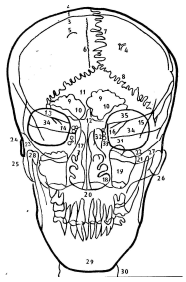
X-ray skull

- X - ray of the bones
- A-P, lateral view
- Stenvers – meatus acusticus internus
- Axial view – basis of the skull
- Brain and blood are not visible

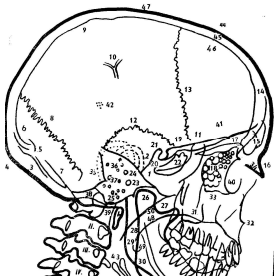
X-ray skull

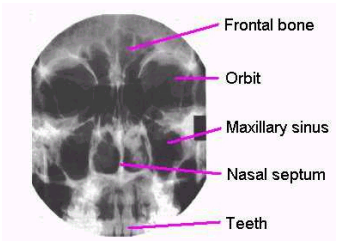
- Indications
- Head injury
- Headache
- Unconsciousness

X-ray skull

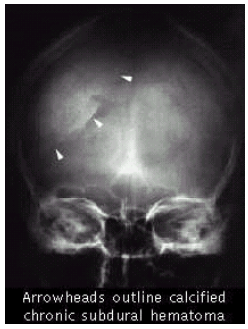


X-ray skull

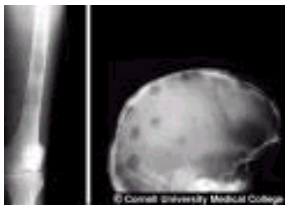




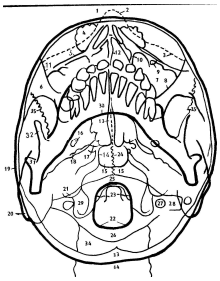
Calcification of subdural heamathoma



Plazmocythoma



X-ray - skull - axial projection



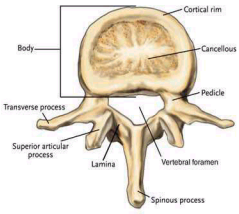
Spinal column X – ray

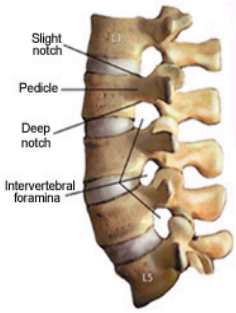
- X - ray of the bones
- A-P, lateral view
- Foramina intervertebralia – under 45 degree

Spinal column X – ray

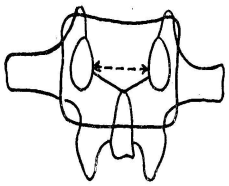
- Indication
- Back pain
- Spinal column injury
- Radiculopaties

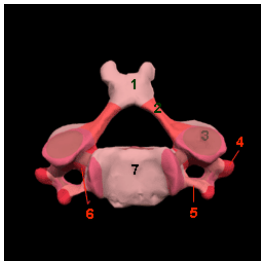
Spinal column - anatomy



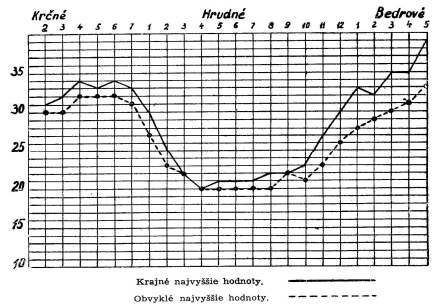


Vertebres - pedicles

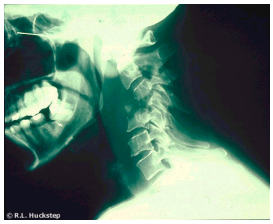




Interpedicular distance

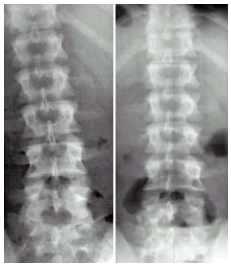


X-ray - spinal column



X-ray - spinal column

X-ray - spinal column



Spinal column CT

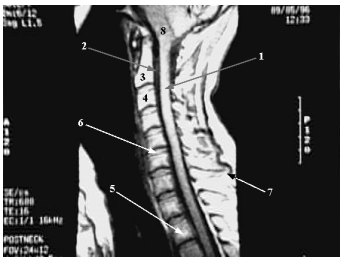
- **Indication**
- **Back pain**
- **Spinal column injury**
- **Radiculopaties**

Prolaps of intervertebral disc

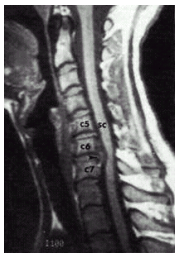
Spinal column MRI

- **Indications**
- **Spinal canal diseases**
- **Radiculopaties**
- **Spinal cord tumors**
- **Spinal canal injury**
- **Spinal cord vessels diseases**
- **Multiple sclerosis**

MRI – spinal column



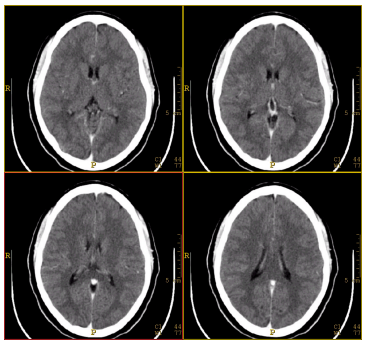

MRI – spinal column



Brain CT

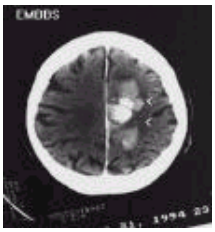
- Brain in the scale of grey colour
- Indications
- Strokes
- Brain tumors
- Headache
- Susp. AVM
- Neuroinfections
- Head injury
- Dementia

Brain CT

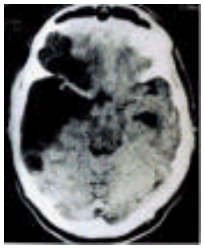


Brain CT

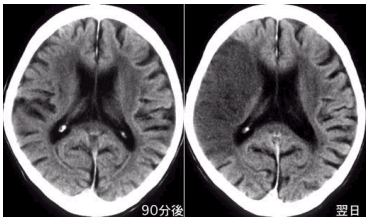
Brain haemorrhage



Brain infarct



CT - brain infarct



Magnetic resonance imaging – MRI

MRI using nonionizing energy provides better resolution of different structures within the brain and spinal cord.

Basic principle: placing the patient within a powerful magnetic field, which causes the protons of tissues and fluids to align themselves in the orientation of the magnetic field.

The images generated by the MRI machines are truly remarkable with high degree of contrast between gray and white matter.

Brain MRI

- Scans are in grey scale of colours
- Light subjects - *hyperintensity*
- Darker – *hypointensity*

T1, T2 weighted MRI

- To differ the tissues – they should have different signal
- There are two types of magnetization:
- Transverzal
- Longitudinal

T1, T2 weighted MRI

- Difference of tissue in longitudinal magnetisation - in T1 – T1 weighted picture.
- Difference in transversal megnetisation – T2 weighted picture.

T1, T2 weighted MRI

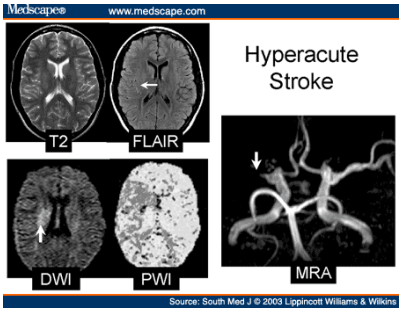
- T1 – brain cortex – darker than white matter, CSF- dark
- T2 brain cortex lighter than white matter, CSF – white.

FLAIR MRI

- **Supression of CSF**
- **Demyelinating lesions in white matter**
- ***FLAIR*** (z anglického „*fluid-attenuated inversion recovery*“).

DWI MRI, ADC maps

- **Diffusion weighted imaging (DWI)** is a form of MR imaging based upon measuring the random Brownian motion of water molecules within a voxel of tissue, and is particularly useful in cerebral ischaemia and tumour characterisation.
- Better - "diffusion demonstrates greater restriction than one would expect for this tissue". is

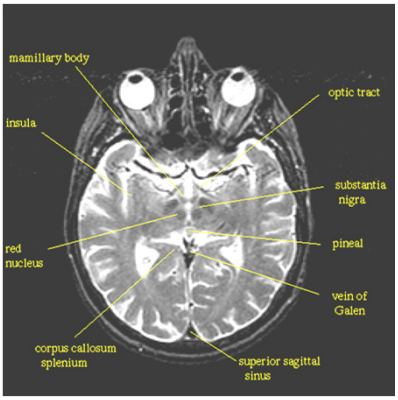


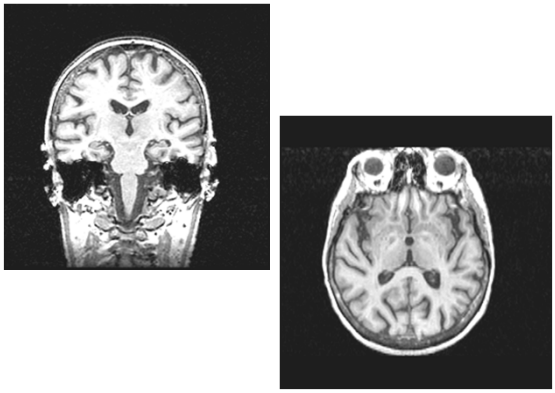
Indications for MRI :

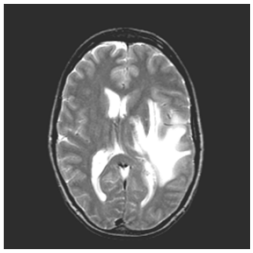
1. **multiple sclerosis**
2. **suspected tumors, especially in fossa posterior and spinal cord**
3. **ischemic vascular disease**
4. **athrophic diseases**
5. **inflammatory spinal and cerebral processes**
6. **subcortical and periventricular lesions**
7. **tissue malformations**
8. **cortical dysplasias.**

MRI

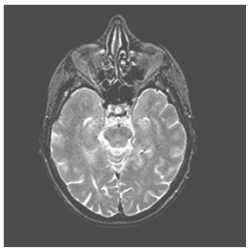
1. MRI of the **spine** provides clear images of the **spinal cord and cauda equina**, intervertebral discs, vertebral bodies, spinal tumors, syringomyelia etc.
2. The administration of **intravenous contrast material – gadolinium**, permits even sharper definition of lesions (enhancement).
3. The main dangers in the use of MRI are **ferromagnetic objects**. Cardiac pacemarker is an absolute contraindication to the use of MRI.
4. MR-AG
5. **Functional MRI (fMRI),** can show cerebral metabolism and blood flow.



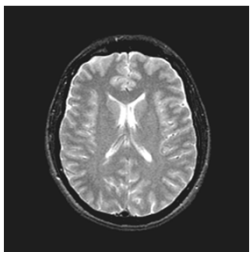




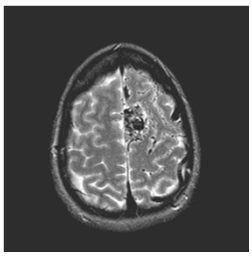
Glioblastoma



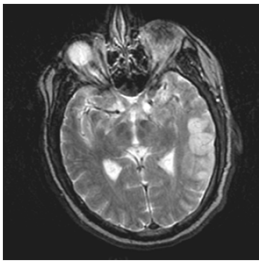
Multiple small infarcts



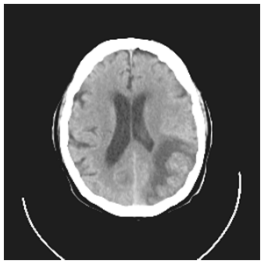
AIDS- frontal hypoperfusion



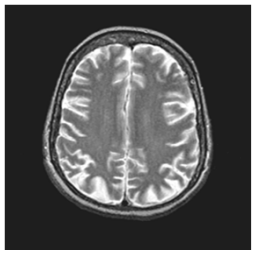
AV malformation

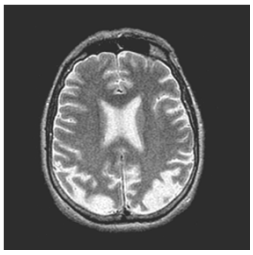


Left HMS, cortical
Ischemia, fluent aphasia

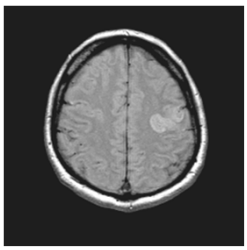


Left HMS, cortical a
ischemia, aphasia

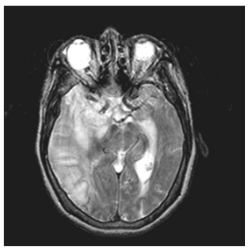




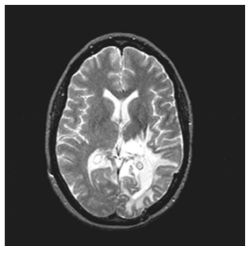
Alzheimer disease, cortical atrophy



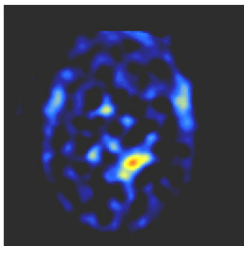
Ischemic stroke, left HMS



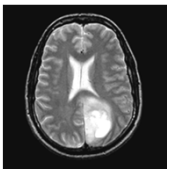
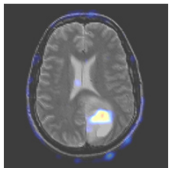
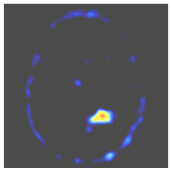
Fatal large ischemia,
right HMS



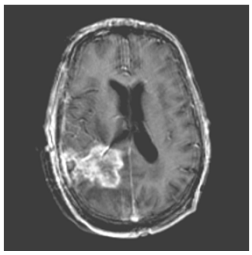
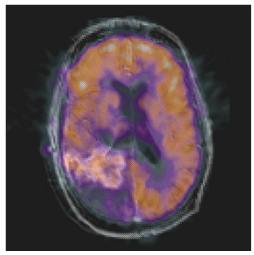
Glioblastoma, MRI



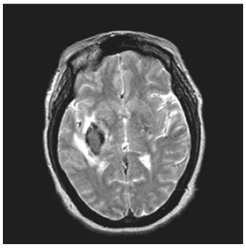
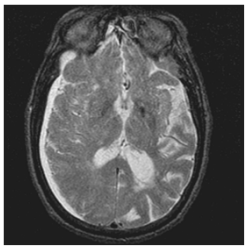
SPECT

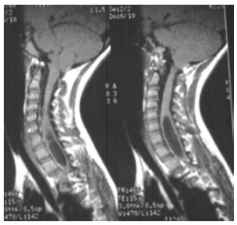
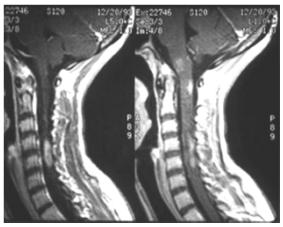
Glioma, MRI SPECT TI SPECT Tc

Glioma, MRI PET

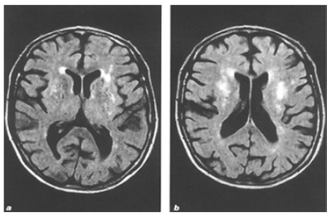
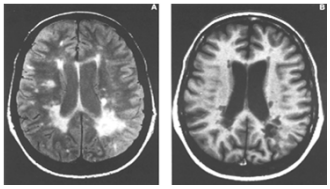



Intracerebral haemorrhage Chronic subdural hematoma

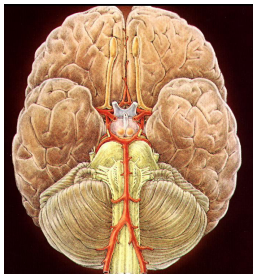
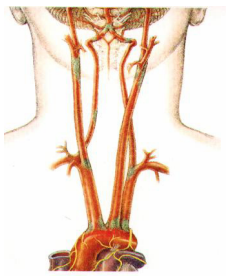
Cervical spinal cord MRI

syringomyelia multiple demyelinative lesions

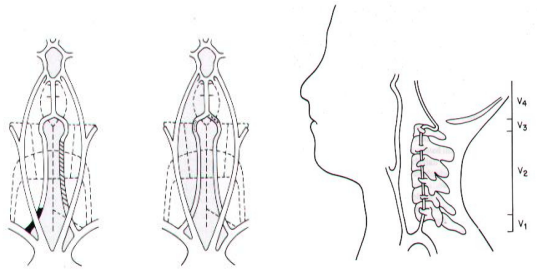



MS, FLAIR sequency

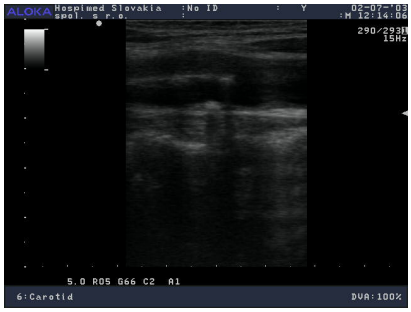
Anatomy of cerebral circulation

Anatomy

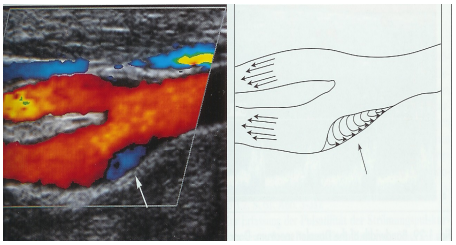


B-scan carotid bifurcation

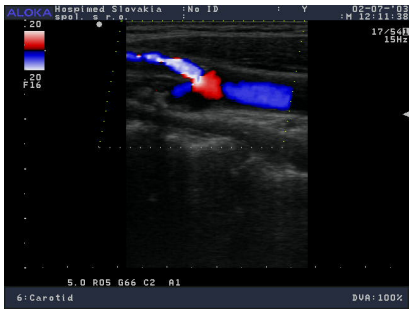


B-scan carotid bifurcation

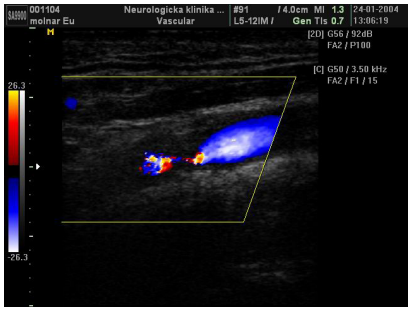
B-scan carotid bifurcation



B-scan carotid bifurcation



B-scan carotid bifurcation



Duplex ultrasound
B-scan + Doppler

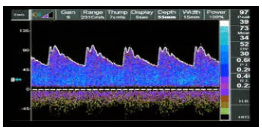
TABLE 14 INTERNAL CAROTID STENOSIS

Stenosis %	Peak Systolic Velocity	Blod flow	End Diastolic Velocity
≤ 50%	≤ 120 cm/s	Laminar	≤ 90 cm/s
51-70%	120-140 cm/s	Turbulent	≤ 90 cm/s
71-95%	≥ 240 cm/s	Turbulent	≥ 90 cm/s
96-99%	≤ 120 cm/s	Turbulent	≤ 90 cm/s
Occlusion	-		-

Table 15 INTERNAL CAROTID STENOSIS CLASSIFICATION

Classification according haemodynamics	Classification according degree of stenosis	Classification according % reduction of lumen
Haemodynamics is not influenced	Light stenosis	≤ 50%
Influenced haemodynamics	Mild stenosis	51-70%
	Moderate stenosis	71-95%
	Severe stenosis	96-99%
Occlusion	Occlusion	Occlusion

Transcranial doppler - TCD



- Neinvazívna ultrazvuková metóda na meranie rýchlosti krvného prietoku v proximálnej časti veľkých mozgových ciev

TCD

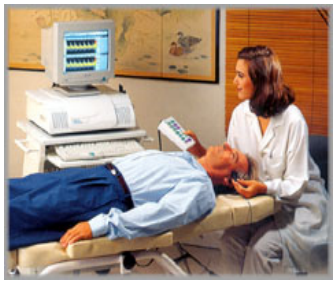


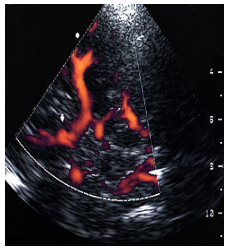
TABLE 16 IDENTIFICATION OF INTRACRANIAL ARTERIES

Artery	**Transducer position**	**Depth of sample volume (mm)**	**Direction of flow**
MCA	transtemporal	30-60	Toward
ACA/MCA bifurcation	Transtemporal	55-65	Bidirectional
ACA	Transtemporal	60-80	Away
PCA (P1)	Transtemporal	60-70	Toward
PCA (P2)	Transtemporal	60-70	Away
ICA	Transtemporal	55-60	Toward
OA	Transorbital	40-60	Toward
VA	Transforaminal	60-90	Away
BA	Transforaminal	80-120	Away

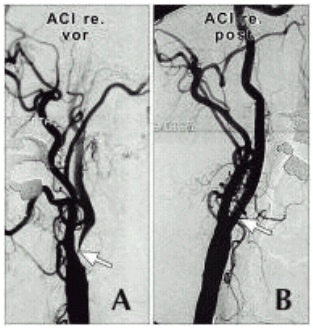
TCD a TCCS

- Indications
- Strokes
- Subarachnoid haemorrhage
- Brain death

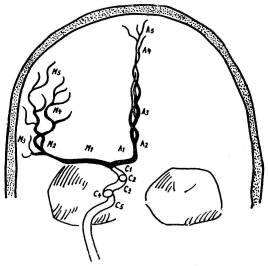
Transcranial colour-coded ultrasound - TCCS



Angiography



Angiography



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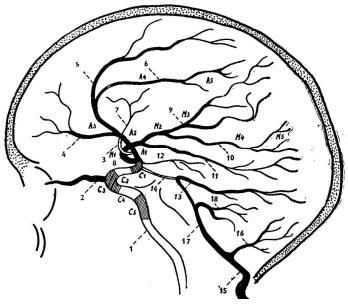


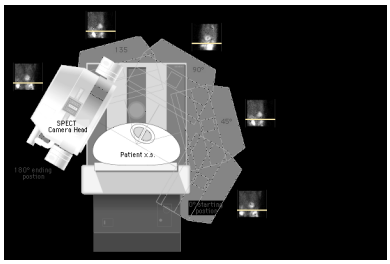
SPECT – single photon emission computed tomography

- Functional nuclear imaging technique performed to evaluate regional cerebral perfusion.
- Because cerebral blood flow is closely linked to neuronal activity, the activity distribution is presumed to reflect neuronal activity levels in different areas of the brain. A lipophilic, PH-neutral radiopharmaceutical (most commonly ^{99m}Tc-hexamethylpropyleneamine oxime [HMPAO] and ^{99m}Tc-ethylene cysteine diethylester [ECD], with a half-life of 6.02 hours) is injected into the patient, which crosses the blood-brain barrier and continues to emit gamma rays. A 3-dimensional representation of cerebral blood flow can be iterated using gamma detectors, allowing for interpretation.

SPECT – single photon emission computed tomography

- Measurment of brain function after application of radioisotopes

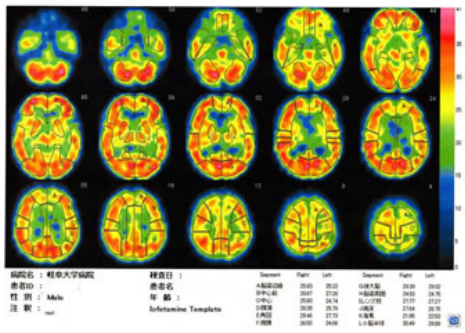
SPECT - kamera



SPECT

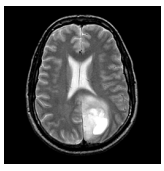
- Indications
- Strokes
- Dementia
- Epilepsy
- Brain tumors

SPECT

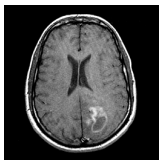


SPECT – brain tumor

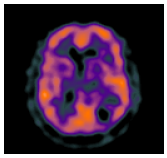
MR – T2



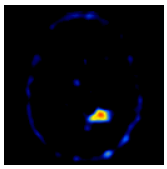
MR – gad



SPECT



Thalium SPECT



Positron emission tomography - PET

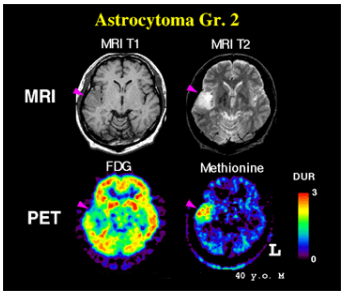
- Measurment of brain function after application of radioisotopes
- Transporters – radioactive carbon, sugar

Positron emission tomography - PET

PET radioisotopes

Labelling agent	**Half-life**
carbon-11	20.3 minutes
oxygen-15	2.03 minutes
fluorine-18	109.8 minutes
bromine-75	98.0 minutes

PET - Astrocytoma



PET – Alzheimer disease