PET IMAGING

GROUP 5: ALVARO FRANCO, KEISHA RICHARDS, RODRIGO GABOR
ADVANTAGES OF PET

Used to image function. This provides an accurate way of analyzing the progression of diseases in the body.

Used in the fields of cardiology, oncology, and neurology.

Can also be used to detect skeletal tissue infections.

Can be combined with other modalities in a single image.

http://www.radiology.info.org/NUCLEAR-MEDICINE-POSITRON-EMISSION-TOMOGRAPHY/PROS-CONSSIDE-EFFECTS.HTML
http://archives.drugabuse.gov/newsroom/03/NR9-08.HTML
DISADVANTAGES OF PET

Exposed to radiation. The total amount is very similar to a typical CT-scan.

Since PET puts a radioactive tracer inside the body, a patient should not be near a pregnant woman soon after the PET scan.

The radioactive tracer has a half life associated with it. This causes the need to use the tracer soon after it is made.

PET scans are expensive and not very readily available. This is mainly due to the use of an expensive cyclotron.
MEDICAL APPLICATIONS

Detects the cancer stage and shows how far it has spread. MRI and CT can not tell the difference between benign or malignant tumors.

Shows the brain functionality in diseases such as Parkinson’s Disease.

Can be combined with other modalities such as MRI or CT to produce images displaying both function and structure in great detail.
MEDICAL APPLICATIONS

PET/MRI of rodent to detect Amyloid Beta plaques associated with Parkinson’s Disease.

HTTP://WWW.NCBI.NLM.NIH.GOV/PUBMED/22427802
NON MEDICAL APPLICATIONS

PET has typically been used almost exclusively for medical purposes. Recently PET has been used in geological studies as a nondestructive way of imaging. This is an ongoing area of research.

PET of flow in uniform porous medium

PET of subsurface bacterial colonies in soil
BEFORE PET IMAGING

1953: William Sweet & Gordon Brownell
Built device that used positron annihilation
for imaging the brain
A precursor to PET scanners

1961: James S. Robertson
Made the “Headshrinker”, another precursor
Produced single-plane PET scan

http://www.doemedicalsciences.org/pubs/sc0033/vital.shtml
http://web2.uwindsor.ca/courses/physics/high_schools/2006/Medical_Imaging/pethistory.html
http://www.cerebromente.org.br/n20/history/neuroimage5_p.htm
1969: Brownell with MIT colleagues make the first positronic tomographic camera.

1972: Brownell Group uses reconstruction algorithm to produce image of brain tumor. The scan shows two levels with the tumor seen in the second level.

http://www.cerebromente.org.br/n20/history/neuroimage5_p.htm
DESIGN OF DETECTORS

Multiple fixed detectors and hexagonal shape
Still didn’t have enough detectors for a good quality image
Used in the PETT II scanner

Several linear detectors that rotate around the patient
Took too long
Very sensitive to movement of patient

http://www.cerebromente.org.br/n20/history/neuroimage5_p.htm
PETT III SCANNER

1975: Edward Hoffman, Michel M. Ter-Pogossian & Michael E. Phelps

Built what is considered the first PET Scanner

Used full ring of detectors (best design)

Still produced low quality and low resolution images

Required a whole team of medical professionals to operate it

All following PET scanners are based on its design

http://www.ehow.com/about_6404835_clinical-history-pet-scans.html
PET TVI
Built in the early 80’s at UBC Hospital and was easier to operate than its predecessors.

1980’s: Able to image how the brain responds to different actions. These were performed by Michael Phelps.

ECAT EXACT HR+
1990’s: Modern design of PET Scanner

HTTP://WWW.EHOW.COM/ABOUT_6404835_CLINICAL-HISTORY-PET-SCANS.HTML
HTTP://WWW.CEREBROMENTE.ORG.BR/N20/HISTORY/NEUROIMAGES5_P.HTM
IMPROVEMENT OF IMAGE QUALITY

- INCREASED NUMBER OF DETECTORS
- IMPROVED ATTENUATION CORRECTION

HTTP://WWW.CEREBROMENDE.ORG.BR/N01/PET/PET_HIST.HTM
RADIOACTIVE TRACERS

1976: Fluorine-18 Fluorodeoxyglucose (FDG) developed for PET
Other common tracers: Oxygen-15, Carbon-11, and Nitrogen-13
Developing tracers to target specific areas like the lungs and heart
Development of multiple tracer to get more information in a single scan

http://www.doemedicalsciences.org/pubs/sc0033/vital.shtml
http://www.diagnosticimaging.com/pet-mr/content/article/113619/1877446
PET/CT SCANNER

Gives structural and functional information
PET scan and CT scan can be done simultaneously
Being used more in hospitals especially for cancer detection

http://www.med.harvard.edu/JPNM/chetan/petct/petct.html
PET/MRI SCANNER

- Fully integrated design of PET/MRI scanner

- Separated design with PET scanner on one end and MRI machine on the other.

PET/MRI SCANNER

Newest technology available
The function and structure can be seen for a better diagnosis
Images are extremely detailed

COST

One of the most expensive imaging modalities

- $1 million to $2.5 million machine cost

Hybrid scanners

- PET/CT: $2.5 million to $3 million
- PET/MRI: cost is unknown but likely to be higher than PET/CT scanner.

Basic PET scan costs:

- FDG radiopharmaceutical fees: Cost of radioactive element to produce image
- Technical fees: Cost of procedure
- Professional fees: associated with radiologist interpreting test results

http://www.comparepetscancost.com/
### NATIONAL STATISTICS

<table>
<thead>
<tr>
<th>Price Category</th>
<th>Price</th>
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[http://newchoicehealth.com/Directory/Procedure/47/Whole%20Body%20PET%20Scan](http://newchoicehealth.com/Directory/Procedure/47/Whole%20Body%20PET%20Scan)
350,000 PET scans were performed in 2002.

Numbers of scans are increasing dramatically.

It is estimated that within the next five years, in excess of 2,000,000 PET scans will be performed per year.

http://www.petforcancer.com/faq/index.html
THANK YOU!