Treating Cardiac Malformations: Origins of the Medical-Surgical Bond

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Cardiac Malformations

- Anatomic abnormality
- Treatment requires anatomic repair
- 1/100 live births, 50% of which will need a procedure
Steps to an Effective Anatomic Repair

- Skill to image the problem - direct or by some other means
- Skill to understand the anatomy and physiology
- Skill to perform a procedure to correct the problem
Physician vs Surgeon
Art of
“Practicing the Art”

The Doctor by Fildes 1891
Tate Gallery London

17th Century Print
British Museum
Medical-Surgical Models

- Traditional: medical doctor $\Rightarrow$ surgical doctor
  - Surgical doctor establishes anatomic diagnosis by visual inspection or by other means before or during surgery
- Congenital heart disease: medical doctor $\Leftrightarrow$ surgical doctor
  - Interdependence necessary to image heart’s internal and external anatomy and by consensus decide which procedure and when
  - This talk attempts to outline the history of this interdependence
Congenital Heart Disease Treatment Before 1938

William Osler 1892

“Nothing can be done to remedy the defect or even to relieve the symptoms.”

Paul Dudley White 1937
(Charter Member AOS)

“There is no curative treatment, surgical or medical, for congenital cardiac defects.”
John Cummings Munro 1907
Boston surgeon

“After death...examination showed an open ductus arteriosus lying easily within reach behind the sternum...it would be possible to ligate the duct provided a diagnosis could be made beforehand.... I would urge those skilled in diagnosis on infantile lesions to lend their aid.”

*Annals of Surgery 1907*
IMAGING
Imaging

- External or invasive
  - Visible body part, surgically exposed, or by autopsy

- Internal-noninvasive
  - “View” internal organs without surgery or autopsy
Invasive Imaging of the Heart
Illustration 16 - 18th Centuries

Vesalius 1543
Lower 1669
Senac 1749
Invasive Imaging of the Heart
Illustration 19th Century

Symington Topographical Anatomy of the Child 1887

Bock Atlas 1880
Noninvasive Imaging: Auscultation
Laënnec 1819 “A Better Eye” Jacalyn Duffin
Noninvasive Imaging: X-Rays
Röntgen December 1895
X-Rays: Imaging Game Changer

“It is some time since a scientific discovery of real importance has excited so much interest and popular attention as Roentgen's recent work on certain hitherto unknown rays of light has done.”

British Medical Journal Feb 1896
Noninvasive Imaging of the Heart: Chest X-Ray

- Béclère 1897
Coeur en Sabot
Medical-Surgical Collaboration
Isolated Successes of Early Teams

Manual or instrumented dilations

- Theodore Tuffier & Alexis Carrel (aortic valve) - Paris 1912
- Elliot Cutler & Samuel Levine (mitral valve) - Boston 1923
- Henry Souttar & Otto Leyton (mitral valve) - London 1925
- Subsequent procedures had mixed results and few done: no medical-surgical revolution
2 Pioneering Teams for Congenital Heart Disease

Medical-surgical revolution

- 1st team - successful ligation of a patent ductus arteriosus
  - Boston Children’s Hospital in the late 1930s: John Hubbard & Robert Gross

- 2nd team - palliative procedure for tetralogy of Fallot
  - Harriet Lane Home at Johns Hopkins in the early 1940s: Helen Taussig, Vivien Thomas, & Alfred Blalock
Patent ductus arteriosus

Tetralogy of Fallot
1st Team: BCH

John P. Hubbard  
(1903-1990)

Robert E. Gross  
(1905-1988)
Short Biography

- John P. Hubbard
  - Born in Philadelphia
  - Harvard MS 1931
  - BCH 1937 Cardiac clinic with Paul Emerson & Hyman Green
  - After WW II US Public Health Service
  - 1950-1966 George S Pepper Professor of Public Health and Preventive Medicine and Chair Department at U Penn SOM then Emeritus
  - 1950-1974 CEO National Board of Medical Examiners
  - 1952-1964 Board of Health of the City of Philadelphia
  - 1974 President of the College of Physicians of Philadelphia (2 terms)
  - Published around 20 articles on heart disease in children

Short Biography

- Robert Gross
  - Born in Baltimore
  - Harvard MS 1931 (inspired by Cushing’s biography of Osler)
  - Medical school rotation with William Ladd
  - 1933 trained with Elliot Cutler
  - 1938 Chief Resident under William Ladd BCH
  - Remained at BCH through WW II
John Hubbard & Colleagues

- Hubbard and his colleagues were students of Maude Abbott

- Maude Abbott’s diary entry for May 18, 1933
  - She reviewed cases at Boston Children’s Hospital with Paul Emerson

- In Hubbard’s 1939 New England Journal article
  - “From a study of the statistical data compiled and recently published by Abbott, it appears that patency of the ductus arteriosus as a single defect may be less rare than it was formerly thought to be. Furthermore, an increasing appreciation of the complications arising at an early age prompted one of us (J.P.H.) to inquire anew into the possibilities of correcting this defect.”
“Sir William Osler, whose keen interest in my work and broad human sympathy pierced the veil of my youthful shyness with a personal stimulus that aroused my intellect to its most passionate endeavor.”
1936 Atlas Statistics: ~1,000 Cases

- ASD 40 isolated 250 with other defects = 290
- VSD 50 isolated 207 with other defects = 257
- **PDA** 92 isolated 150 with other defects = 242
Hubbard-Gross

- Lack of primary source material (Gross threw out all papers), any suggestions for Hubbard?
- Hubbard approached Gross (? medical schoolmates, Gross trained with Elliot Cutler, other factors)
- Worked out surgical approach in the animal laboratory
- Approved by Paul Dudley White
- Performed when William Ladd was away
1st Successful PDA Ligation

Photo by Harvard cardiologist Edward Bland on August 26, 1938
Medical-Surgical Bond

• Elliot Cutler @ American Surgical Association May 1939
  “This work might not have been accomplished, unless in the pediatric service of the Children’s Hospital in Boston had there not been competent, wide-awake and courageous young pediatricians, because the surgeon alone, when he enters such a field, must have compatriots to help him.”
2nd Team: Johns Hopkins

Short Biographies

- Alfred Blalock
  - Culloden, GA
  - Johns Hopkins Medical School 1922
  - General surgery residency Vanderbilt in Nashville and full professor by 1938
  - Chief of Surgery JH 1941

- Vivien Thomas
  - New Iberia, LA
  - Moved to Nashville after Stock Market crash 1929
  - Wanted to go to MS
  - Blalock hired in Nashville as animal laboratory tech then to Johns Hopkins

- Helen Taussig (later a Fellow College of Physicians of Philadelphia)
  - Boston, MA
  - Harvard rejected
  - Johns Hopkins MS 1928, residency 1930
  - Pediatric cardiac clinic 1930, developed artificial ductus theory
  - Directly influenced by Maude Abbott
The Artificial Ductus Arteriosus

- Taussig originated the concept for tetralogy of Fallot-Rejected by Robert Gross

- Blalock agreed with concept and proceeded with animal experiments ~ 1943

- Thomas conducted the experiments and innovated necessary techniques and equipment

- First patient operated on November 29, 1944
Ductus Arteriosus
Systemic Artery-to-Pulmonary Artery Shunt
“Artificial ductus creation” or shunt surgery order of magnitude > PDA ligation

Shunt improved cyanosis but also caused cardiac overload if it was too large

Taussig provided ongoing feedback to Blalock to adjust surgical technique

Correspondence documented collaboration
Baltimore-5, Maryland

Cotuit
Massachusetts

July 30, 1945

Dr. Alfred Blalock
Johns Hopkins Hospital
Baltimore 5, Maryland

Dear Dr. Blalock:

I trust you will forgive my telling you what is in the back of my mind in regard to [redacted]. His heart is a little larger and his action a little more tumultuous than the other patients upon whom you have operated. For this reason, I am hesitating upon the safety of an innominate anastomosis, especially because [redacted] heart had enlarged so much. I am sure his heart would not maintain compensation with a proportionate increase in size. Therefore, I think that if the subclavian is a fair sized vessel, and I am quite sure his should be, it would be safer to do a subclavian anastomosis, even though it might be necessary to do a second operation in subsequent years.

It is lovely and cool here and little Frank Opie reports the fishing excellent. He caught seventeen butter-fish one morning, which is a pretty good record for a nine year-old.

Always cordially yours,

[Signature]
Taussig Letter 7-30-1945

- Blowup

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Blalock-Taussig Shunt (Operation)

- November 1945 - Blalock’s Harvey Lecture NYAM

  “Following the original suggestion of Dr. Taussig.... I undertook studies on experimental animals.... [following animal experiments] Dr. Taussig and I decided to attempt the operation. The selection of patients has been performed by Dr. Taussig and her associates.”

- April 1946 - Claude S. Beck (Cleveland) first used the term “Blalock-Taussig operation”

- Should have been Blalock-Taussig-Thomas operation

- But eponym does memorialize the medical-surgical bond
Medical-Surgical Bond: Necessary ... but sometimes...
Medical-Surgical Bond: Necessary ... but sometimes awkward?
Thank You!

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