Computerised Tomography (CT) Scans

Computerised tomography (CT) scanning is used commonly in medicine today. It is similar to conventional radiology as it uses X-rays. Computerised tomography is also referred to as computed tomography.

In order to obtain a CT scan patients lie in a CT scanner - similar to a bed inside a ‘Polo® mint’. The X-ray tube and the detectors are opposite to each other. Both of these rotate around the patient and information is obtained, usually in slices. The data are constructed by a computer and provide, most commonly, cross-sectional images in a single plane, which can be interpreted.

The pictures are obtained by differences in X-ray absorption - compared with conventional radiology these differences are very small, allowing different shades of grey and distinction between different tissues - eg, between fat and soft tissues and between brain and cerebrospinal fluid.

Types of computerised tomography scanning

There are essentially two types of CT scans:

- **Conventional CT scan** - the scan is taken slice by slice and after each slice the scan stops and moves down to the next slice - eg, from the top of the abdomen down to the pelvis. This requires patients to hold their breath to avoid movement artefact.
- **Spiral/helical CT scan** - this is a continuous scan which is taken in a spiral fashion. It is a much quicker process and the scanned images are contiguous.

CT scans can also be distinguished according to the plane in which the images are taken. In fact CT scanning has been called 'computed axial tomography (CAT)' scanning, describing axial images that are taken - axial being the most common plane. However, other planes of imaging can also be performed - eg, coronal or sagittal. Furthermore, the newer CT scanners can project these images into a 3D image.

When CT scans are produced the operator can choose the section level (eg, brain) and also the thickness of the sections. The thickness of the sections is usually between 1-10 mm - the thinner the slices, the more information in the images - although, with the spiral CT scans, this is superseded.

Advantages of computerised tomography scanning

- Better detail compared with ultrasonography.
- Relatively quick compared with MRI scanning.
- Most systems can be scanned - eg, brain to leg.

Disadvantages of computerised tomography scanning

- Requires breath holding which some patients can not manage.
- Artefact is common - eg, metal clips.
- CT scans of the brain can be affected by bone nearby.
- High doses of radiation are involved in CT scanning - chest CT scan is equivalent to 350 chest X-rays; CT abdomen to 400 chest X-rays and CT pulmonary angiography 750 chest X-rays.\(^1\,\,^2\)
- There is also a risk of childhood cancer and leukaemia in mothers who have imaging during pregnancy.\(^2\) However, some of the studies are small and difficult to interpret due to confounding factors. Imaging to aid potentially fatal conditions during pregnancy should not be withheld.\(^3\)
Computerised tomography scanning with contrast

CT scanning provides images in shades of grey - occasionally the shades are similar, making it difficult to discern between two areas. Contrast enhancement can be used to try to overcome this problem. Barium is commonly used to outline the gastrointestinal tract; intravenous contrast is used to outline arterial blood vessels.

Intravenous contrast agents are iodine-based and there is a risk of anaphylaxis with these and worsening of renal impairment. Newer agents are non-ionic and are less likely to cause allergic reactions. However, they are more expensive.

Side-effects of intravenous contrast

- Injections are usually given rapidly and can cause a feeling of warmth in the arm, or even severe pain.
- Contrast can be extravasated, which can be severe enough to require skin grafting.
- Nausea and vomiting.
- Urticaria.
- Anaphylaxis with bronchospasm, laryngeal oedema and hypotension.
- Renal failure - contrast is cleared renally and patients with pre-existing renal impairment may develop worsening renal function and even renal failure requiring haemodialysis (see "Contrast-induced renal impairment", below).

Asthma and hypersensitivity to contrast agents

- Those with asthma are at increased risk of atopy and are, therefore, at an increased theoretical risk of anaphylaxis to intravenous contrast.
- Interestingly, a recent survey revealed that, although the use of non-ionic contrast media has increased, the use of premedication with steroids is being increasingly used. This is unnecessary, as the risk of allergic reactions is low with non-ionic contrast media. [4]

Contrast-induced renal impairment

- Contrast is excreted renally.
- If patients have renal impairment, diabetes mellitus or reduced intravascular volume then they run the risk of accumulating the contrast. [5]
- This can lead to worsening of renal impairment or even renal failure.
- Generally, good hydration prior to contrast will reduce the risk of developing renal impairment.
- Other factors that will reduce the risk are identifying high-risk patients early and stopping any nephrotoxic medicines. [6]
- Metformin is usually withheld before a CT scan.
- N-acetylcysteine (NAC) has also been used; it is given orally the day before and the day of the procedure. The efficacy of NAC is unclear, although a recent meta-analysis showed that NAC used prophylactically reduces the risk of contrast-related nephropathy.

Further reading & references

- Committee on Medical Aspects of Radiation in the Environment (COMARE)
- Modern CT - Hiroshima revisited, or a walk in the park; Anaesthetist.com, Aug 2005
- Davies HE, Wathen CG, Gleeson PV; The risks of radiation exposure related to diagnostic imaging and how to minimise BMJ. 2011 Feb 25;342:d947. doi: 10.1136/bmj.d947.

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