Title: Bismuth Shields For Computed Tomography Scanners: Clinical And Cost Effectiveness

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Research question:

1. What is the evidence that bismuth shields reduce patient radiation exposure compared to lead shields for computed tomography (CT) scans?

2. What is the cost effectiveness of bismuth shields for use with CT scans?

Methods:

A limited literature search was conducted on key health technology assessment resources, including PubMed, the Cochrane Library (Issue 1, 2008), University of York Centre for Reviews and Dissemination (CRD) databases, ECRI, EuroScan, international HTA agencies, and a focused Internet search. Results include articles published between 2003 and March 2008 and are limited to English language publications only. No filters were applied to limit the retrieval by study type. Internet links are provided, where available.

Results:

HTIS reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews and meta-analyses are presented first. These are followed by economic evaluations, randomized controlled trials, and observational studies.

Five observational studies were identified from the literature search results. No relevant health technology assessments, systematic reviews, meta-analyses, or randomized controlled trials were identified. No studies were identified that compared bismuth shields to lead shields and no cost effectiveness studies were identified.
Overall summary of findings:

Four of the included studies investigated the effectiveness of the bismuth shield in reducing the radiation dose to the breast,\textsuperscript{1,2,3,5} two studies investigated the effectiveness of shielding the eye,\textsuperscript{3,4} and one study investigated the effectiveness of shielding the thyroid.\textsuperscript{4} Four of the five studies used an anthropomorphic phantom to calibrate their results.\textsuperscript{1,2,3,5}

Yilmaz et al. found that the radiation dose was decreased by 40.53\%, from 14.46 ± 3.94 mGy in the exposed breast to 8.6 ± 2.33 mGy in the shielded breast.\textsuperscript{1} In their second study, Yilmaz et al. also found there was a statistically significant reduction in radiation dose between the shielded and unshielded breast.\textsuperscript{2} The radiation dose was decreased by 37.12\%, from 9.08 ± 1.5 mGy to 5.7 ± 1.1 mGy in the shielded breast. Colombo et al. found a 34\% reduction in radiation dose to the breast.\textsuperscript{3} Fricke et al. examined the radiation dose reduction to the breast in an anthropomorphic phantom and found that radiation dose to the breast was decreased by 29\% when using the bismuth shield.\textsuperscript{5} This study assessed image quality using the pediatric patient population.\textsuperscript{5} All four studies concluded that the bismuth shield was effective in reducing the radiation dose to the breast without significant changes to image quality.\textsuperscript{1,2,3,5}

Colombo et al. also examined the efficacy of the bismuth shield in reducing radiation dose to the eye during CT scans.\textsuperscript{3} They found that radiation dose was decreased by 50\% when the bismuth shield was used. McLaughlin et al. found that the use of the bismuth shield resulted in a reduction in radiation dose to the eye from 6.0 ± 0.3 mGy to 4.9 ± 0.2 mGy.\textsuperscript{4} Because there was not a great reduction in radiation dose to the eye, they suggested that the eye shield be used only when the eye is in the direct path of the radiation beam.

McLaughlin et al. also examined the efficacy of the bismuth shield in reducing radiation dose to the thyroid during routine CT scans of the chest.\textsuperscript{4} The radiation dose to the thyroid was reduced from 16.4 ±1.2 mGy to 7.1 ± 0.5 mGy when the bismuth shield was used. From these results, they recommended that the bismuth shield be used during all CT scans of the chest.

Overall, all studies found a reduction in the radiation dose as a result of the use of the bismuth shield, with four studies\textsuperscript{1,2,3,5} reporting a percent reduction in radiation dose ranging from 29\% to 50\%. A fifth study reported a decrease in radiation dose to the eye of 6.0 ± 0.3 mGy to 4.9 ± 0.2 mGy and to the thyroid of 16.4 ±1.2 mGy to 7.1 ± 0.5 mGy.\textsuperscript{4} In addition, no significant changes to image quality were observed as a result of using the bismuth shield.
References summarized:

Health technology assessments
No literature identified

Systematic reviews and meta-analyses
No literature identified

Economic analyses and cost information
No literature identified

Randomized controlled trials
No literature identified

Observational studies


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Appendix – Further information:

Observational studies – anthropomorphic phantom


Additional references

