nervous sciatica or nervous hip gout*. London: Wilkie, 1775.
- 8 Olmstead JMD. *Francois Magendie*. New York: Schuman's, 1944.
- 9 Munk's Roll. *Walter Essex Wynter*, in (4: 400–401) London: Royal College of Physicians, 1955.
- 10 Obituary, *Walter Essex Wynter*. *British Medical Journal* 1945;**1**:100–1.
- 11 Wynter WE. Four cases of tubercular meningitis in which paracentesis was performed for the relief of fluid pressure. *Lancet* 1891;**i**:981–982.
- 12 Munk's Roll. *Reginald Southey* in 4:155–156, London: Royal College of Physicians, 1955.
- 13 Pagel J. *Biographisches Lexikon Hervorragender Ärzte des Neunzehnten Jahrhunderts*. Berlin: Urban & Schwarzenberg, 1901.
- 14 Obituary. *Heinrich Quincke*. *Lancet* 1922;**i**:1259.
- 15 Haymaker W. *Founders of neurology*. Springfield: Thomas, 1953.
- 16 Shelley WB, Crissey J. *Classics of dermatology*. Springfield: Thomas, 1953.
- 17 Quincke, HI. Zur physiologie der cerebrospinal flüssigkeit. *Archiv für Anatomie, Physiologie und Wissenschaftliche Medizin*, 1872,**153**–77.
- 18 Zehnter Congress für Innere Medizin, Wiesbaden *Deutsche Medizinische Wochenschrift* 1891;**17**:809.
- 19 Quincke HI. *Ueber Hydrocephalus*. Verhandlung des Congress Innere Medizin (X), 1891;**321**–39.
- 20 Wilkins RH. Neurosurgical classics - XXXI. *Neurosurgery*. 1965;**22**:294–308.
- 21 Quincke HI. Die Lumbalpunktion des Hydrocephalus, *Berliner Klinische Wochenschrift*. 1891;**28**:929–33.
- 22 Stender A. Concerning Queckenstedt and his test. *Neurosurgery* 1949;**6**:337–40.
- 23 Queckenstedt HHG. Zur Diagnose der Rückenmarkskompression. *Deutsche Zeitschrift für Nervenheilkunde* 1916;**55**:325–33.
- 24 Queckenstedt HHG. Ueber Veränderungen der Spinalflüssigkeit bei Erkrankungen peripherer Nerven, insbesondere bei Polyneuritis und bei Ischias. *Deutsche Zeitschrift für Nervenheilkunde* 1917;**57**:316–29.
- 25 Gray H. History of lumbar puncture (rachicentesis): The operation and the idea. *Arch Neurol Psych* 1921;**6**:61–9.
- 26 Morton CA. The pathology of tuberculous meningitis with reference to its treatment by tapping the subarachnoid space of the spinal cord. *Br Med J* 1891;**iii**:840–1.
- 27 Froin, MG. Inflammations meningées: Reactions chromatique, fibrineuse et cytologique du liquide cephalo-rachidien. *Gazette des Hôpitaux* 1903;**76**:1005–6.
- 28 Mestrezat W. *Le liquide cephalo-rachidien normal et pathologique: valeur de l'examen chimique*. Montpellier: These No. 17, 1911.
- 29 Dandy WE. Roentgenography of the brain after the injection of air into the spinal canal. *Annals Surg* 1919;**70**:397–403.
- 30 Sicard JA, Forestier J. Méthode radiographique d'exploration de la cavité epidurale par la Lipiodol. *Rev Neurologie (Paris)* 1921;**28**:1264–6.
- 31 Ayer JB. Puncture of the cisterna magna. *Arch Neurol Psych* 1920;**4**:529–41.
- 32 Corning JL. Spinal anaesthesia and local medication of the cord. *New York Med J* 1885;**42**:483–5.
- 33 Mackintosh R. *Lumbar puncture and spinal analgesia* (5th edn) London: Churchill Livingstone, 1985.
- 34 Bier A. Versuchen uber cocainisierung des Rückenmarkes. *Deutsche Zeitschrift für Chirurgie* 1899;**51**:361–9.
- 35 Tuffier T. Analgesie chirurgicale par l'injection sous arachnoidienne lombaire de cocaine. *Comptes Rendus des Séances de la Société de Biologie (Paris)* 1899;**51**:882.

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