Post-1945 Developments:
New technology and bioethics

Kidney dialysis
Ventilator
Heart-lung machine
Post-1945 Developments: New technology and bioethics

1921 saw the first attempts to clear the blood of impurities externally using chemical and mechanical means. Clotting was as much a problem as adequate blood for circulation.

The first practical human haemodialysis machine was developed by WJ Kolff and H Berk from the Netherlands in 1943.

Willem Kolff (1911- ) and his wife, in 1941

Dialysis machines in Netherlands during WWII
New technology and bioethics

Kolff’s invention used cellophane wound around a drum of wooden slats.

“Professor Brinkman at Groningen was the man who first told me about cellophane and dialysis. Brinkman was a wonderful man, and he knew cellophane. Cellophane tubing looks like ribbon, but it’s hollow. It’s artificial sausage skin, and it’s an excellent membrane for dialysis. If you have blood inside here, small molecules will go through the pores of the membrane to the outside where you have the dialyzing fluid. So urea and other products that the kidneys normally excrete will go out.”

Dialysis by 1960s

I do sympathize with you, sir, but I’m afraid it cannot be viewed as ‘carry on’ luggage.
Post-1945 Developments: New technology and bioethics
The ventilator

Another addition to life support was ventilation, or artificial breathing, when the diaphragm was too weak to inflate and expel air from the lungs.

New technology and bioethics
The ventilator

The theory behind intubation is simple: insert a tube through the nose to the air passage in order to inflate the lungs.
New technology and bioethics
The ventilator

By 1953 mechanical devices and additional gauges and monitors were part of more complex ventilators.

A variation of the ventilator, widely used for polio victims by the 1950s was the so-called “iron lung.”
New technology and bioethics
The ventilator

Modern ventilators soon became much more compact

Post-1945 Developments:
New technology and bioethics
The heart-lung machine

The ultimate technological device to maintain life was the heart-lung machine which bypasses the patient's own heart, oxygenating the blood and pumping it around the body during surgery. For the first time they made possible operations on common congenital heart problems such as a hole in the heart, which had previously caused much illness and early death.
John H. Gibbon Jr. (1903-1973), the original designer and developer of the heart-lung machine, performed the first successful open-heart surgery on a patient with congenital heart disease on 6 May 1953.

This experimental machine used two roller pumps and had the capacity to replace the heart and lung action of a cat. John Gibbon joined forces with Thomas Watson in 1946. Watson, an engineer and the chairman of IBM (International Business Machines), provided the financial and technical support for Gibbon to further develop his heart-lung machine. Gibbon, Watson, and five IBM engineers invented an improved machine that "minimized haemolysis and prevented air bubbles from entering the circulation."
New technology and bioethics
The heart-lung machine

Later machines used more sophisticated technology to oxygenate the blood

New Hearts for Old
The Story of Transplantation
Changes in view of human body

12th century anatomy manuscript

Illustration for potential donors

History of Transplantation
from Transweb at U. of Michigan
http://www.transweb.org/reference/timeline/800bc.htm

Dates refer to developments in history of transplantation
Transplantation & Transfusion Milestones
(plus procurement of body, parts and fluids)

General observations:
- follows general pattern of development of modern medicine, but with significant differences
- fewer developments early, before 1900
- a lot more developments later, especially after 1950
- Not for lack of trying: example of Harvey and early transfusion

Susruta (6th century b.c.) Indian surgeon described rhinoplasty
Illustration from Tagliocozzi, 16th century

Alexis Carrel (1873-1944)

Carrel demonstrating microsurgery at Rockefeller institute
Carrel's Anastomosis (1902)

Fig. 16. Alexis Carrel's technique (1902) of vascular anastomosis with the use of three guide sutures arranged triangularly.

Direct transfusion from parent to child (1914)

Fig. 1. Position of baby and the arm of the donor in direct transfusion. The radial artery of the donor and the femoral vein of the baby are used for the transfusion which is done according to the Crile technique (reproduced from Loquinant. The treatment of hemorrhagic disease of the newborn by direct transfusion of blood. J. A. M. A. 62: 1899, 1914.)
Transplantation & Transfusion Milestones
(plus procurement of body, parts and fluids)

After 1950: transplantation takes off. Why?

1) Improvements in surgery (example)
Transplantation & Transfusion Milestones
(plus procurement of body, parts and fluids)

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Transplantation & Transfusion Milestones
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2) Better understanding of immunology and compatibility (example)
   • 1952 Jean Dausset (France) described the histocompatibility complex genes in humans, 1958 Dausset discovers the first leucocyte antigen, then in 1965 the HLA tissue grouping system.

3) Immune suppressant drugs (examples)
Transplantation & Transfusion Milestones (plus procurement of body, parts and fluids)

After 1950: transplantation takes off. Why?

3) Immune suppressant drugs (examples)
   - 1959 William Dameshek and Robert Schwartz at Tufts University discover immunosuppressive properties of 6-mercaptopurine (reformulated as azathioprine or Imuran in 1962),
   - 1972 Dr Jean-François Borel at Sandoz Laboratoires (Basel) discovered the immunosuppressive properties of a fungus that grows in the high plateaus of Norway. He called it cyclosporine.
After 1950: transplantation takes off

1954 first successful kidney transplant by surgeons Joseph E. Murray and John Hartwell Harrison between identical twins -- at the Peter Bent Brigham Hospital in Boston

1959 First bone marrow transplantation by E. Donnall Thomas, MD, and his colleagues at Mary Imogene Bassett Hospital in Cooperstown, New York

1963 Dr. Thomas E. Starzl performs the first human liver transplant at the University of Colorado Medical School

1967 (December 3) First heart transplant operation performed by Dr Christian Barnard in Cape Town, South Africa. The heart functioned for 18 days following surgery. On January 6, 1968, Dr. Norman Shumway performs the first U.S. heart transplant at Stanford University. May 3, 1968 Denton Cooley in Houston performs heart transplant.

1969 first in vitro fertilization of human egg by Bavister and Edwards; 1978 first human birth using in vitro fertilization; to date over 1 million births

1982 Jarvik-7 artificial heart was implanted by William DeVries in patient Barney Clark who survived 112 days. 2001 Robert Tools receives the first Abiocor implanted heart in Louisville; the patient survived 151 days.
Transplantation & Transfusion Milestones

(plus procurement of body, parts and fluids)

Some dates in history of procurement (including donation)

- **1968** Harvard Medical School Ad Hoc Committee on Brain Death publishes report with criteria to be used to determine death

- **1968 (August)** The Uniform Anatomical Gift Act was enacted for the purpose of establishing comprehensive and uniform laws regarding organ and tissue donations.

- **1978** Brain Death Act passed which recognized and defined brain death, including the process used to determine death.

- **1984** National Organ Transplant Act passed. Donor and transplant process reviewed, Organ Procurement Organizations (OPO’s) established, scientific registry started, purchase of organs prohibited, and bone marrow registry started.

- **1985** the international council of the Transplantation Society issues guidelines prohibiting the buying or selling of organs and tissues
Transplantation & Transfusion Milestones
(plus procurement of body, parts and fluids)

After 1950: transplantation takes off

2004 organ transplants 2004 (Source: OPTN)

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<th>Measure</th>
<th>Kidney live cadaver</th>
<th>Liver</th>
<th>Pancreas</th>
<th>Kidney-Pancreas</th>
<th>Heart</th>
<th>Lung</th>
<th>Heart-Lung</th>
<th>Intestine</th>
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<td>Patients</td>
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The Essential Issue
Need for Organ Donation in U.S.

Waiting List (4/16/05)

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<tr>
<th>Measure</th>
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<th>Liver</th>
<th>Heart</th>
<th>Lung</th>
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<tbody>
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<td>Patients</td>
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