Neurosurgery: A Historical Perspective

NEUROSCIENCE SYMPOSIUM 2012
By
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Objectives

- Review pertinent findings from neuroscience
- Review history of neuro diagnostics
- Discuss history of trepanation/trephination
- Review advances in neurosurgical techniques
- Discuss relevant neurosurgeons who made those advances
“Only the man who knows exactly the art and science of the past and present is competent to aid in its progress in the future”.

Christian Albert Theodor Billroth
Trephination or Trepanation

- From Greek word *trypanon*
  - Meaning borer or creation of a hole in the skull
- Evidence suggests that the first trepanations may have occurred up to 10,000 years ago
Trephination

- In 1860's Ephraim George Squier (archaeologist) sent to Peru by President Lincoln to study trepanned skulls
- In 1867 trepanned skulls sent to Dr. Paul Broca (Paris)
  - Skulls mostly from infants
  - Openings never taken from area of skull that would cause disfigurement
  - Otherwise undamaged healthy skulls
  - Felt they were most likely based on a diagnosis of infantile seizures
Trephination

- Sir Victor Horsley was also given trepanned skulls to study
  - Trepanations due to traumatic epilepsy
  - Left sided trepanations more common
  - 70% of skulls were men
  - He concluded that most were right handed warriors causing left sided head injury in confrontational fighting
  - He concluded they were a result of treatment of TBI
Trephination

- Hippocrates in 460-370 described types of trauma in which trepanation may have been utilized.
- Galen in 129-200 AD described hydrocephalus as a reason for trepanation.
Trephination

- Technique
  - Scraping
  - Grooving (circular scraping)
  - Cutting (Tumi knife)
  - Drilling
Trepanation

- Basic reasons for trepanation
  - **Magico-therapeutic**
    - Treatment or releasing "evil" from individual
  - **Magico-ritual**
    - Rituals or celebrations
  - **Post Mortem**
    - Skull had mystical healing properties
Trepanation

- Today MOSTLY done by neurosurgeons therapeutically
- OR NOT?
Neuroradiology

- Dr. Roentgen discovered x-rays in 1895.
- Initially began using skull radiographs in early 1900's
  - Looking for pineal shifts, sellar enlargement/erosion, calcifications, bone erosion or destruction, hyperostosis
Skull x-rays
Neuroradiology

- First major innovation was Ventriculography
  - Developed by Walter Dandy, M.D. at Johns Hopkins in 1918
Neuroradiology

- In 1919 Walter Dandy developed Pneumoencephalography.
- CSF removed from lumbar SAS and air injected.
- Patients were rotated to spread air throughout ventricular system.
Pneumoencephalography
In 1927 Egas Moniz, a Portuguese neurologist, introduced the first “cerebral angiogram” using sodium iodide. Injections initially were done on common carotid and vertebral arteries.
Neuroradiology

- Myelography
  - Injection of a contrast agent into the spinal canal to view the cord, canal, nerve roots and meninges on x-ray/fluoroscopy.
CT Scan (computerized axial tomography)

- Both won Nobel Peace Prize in 1972
- This revolutionized neuroradiology
- First actual view of the brain!
Neuroradiology: historical trivia

- EMI scanner
- EMI = Electric and Music Industries
- Beatles success in the 1960’s funded Hounsfield’s research
- Who wanted to be the first to obtain radiographic imaging of the brain?
  - Thomas Edison in the 1900’s
CT Scan
CT Scan

- Initially dedicated to head imaging
- First scanner by Hounsfield took several hours to acquire raw data for a single image & days to reconstruct it
- Eventually leading to full body scans and angiography capabilities
MRI

- NMR discovered in the 1930's by physicists Block & Purcell
- First full body MRI built by Dr. Damadian in 1977
- 1979 First commercially available MRI
MRI

- Functional MRI
- MR spectroscopy
- Diffuse tensor imaging (DTI)
Sir Victor Horsley

- Accomplished scientist (physiology) and surgeon
- Studied functions of the brain, primarily cerebral cortex including stimulation
Sir Victor Horsley

- Was the first to use intra-operative stimulation of the cortex for cerebral localization of epileptic foci from 1884-1886.
- The electrical studies translated later to pioneering work in neurosurgery for epilepsy.
Sir Victor Horsley

- Developed bone wax for hemostasis & utilization of bone rongeurs
- Utilization of skin flaps
- Ligation of the carotid artery to treat aneurysms
- Transcranial approach to the pituitary
- Intradural division of the trigeminal nerve root for treatment of trigeminal neuralgia
Sir Victor Horsley

- Best known for development of the Horsley-Clarke stereotactic frame (with Robert Clarke) in 1908
- Horsley handle with trephines
Sir Victor Horsley

- Confirmed the cause of rabies and helped to abolish the disease in UK
- Reported 44 successful operations
- Was a politician supporting the right for women to vote, National insurance
- Known for his surgical competence and speed.
- Cushing observed a trigeminal ganglion procedure completed in 1 hour by Horsley...“there was nothing of modern neurosurgery that I could learn from him”
Sir Victor Horsley

- Died at age 59 in Amaara Iraq while serving as field surgeon for the British army
- Died from heat stroke complicating bacillary dysentery.
Harvey Cushing

- Born in Cleveland, OH
- April 8, 1869 – October 7, 1939
- Youngest of 10 children
- Third generation physician
- Married Katharine and had five children
Harvey Cushing

- Voted Neurosurgeon of the first half of the 20th century
- Graduate of Yale in 1891 and Harvard Medical school in 1895
- Internship at MGH
- Residency at Johns Hopkins Hospital with Dr. Halstead
Harvey Cushing

- 1900-1901 travelled through Europe
- Spent time with Dr. Kocher & studied blood pressure and brain compression which led to Cushing response
- Also travelled to Oxford to study with Dr. Sherrington on mapping motor & sensory cortices
Harvey Cushing
Achievements

• In his lifetime, took neurosurgery mortality from 80-90% to less than 10%
• Reduction of intra-operative blood loss
  ✷ Together with Dr. Bovie developed electrocautery for control of bleeding (1928)
• Developed anesthesia record & added blood pressure to vital signs
• Used x-rays to diagnose brain tumors
Harvey Cushing's Achievements

- Used electrical stimuli to study the human motor/sensory cortex
- Performed destruction of the trigeminal ganglion in 1900
- Utilized infiltrative anesthesia (1902)
- Internationally known & leader in teaching neurosurgeons in the first decades of the 20th century.
Harvey Cushing's Achievements

- Function of the pituitary gland in 1910
- Experimental hypophysectomy in 1910
Harvey Cushing

- Worked long hours
- Dedicated to his patients, especially children
- Dedicated researcher with meticulous record keeping including his own drawings of EVERY operation performed
  - Wrote 1000 words per day on average
- Collected brain specimens to study
Harvey Cushing

- Driven
- Determined
- Attention to detail
- Competitive
Harvey Cushing

“The father of effective neurosurgery.”
“Ineffective neurosurgery had many fathers.”
Michael Bliss
Commissioned in the army
TUMORS OF THE NERVUS ACUSTICUS

One year ago a period of vertigo, headache and fever, diagnosed "meningitis", followed by daily vomiting has persisted. Vertigo... horizontal disturbances on left. Tinnitus is often heard with eyes closed. On examination a number of patients complained of eye movements in various directions. Tinnitus, frequent and disturbing. Right temporal extinction.

Positive neurological findings - (a) General weakness: Marked weakness of the lower extremities, particularly the left side, and of the right arm. (b) Disturbances of vision: The patient complained of a constant decrease in vision, especially in the left eye. (c) Disturbances of hearing: The patient complained of a constant decrease in hearing, especially in the left ear. (d) Disturbances of speech: The patient complained of a constant decrease in speech, especially in the left side. (e) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (f) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (g) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (h) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (i) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (j) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (k) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (l) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (m) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (n) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (o) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (p) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (q) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (r) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (s) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (t) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (u) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (v) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (w) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (x) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (y) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side. (z) Disturbances of swallowing: The patient complained of a constant decrease in swallowing, especially in the left side.

Post-operative and subsequent course - (a) Satisfactory primary wound healing (Fig. 4). No evidence of meningitis, and the patient was discharged on Dec. 3, 1917. (b) However, no abnormal condition was noted when examined on December 31. A return of slight, though definite, symptoms was noted in the left ear, and slight vision disturbance was also noted.

FEB. 22, 1917. Discharge. Considerable advance in loss of memory, speech, and swallowing, and slight improvement in hearing.

FEB. 25, 1917. Discharge. Considerable further improvement in memory, speech, and swallowing, and slight improvement in hearing. A return of slight vision disturbance was noted.

MAR. 5, 1917. Discharge. Further improvement in memory, speech, and swallowing, and slight improvement in hearing. A return of slight vision disturbance was noted.

MAR. 20, 1917. Discharge. Further improvement in memory, speech, and swallowing, and slight improvement in hearing. A return of slight vision disturbance was noted.

FEB. 22, 1917. Discharge. Considerable advance in loss of memory, speech, and swallowing, and slight improvement in hearing. A return of slight vision disturbance was noted.
Harvey Cushing
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Cushing volunteered to head a unit from Harvard to take over a French hospital, called the Ambulance américain for three months. The Harvard unit was preceded and followed by units from other medical schools.
Harvey Cushing

Asked to write a biography of Sir William Osler by his widow. Won a Pulitzer prize in 1926.
Harvey Cushing
Harvey Cushing
Harvey Cushing

Last surgical operation on August 17, 1932
Cushing and Dandy

Jekyll Island, Ga. 1921. Tennis match. “Cushing had form, but Dandy won the game”.
In 1901, Cushing visited Italy with Riva Rocci and brought back a version of his blood pressure “apparatus”
Illumination and Magnification
Harvey Cushing
Walter Dandy

- April 6, 1886–April 19, 1946
- One of the founding fathers of Neurosurgery
- Graduate of Johns Hopkins 1910
- Was the sixth appointee of the Hunterian Laboratory of Experimental Medicine under Harvey Cushing
Walter Dandy

- 1911-1912 was Cushing’s assistant resident
- Joined staff at Johns Hopkins Hospital in 1918
- Published 5 books and 160 peer reviewed articles
Walter Dandy

- Studied and discovered CSF circulation and hydrocephalus
  - Coined communicating and obstructive
- Needed diagnostics other than skull x-rays
- Ventriculogram in 1918
- Pneumoencephalogram in 1919
Walter Dandy

- With Dr. Walker, describe Dandy-Walker cysts/malformation/syndrome
- Established what was considered the first ICU
- Performed 1000 operations per year
Walter Dandy

- Known as "fast & dextrous"
- Reported removing tumors of pineal region in 1921.
- Removal of CP angle tumors in 1922
- Endoscopy for treatment of hydro and ventriculoscopy in 1922
Walter Dandy

- 1925 sectioning trigeminal nerve at the brainstem to treat TN
- 1928 sectioned vestibular nerves to treat Meniere’s disease
- 1929 removal of herniated disc from the spine
- 1933 hemispherectomy to treat malignant tumors
Walter Dandy

- 1933 removal of deep ventricular tumors
- 1938 clipped the first intracranial aneurysm
  - PCoA using hemostatic clip (no microscope!)
- Dandy’s Brain Team
  - Delivered outstanding care
  - Training of surgical residents
Walter Dandy

- Did have a bout of sciatica
- Suffered a second heart attack and died as a patient at Johns Hopkins Hospital at age 60 years.
Wilder Penfield

- Born in Spokane, WA
- January 26, 1891 - April 5, 1976
- Graduated from Princeton 1913 with a degree in literature and was briefly the football coach
- M.D. from Johns Hopkins in 1918
- Obtained Rhodes Scholarship & went to Oxford where he studied neuropathology under Dr. Sherrington (1919-1921)
- Surgical apprenticeship under Harvey Cushing
Wilder Penfield

- In 1919-1921
Wilder Penfield

- Went to NY began epilepsy surgery
- Met David Rockefeller who wanted to provide an endowment for a neurologic institute
- Eventually being the Montreal Neurological Institute in 1934 (due to medical politics in NY)
Wilder Penfield's Achievements

- Researcher utilizing cortical stimulation and published the first organized “homunculus” illustration in 1937
- Recognized auras & then reproduced them in the OR with stimulation for resection
- Ground breaking procedures for epilepsy
Wilder Penfield’s Achievements

- **Penfield’s syndrome**
  - In 1929 Penfield described peculiar attacks characterized by a wide variety of symptoms and manifestations that he designated as "diencephalic autonomic epilepsy." Signs and symptoms consisted of prodromal restlessness, sudden vasodilatation of skin in area supplied by the cervical sympathetic nerves, sudden rise in blood pressure, lacrimation, diaphoresis, salivation, dilatation or contraction of pupil, sometimes protrusion of eyes, increased rate and pressure of pulse, marked retardation of respiratory rate, elicitability of pilomotor reflex, and rarely loss of consciousness.

- **Caused by hypothalamic tumors**
Wilder Penfield’s Achievements

- Montreal Procedure
- Penfield dissector
- After retirement he dedicated himself to public service
  - Promoted education in the home
  - Early second language learning
Wilder Penfield’s Achievements

- Wrote historical novels & medical biographies
- Authored:
  - “The Mystery of the Mind”
  - No Man Alone: A Surgeon’s Story (1977)
Mahmut Gazi Yasargil

- July 6 – present
- Born in Turkey where he went to college
- Graduate of Univ. of Basle, Switzerland
- Residency at University of Zurich
- Considered the father of MODERN neurosurgery and MICRONEUROSURGERY
Gazi Yasargil

- Genius in developing microsurgical techniques for use in cerebrovascular surgery which included instrument design
  - Transformed outcomes of patients whose conditions had been considered inoperable.
Gazi Yasargil

During his 20 years of practice in Zurich:
- Operated on over 7500 patients with intracranial pathology
- Carried out clinical research & laboratory work that advanced microsurgical techniques
- Mentored & trained over 3000 neurosurgeons spanning 3 generations
Also educated surgeons in his lab & operating room from all over the world... even Tucson, Arizona

Famous neurosurgeons that visited Dr. Yasargil
Gazi Yasargil

- Together with Cushing, is hailed as one of the greatest neurosurgeons of the twentieth century
- Demonstrated what is possible in neurosurgery & how to achieve it
- Named Neurosurgeon of the Century 1950-1999
- Publications include 330 papers, 13 monographs, & 6 volume publication “Microneurosurgery”
Gazi Yasargil

- 1994 accepted appt as Professor of Neurosurgery at University of Arkansas for Medical Sciences in Little Rock
- At 87 still teaches, works in the lab, and performs surgery (need referral for appt!)
- Married OR Nurse supervisor Dianne who still works with him