Background

It is a requirement of the Ionising Radiation (Medical Exposure) Regulations that all CT examinations must be justified and optimised by implementing practical and reliable dose reduction techniques. In the past, the most common method for dose reduction was to use lead (and now more recently bismuth) shields which protect radiosensitive organs by attenuating the beam and reducing the dose local to that organ. In particular, shields were used for the eyes, thyroid, breasts and gonads. Now with advances in CT technology, there are many questions as to whether the use of shielding is still effective. This leaflet aims to summarise the current views on this issue and advise whether there is a benefit to using shielding in CT.

Advantages

- **Easy to use** – basic training is required for radiographers to learn how to position shields correctly.
- **Inexpensive** – many departments have shields readily available.
- **Reduced dose** – shields reduce the anterior dose to anterior radiosensitive organs.
- **Patients feel protected**

Disadvantages

- **Wasted dose –** in CT the beam goes all the way around the patient so anterior shields will attenuate photons that are exiting the patient. This is inefficient and leads to increased noise in the image.
- **Degraded image quality** – the use of shields can cause streaking and beam hardening artefacts, obscuring the relevant anatomy for diagnosis.
- **Interaction with CT automatic exposure control (AEC) (i.e. tube current modulation)** – the CT AEC may detect the increased attenuation of the shield and increase the dose to compensate. If the shield is applied prior to the scout image, there is the potential for higher doses; if applied after then image quality may suffer. On CT scanners that adjust the tube current during scan acquisition, the use of shields is not recommended.

It has been shown that the same dose reductions can be achieved by using tube current modulation and organ dose modulation[1].

[1] Wang, J. et al., 2012. *Bismuth shielding, organ-based tube current modulation, and global reduction of tube current for dose reduction to the eye at head CT.* Radiology.

Guidance from the Relevant Bodies

The American Association of Physicists in Medicine released a position statement in 2012 which has since been re-released in 2017. The policy states:

"*Alternative techniques exist that can provide equivalent anterior dose reduction at the same or superior image quality without the limitations of bismuth shields. The AAPM recommends that these alternatives to bismuth shielding be carefully considered, and implemented when possible."*

The International Commission of Radiation Protection (ICRP) advise that bismuth shielding should be used with caution in CT and should only be used if placed in such a manner that does not interfere with the AEC system of the scanner. The ICRP makes reference to the statement from the AAPM and continues to say:

"*In many situations, proper field size limitation and appropriate tube current modification can result in significant overall reductions in doses, even without shielding apparatus.*"

Advice and Recommendations

Based on the current guidance and a review of recent published studies, RPC recommends against the use of bismuth shielding for patient dose reduction in CT scanning. Instead, patient dose should be optimised by making good use of tube current modulation, field size limitation and other dose reduction methods such as organ dose modulation.

Further Information

We hope you find this information useful. If you would like any additional information or have any concerns, please contact the Radiological Protection Centre (details on the next page).

This leaflet was produced by:

The Radiological Protection Centre
Unit 5, Tramlink Park
24 Deer Park Road
London SW19 3UA
Tel: 020 8725 1050

www.sghrpc.co.uk

St George's Healthcare NHS
NHS Trust

THE RADIOLOGICAL
RPC
PROTECTION CENTRE
Incorporating The John Perry Laboratory

Patient Shielding During CT Examinations

Advice on Best Practice

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