Surgery for Congenital Heart Defects; science or art?

M artin E lliott
37th Gresham Professor of Physic
Professor of Cardiothoracic Surgery at UCL
Consultant Paediatric Cardiothoracic Surgeon
&
co-Medical Director
The Great Ormond Street Hospital for Children
remember the last time?
remember the last time?
today, I am going to talk about innovators
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“There is nothing more difficult to take in hand, more perilous to conduct, nor uncertain in its success, than to take the lead in the introduction of a new order of things.

For the innovator has for enemies all of those who have done well under the old, and lukewarm defenders in all of those who may do well under the new.”

Niccolò Macchiavelli (1469–1527)
‘Ein Chirurg, der versuchte, eine Wunde des Herzens zu nähen, verlöre die Achtung seiner Kollegen.’

‘Eine Operation, die nach meiner Auffassung erreicht, was einige Chirurgen Prostitution der chirurgischen Kunst, andere eine chirurgische Frivolität nennen’

http://www.aerzteblatt.de/archiv/54013/Medizingeschichte-Herznaht-wider-ethische-Bedenken
A surgeon who tries to suture a heart wound deserves to lose the esteem of his colleagues.

Performing an operation to the heart is tantamount to an act of prostitution in surgery or surgical frivolity.

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In addition to his work as a doctor, he was Professor of Physic at Gresham College and lectured there for many years. Although some of his ideas seem bizarre now, he was accepting of the scientific discoveries of his lifetime, but sought to reconcile them with his deeply held religious beliefs. He expressed this through membership of the Guild of Saint Luke, an organisation founded by some surgeons in 1868. At its height it held annual services in St. Paul’s Cathedral or Westminster Abbey attended by large numbers of the medical profession.*

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“**The time may possibly come when wounds of the heart itself will be treated by pericardial incision to allow extraction of clots and perhaps to suture the cardiac muscle.**”
1937

Vincent Sutherland Hodson
John Streider
(Boston)

1937

Vincent Sutherland Hodson
Robert Gross
(Boston)

1937 1938

Vincent
Sutherland
Hodson
Robert Gross
(Boston)

1937 1938

Vincent Sutherland
Hodson

Lorraine Sweeney & Gross 1963
1937 1938

Vincent Sutherland Hodson
Vincent Sutherland Hodson

Tobacco Garbling Knife

1937

Robert Gross (Boston)
Robert Gross
(Boston)

1937 1938

Vincent
Sutherland
Hodson
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During World War II, military doctors, facing injury and suffering on a massive scale, pioneered advances in antibiotics, anesthesia, and blood transfusions—advances that would usher in the age of modern surgery.
In 1948 he was promoted to Chief of the Surgical Department of the UCLA and from then on made his outstanding reputation as a general gastro-intestinal surgeon, but remained naturally interested in problems of cardiac surgery. His coronary endarterectomies of 1958 remain a milestone on the road to modern cardiac surgery. Before coronary angiography (1962 Sones) he performed five operations of extensive coronary endarterectomies based only on palpation, without cardiopulmonary bypass and on the beating heart. As any contemporary cardiac surgeon can understand those were daring and difficult operations. Four of five patients survived and were improved.

Coming back to Blalock who, besides having trained and inspired a whole generation of leaders—Cooley among others, had a remarkable vision and open mind concerning the future of cardiovascular surgery. Therefore, obviously thinking of Blalock, his mentor, Longmire in his 1956 Presidential Address at the American Surgical Association meeting said: "Fortunate are those who have the proper combination of enthusiasm, critical judgment and also an OPEN MIND". In 1955, when Lillehei and Varco had presented their controversial paper on 'cross-circulation' at the American Surgical Association, it was Blalock, the uncontested authority, who opened the discussion in a highly positive manner: "I must say that I never thought I would live to see the day when this type of operative procedure could be performed. I want to commend Drs Lillehei and Varco for their imagination, their courage and industry". So much for the, I might say, giant of modern surgery, Alfred Blalock.

3.3. Patent ductus arteriosus and coarctation

Six years before Blalock the patent ductus operation never had the same impact on cardiac surgery. Looking at an anatomical drawing of the heart the 'ligamentum arteriosum' or, for that matter, an open patent ductus seemed to be an easy structure to ligate. In fact, today an operation for patent ductus is probably an operation for beginners. Even in my time, when from 1947 (my first case) on I closed them with multiple ligatures, in primitive operating rooms of small private hospitals, I usually succeeded with no trouble. As everybody knows, the operation may turn into a drama when, during dissection, the surgeon tears the vessel. I vividly remember the time once this happened to me, when assisted by Professor Jean-Claude Rudler, the chief of the Geneva Hospital where I had been associate cardiac surgeon since 1960, I tore into the posterior wall of the duct. Fortunately, between the two of us, we got the situation under control and cured the patient. I am not ashamed of this incident because it happened to much greater surgeons than myself.

Clarence Crafoord (Fig. 8), a monument in cardiothoracic surgery and teacher of other world famous heart surgeons—Ake Senning and Bjork among others—had to manage a hemorrhage during a ductus operation by cross-clamping the aorta. He had studied the problem of cross-clamping the aorta in the laboratory since 1935 and this...
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Helen Taussig

Dr. Alfred Blalock
Vivien Thomas

PHOTOS BY BY THE ALAN MASON CHESNEY MEDICAL ARCHIVES OF THE JOHNS HOPKINS MEDICAL INSTITUTIONS

1941 1944
Helen Taussig

1941  1944

Images and Movie courtesy of Prof Luca Vricella, Johns Hopkins, Baltimore
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Eileen Saxon, age 15m
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“.. On evening rounds, we arrived at the crib of this fifteen-month old baby...
I was immediately astounded by the deep cyanotic appearance of the child, much more cyanotic than any patient I had ever seen before: the lips were a deep, dark blue .. The face was suffused with dilated veins, the conjunctiva almost purple.”
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Bill Longmire

“At operation we lacked all the modern vascular instruments and really had very little but the professor’s determination to carry us through the procedure. With the extremely thin wall of an extremely small pulmonary artery I marveled at Dr Blalock’s determination in completing this first anastomosis, certainly the most difficult I have ever seen.”
Eileen Saxon became blue again in a few months.

She died shortly after having a Blalock-Taussig shunt on the opposite side.
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http://www.medicalarchives.jhmi.edu/tausbio.htm
getting into the heart safely

air, time, movement
getting into the heart safely

air, time, movement
At the start of the 20th century, 15% of all infants in England and Wales died in the first year of life. Newman's classic work *Infant mortality*, published in 1906, identified the causes of these deaths, the significance of the period immediately after birth, the social problems underlying mortality, and possible methods of prevention. Later, as chief medical officer to the Board of Education (1907–1935) and to the Ministry of Health (1919–1935), he achieved many important and wide ranging improvements to the health of infants and children.

George Newman (fig 1) was born in Leominster, Herefordshire, on 23 October 1870. His father, Henry Stanley Newman, was a minister of the Society of Friends who had made several missionary journeys to India. He was also editor of the *Quaker journal* Friend. His mother was Mary Anne Pumphrey. They had six children, three boys and three girls. George was the fourth child and the second son. He received his education at Sidcut School in Gloucestershire (1881–1885) and then at the Quaker school Bootham in York (1885–1887). He grew up an optimistic and idealistic boy with a love of natural history, a desire to seek out the cause of problems, and with a devout Christian faith. At first he wished to be a missionary in India, but then decided to become a doctor. In 1887 at the age of 17 he began to study medicine first at Edinburgh University and afterwards at King's College, London, graduating in 1892. While in Edinburgh he gained firsthand experience of the city slums and even established a dispensary in the Cowgate. Three years after qualification, Newman gained the MD (Edin) with gold medal, and, having won a Gunning scholarship in public health, then acquired the DPH (Cantab, 1895). In 1896 he became a demonstrator in bacteriology and lecturer in infectious diseases at King's College, a post he held until 1900. During that time he published his first book *Bacteria, especially as they are related to the economy of nature, to industrial processes and to public health*. Next Newman took on the post of Medical Officer to the urban borough of Finsbury together with the mainly rural county of Bedfordshire (1900–1907). The results and conclusions gained from this experience were published in 1906, using infant mortality as an indicator of underlying social problems. *Infant mortality: a social problem* (fig 2) remains a classic. Newman began by pointing out that infant mortality had not fallen over the previous 50 years:

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''The young of all animals are more susceptible than the adult to the influence of environment and the approach of death. Hence, it is inevitable that, even under the most favourable circumstances, the deaths of infants will furnish a large contribution to the bills of mortality. As civilisation advances, however, this should become less. That it does not, in fact, become substantially less is surely a matter calling for consideration, for at the present time there is an annual loss to England and Wales of 120,000 lives by the death of infants … A high death rate of infants is an indication of the existence of evil conditions in the homes of people … Poverty is not alone responsible, for in many poor communities the infant mortality is low. Housing and external environments alone do not cause it, for under some of the worst conditions in the world the evil is absent. It is difficult to escape the conclusion that this loss
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Sir George Newman, MD (1870–1948) and the prevention of perinatal disease

P M Dunn


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''The young of all animals are more susceptible than the adult to the influence of environment and the approach of death. Hence, it is inevitable that, even under the most favourable circumstances, the deaths of infants will furnish a large contribution to the bills of mortality. As civilisation advances, however, this should become less. That it does not, in fact, become substantially less is surely a matter calling for consideration, for at the present time there is an annual loss to England and Wales of 120,000 lives by the death of infants … A high death rate of infants is an indication of the existence of evil conditions in the homes of people … Poverty is not alone responsible, for in many poor communities the infant mortality is low. Housing and external environments alone do not cause it, for under some of the worst conditions in the world the evil is absent. It is difficult to escape the conclusion that this loss
PERINATAL LESSONS FROM THE PAST

Sir George Newman, MD (1870–1948) and the prevention of perinatal disease

P M Dunn

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“He (Gibbon) blasted open the door that had been locked for centuries against any medical therapeutic intrusion into the cardiovascular field”.

Michael DeBakey
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"One night I awoke with a simple solution to the problem, and one that did not require pumps and tubes -- cool the whole body, reduce the oxygen requirements, interrupt the circulation, and open the heart."
At the start of the 20th century, 15% of all infants in England and Wales died in the first year of life. Newman's classic work, published in 1906, using industrial processes and to public health as they are related to the economy of nature, to communities the infant mortality, and possible methods of prevention. Later, as Sir George Newman, MD (1870–1948) and the prevention of infant mortality, and possible methods of prevention. Upon his appointment as Professor Dunn, MCh, FRCS, Professor of Surgery at the University of Liverpool, to the health of infants and children.}

## Groundhog Days

- **1931**: Sir George Newman
- **1945**: Wilfred Bigelow (Toronto)
- **1947**: John Lewis and Richard Varco (Minnesota)
- **1950**: John Leonard D'Silva

Groundhog Days is a term used to refer to the period of hibernation in groundhogs. The groundhogs were able to withstand hypothermia, and the team working on the project discovered that the animals were able to lower their body temperature and metabolic rate to levels that would be considered fatal in other species. The research on hibernation in groundhogs has been crucial in understanding how animals can survive extreme environmental conditions without intervention.
At the start of the 20th century, 15% of all infants in the United Kingdom died before reaching the age of one. This high rate of infant mortality, and possible methods of prevention. Later, as Chief Medical Officer to the Board of Education (1907–1910), Sir George Newman, MD (1870–1948) and the prevention of perinatal disease became a social problem. Newman began by pointing out that infant mortality had not fallen over the previous 50 years:

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\frac{\text{Infant mortality}}{\text{number of deliveries}} = \text{constant}
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... over the previous 50 years. Later... that this loss is a constant... of the loss of children... that this is a constant... the conclusion that this loss is a constant... and that infant mortality... the conclusion that... they do not cause it... under some of the worst conditions... Housing and external environments alone... Poverty and overcrowding... are an indication of the existence of evil...婴儿死亡率... 一个儿童的死亡... 他们没有... 他们没有... 他们... 他们... 他们没有... 恶...的... 来... 来... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 他们... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... 看... ...
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*Infant mortality: a social problem* (fig 2) remains a classic. Newman began by pointing out that infant mortality had not fallen over the previous 50 years: "The young of all animals are more susceptible than the adult to the influence of environment and the approach of death. Hence, it is inevitable that, even under the most favourable circumstances, the deaths of infants will furnish a large contribution to the bills of mortality. As civilisation advances, however, this should become less. That it does not, in fact, become substantially less is surely a matter calling for consideration, for at the present time there is an annual loss to England and Wales of 120,000 lives by the death of infants … A high death rate of infants is an indication of the existence of evil conditions in the homes of people … Poverty is not alone responsible, for in many poor communities the infant mortality is low. Housing and external environments alone do not cause it, for under some of the worst conditions in the world the evil is absent. It is difficult to escape the conclusion that this loss …

Illustration of the atrial well method to close ASD as described by Robert Gross in 1952.
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Accepted 9 July 2004

**Figure 1**

George Newman (1870–1948).
Sir George Newman, MD (1870–1948) and the prevention of perinatal disease

P M Dunn

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Arch Dis Child Fetal Neonatal Ed

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''The young of all animals are more susceptible than the adult to the influence of environment and the approach of death. Hence, it is inevitable that, even under the most favourable circumstances, the deaths of infants will furnish a large contribution to the bills of mortality. As civilisation advances, however, this should become less. That it does not, in fact, become substantially less is surely a matter calling for consideration, for at the present time there is an annual loss to England and Wales of 120,000 lives by the death of infants … A high death rate of infants is an indication of the existence of evil conditions in the homes of people … Poverty is not alone responsible, for in many poor communities the infant mortality is low. Housing and external environments alone do not cause it, for under some of the worst conditions in the world the evil is absent. It is difficult to escape the conclusion that this loss …''

Figure 1
Sir George Newman (1870–1948) was a medical officer in the UK who contributed significantly to the reduction of infant mortality. His work focused on understanding the causes of infant deaths and developing methods to prevent them. Newman's approach emphasized the importance of social conditions and their impact on mortality rates.

At the start of the 20th century, 15% of all infants in England and Wales died in the first year of life. Newman's classic work, "Infant Mortality: A Social Problem," published in 1906, identified bacteria, especially tuberculosis, as significant causes of infant mortality. This research was a result of his experience working in the city slums of Finsbury, where he established a dispensary.

Newman's work was not limited to the UK; he also contributed to the Ministry of Education (1907–1935) and the Board of Education (1907–1919). His efforts and the results gained from his research led to many important and wide-ranging improvements in public health. Newman's contribution to the study of infant mortality highlights the importance of understanding the social and environmental factors that affect health outcomes.
At the start of the 20th century, 15% of all infants in England and Wales died in the first year of life. Newman's classic work, published in 1906, identified the causes of these deaths, the significance of the period immediately after birth, the social problems underlying mortality, and possible methods of prevention. Later, as chief medical officer to the Board of Education (1907–1935) and to the Ministry of Health (1919–1935), he achieved many important and wide ranging improvements as they are related to the economy of nature, to industrial processes and to public health conditions in the world the evil is absent. It is not alone responsible, for in many poor communities the infant mortality is an indication of the existence of evil. A high death rate of infants will furnish a large contribution to the bills of mortality. As civilisation advances, poverty is not alone responsible, for in many poor conditions in the homes of people … Poverty does not, in fact, become substantially less is however, this should become less. That it surely a matter calling for consideration, for the urban borough of Finsbury together with the city slums and even established a dispensary to the health of infants and children.
Sir George Newman (1870–1948). His mother was Mary. Infant mortality is low. Newman's classic work (fig 1) remains a classic. Newman began by identifying the causes of these deaths, the significance of the period immediately after birth, the social problems underlying mortality, and possible methods of prevention. Later, as chief medical officer to the Board of Education (1907–1935) and to the Ministry of Health (1919–1935), he achieved many important and wide ranging improvements to the health of infants and children. The results and conclusions gained from this experience were published in 1906, using Bacteria, especially Friend

...
PERINATAL LESSONS FROM THE PAST

Sir George Newman, MD (1870–1948) and the prevention of perinatal disease

P M Dunn

Arch Dis Child Fetal Neonatal Ed


At the start of the 20th century, 15% of all infants in England and Wales died in the first year of life. Newman's classic work on infant mortality, published in 1906, identified the causes of these deaths, the significance of the period immediately after birth, the social problems underlying mortality, and possible methods of prevention. Later, as chief medical officer to the Board of Education (1907–1935) and to the Ministry of Health (1919–1935), he achieved many important and wide ranging improvements to the health of infants and children.

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Figure 1

George Newman (1870–1948).

3

Infant mortality: a social problem

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Figure 2


John & Mary Gibbon (Boston)
C Walt Lillehei
The Father of Open-Heart Surgery
“The King of Hearts”
"When going into the wilderness, do not expect to find a paved road"
- C. Walt Lillehei
"When going into the wilderness, do not expect to find a paved road"
- C. Walt Lillehei
"When going into the wilderness, do not expect to find a paved road”
- C. Walt Lillehei
"When going into the wilderness, do not expect to find a paved road”
- C. Walt Lillehei

“An operation that could have a 200% mortality.”
- Unknown critic
cross circulation was LOUD
cross circulation was LOUD
Cross-Circulation
Cross-Circulation

First VSD closure
March 26, 1954

First AVSD closure
August 6, 1954

First Tetralogy of Fallot repair
August 31, 1954

45 operations

28 survivors
Cross-Circulation

First VSD closure
March 26, 1954

First AVSD closure
August 6, 1954

First Tetralogy of Fallot repair
August 31, 1954

45 operations

28 survivors

62% survival cross-circulation vs.
6% survival CPB
C Walt Lillehei

Brash  Charismatic  Driven  Maverick
C Walt Lillehei

- X-circulation
- first operations CHD
- first pacemakers
- mechanical heart valves
- drove research into transplantation
- trained 150 world-leading surgeons
- Med Director of St Jude Inc
- Bravery medal in WW2 (Italy)

Brash Charismatic Driven Maverick
John W Kirklin

Calm      Clear-Thinking      Legendary Hard Worker       Academic
John W Kirklin

- took CPB to next stage
- obsessional and scientific
- wrote ‘definitive’ text book
- outcome-driven
- academic leader
- role model for modern surgery

Calm      Clear-Thinking      Legendary Hard Worker      Academic
John W. Kirklin (1917-2004) and colleagues at the Mayo Clinic launched their open heart program on March 5, 1955. They used a heart-lung machine based on the Gibbon-IBM machine.
De Wall - Lillehei Bubble oxygenator

simple in concept
mass producable

brought open-heart surgery to the world
Denis Melrose

Stop the Heart Moving!
Stop the Heart Moving!

to stop, replace the blood flowing through the coronary arteries with cold, potassium-containing fluid
Stop the Heart Moving!

to stop, replace the blood flowing through the coronary arteries with cold, potassium-containing fluid

to restart, flush out the cold fluid with warm blood
All the Ingredients were now Prepared
All the Ingredients were now Prepared

the underlying need was clear
All the Ingredients were now Prepared

the underlying need was clear

the heart could be bypassed
All the Ingredients were now Prepared

the underlying need was clear

the heart could be bypassed

the heart be stopped, and restarted
All the Ingredients were now Prepared

the underlying need was clear

the heart could be bypassed

the heart be stopped, and restarted

people were being trained
All the Ingredients were now Prepared

the underlying need was clear

the heart could be bypassed

the heart be stopped, and restarted

people were being trained

all that was needed was the correct operations
what did it take for these pioneers to do the first operations on people like these?
Just imagine it was you....you *must*
Just imagine it was you....you must understand what is wrong, and in 3-D
Just imagine it was you....you must understand what is wrong, and in 3-D know what to do, and have a back-up plan.
Just imagine it was you....you *must*

understand what is wrong, and in 3-D

know what to do, and have a back-up plan

explain, orchestrate & lead
Just imagine it was you....you *must*

understand what is wrong, and in 3-D

know what to do, and have a back-up plan

explain, orchestrate & lead

have confidence to make the first cut
Just imagine it was you….you *must*

understand what is wrong, and in 3-D

know what to do, and have a back-up plan

explain, orchestrate & lead

have confidence to make the first cut

have technical skill, and speed
Eponymous Operations
Eponymous Operations

making a name for yourself
abnormal connections

superior vena cava

inferior vena cava

right atrium

left atrium

right ventricle

left ventricle

aorta

pulmonary veins

pulmonary artery

transposition of the great arteries (TGA)
superior vena cava
inferior vena cava
right atrium
left atrium
right ventricle
left ventricle
pulmonary veins
aorta
pulmonary artery
abnormal connections
transposition of the great arteries (TGA)
abnormal connections

superior vena cava
inferior vena cava
right atrium
left atrium
right ventricle
left ventricle
pulmonary veins
pulmonary artery

transposition of the great arteries (TGA)

aorta
1931
Sir George Newman

1947
Hamilton Hartridge

1952
William Mustard (Toronto)

1955
John Leonard d'Silva
1931
Sir George Newman

1947
Hamilton Hartridge

1952
William Mustard (Toronto)

1955
John Leonard d’Silva

(toronto)
using a monkey lung as oxygenator
Arterial Switch Operation (ASO) was first undertaken successfully by Jatene in 1975. It is used when the great arteries are connected to the reverse ventricles (i.e., discordant arterial connection). It is most commonly performed in simple transposition but is also used in patients with complex heart problems.

The first diagram shows the aorta (Ao) lying anterior to the pulmonary artery. The great vessels are divided above the coronary origins. The coronary arteries are then removed on a button of tissue from the original aorta and stitched in place on the original PA (second diagram). Finally, the PA is moved anterior to the aorta and both great vessels are sewn into place the correct way around.

It is the movement of the coronary arteries that is the critical part of the operation. If they are left in their original position, they will receive venous blood. They therefore have to be moved backwards so that they come from the aorta and have oxygenated blood.

The switch operation has to be undertaken within the first month of life otherwise the LV which is emptying into the low resistance pulmonary circuit atrophies and cannot manage to support the systemic circulation after the switch procedure. The mortality for this procedure in most centres is now considerably less than 5% with an excellent long term prognosis.
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The switch operation has to be undertaken within the first month of life otherwise the LV which is emptying into the low resistance pulmonary circuit atrophies and cannot manage to support the systemic circulation after the switch procedure. The mortality for this procedure in most centres is now considerably less than 5% with an excellent long term prognosis.
William Mustard (Toronto)

7 cases in a year

ALL died within a few hours

Bailey (1953), Senning (1954) same result
Senning procedure, Stockholm, 1957

Ake Senning
1915-2000
BRADY AND HINDLEY GO TO JAIL FOR LIFE

“Calculatred, cruel murders,” says judge

Watery beer upsets an MP

1966
BRADY AND HINDLEY GO TO JAIL FOR LIFE
William Rashkind (Philadelphia)
William Rashkind (Philadelphia)

Balloon Atrial Septostomy (Rashkind Procedure)

- Balloon-lipped catheter is inserted through the atrial septal defect (ASD).
- Transposition of Great Arteries
- Once the balloon is inflated, the catheter is pulled back through to widen the ASD.
- An opening in the septum allows oxygen rich and oxygen poor blood to mix to improve circulation.

http://users.skynet.be/bbnrc/hartafw/Rashkind.jpg

1966
“It’s not the science, it’s the jerk on the end of the catheter that matters”

William Rashkind (Philadelphia)

1966

http://users.skynet.be/bbnc/harlafw/Rashkind.jpg
Prostaglandin E1
By the mid-1980’s
Senning > Mustard
Mortality < 5%
By the mid-1980’s
Senning > Mustard

Mortality < 5%

BUT
By the mid-1980’s
Senning > Mustard
Mortality < 5%

Pre-op (delay) BUT Late (RV)
Switching the Outlets; the Arterial Switch
1982

THE TIMES

UK trade plunges into deficit

Fleet assembles for Falklands action

Galtieri pledges 'no disruption'

High Court refuses

Largest oil platform in North Sea accident

Call for more playgroups

emmarna 4

982
Adib Jatene
(Sao Paolo)
Adib Jatene
(Sao Paolo)

Yacoub, Planché, Casteneda, Mee, de Leval, Brawn and others
Adib Jatene
(Sao Paolo)

> 30%
Yacoub, Planché, Casteneda, Mee, de Leval, Brawn and others
Adib Jatene
(Sao Paolo)

> 30% Yacoub, Planché, Casteneda, Mee, de Leval, Brawn and others

> 2%
missing or small components

univentricular heart
absent right ventricle

superior vena cava
inferior vena cava
right atrium
left atrium
pulmonary veins
pulmonary artery
aorta
missing or small components

univentricular heart
absent right ventricle

superior vena cava
inferior vena cava
right atrium
left atrium
pulmonary veins
pulmonary artery
aorta
William Glenn
(Yale)

http://www.averybiomedical.com/images/williamGlenn.gif

1957
William Glenn
(Yale)

http://www.averybiomedical.com/images/williamGlenn.gif

1957
Los Angeles, Wednesday, 12:15 am

Robert Kennedy lies with a bullet in his head—and a supporter cries...

GOD! NOT AGAIN!

Daily Mirror

Dr. King Fatally Shot by Assassin in Memphis

U.S. Shocked, Saddened by Slaying, Johnson Says

Anguish Voiced by U.S. Leaders

Dr. Martin Luther King

King: Been to Mountaintop—No Matter What Happens

Negroes Smash Auto Windows

1968
GOD! NOT AGAIN!

LOUISIANA, WEDNESDAY, 12:15 am
Robert Kennedy lies with a bullet in his head—and a supporter cries...

DR. KING FATALY SHOT BY ASSASSIN IN MEMPHIS

U.S. Shocked, Saddened by Slaying, Johnson Says
ANGST FORCED BY U.S. LEADERS

DR. MARTIN LUTHER KING
R.I.P. Civil Rights Hero, 1929-1968

An epic drama of adventure and exploration

JIMI HENDRIX EXPERIENCE
SUNDAY, MARCH 31
8 P.M.
ARENA
46th and MARKET STS.
also SOFT MACHINE
and WOODY'S TRUCK STOP

Admission $3.00-$4.00
$5.00

2001: A Space Odyssey

An epic drama of adventure and exploration
Francis Fontan
(Bordeaux)
Francis Fontan
(Bordeaux)

He was trusted to do this by his boss, Broustet, despite it never having been done before.
Francis Fontan (Bordeaux)

He was trusted to do this by his boss, Broustet, despite it never having been done before.
Bill Norwood
(Boston & Philadelphia)
Bill Norwood
(Boston & Philadelphia)
Bill Norwood (Boston & Philadelphia)

untreated, all neonates with HLHS will die in < 4 weeks
Bill Norwood (Boston & Philadelphia)

untreated, all neonates with HLHS will die in < 4 weeks
Symbiosis?
mortality of surgery for congenital heart disease
mortality of surgery for congenital heart disease

EVERYTHING has got better
mortality of surgery for congenital heart disease

![Graph showing mortality (%)](image)
mortality of surgery for congenital heart disease

Risk

Mortality (%)

Year

mortality of surgery for congenital heart disease
Back in Norwood's Boston days, there were still big problems left to solve. It's different now. Today, most heart-defect operations have very good results. “Now, it's a matter of refining the technique … rather than enormous leaps forward. The mavericks like Norwood have gone by the wayside. The field is full of fastidious surgeons who have had to become expert at managing risk.”

Jim Tweddell, Milwaukee
efficient, gentle, graceful
efficient, gentle, graceful
& the best cardiologists

Science

Art

Craft
Thank you to all my colleagues, and especially Michiel Vriesendorp
“I was born with half a heart, not half a life.”

Thank you to all my colleagues, and especially Michiel Vriesendorp
Could we do now what we did then?

21st January 2015

Martin Elliott
37th Gresham Professor of Physic
Professor of Cardiothoracic Surgery at UCL
Consultant Paediatric Cardiothoracic Surgeon
&
co-Medical Director
The Great Ormond Street Hospital for Children