The use of patient drapes for staff dose reduction in fluoroscopically-guided interventions

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While several radioprotective measures have been implemented to reduce dose to the operator and staff, there are still growing concerns among the occupationally exposed in regards to carcinogenic risks and cataract formation [1, 2]. Patient drapes to reduce occupational exposure have been developed and marketed to address these risks.

Radioprotective patient drapes have the potential to minimise the scattered dose received by the operators and patient. Most radioprotective drapes are designed to be single-use, sterile, disposable sheets which are placed over the patient during fluoroscopically-guided interventional procedures to limit the amount of scattered radiation generated from inside the patient from reaching the operator. The most common commercially available drapes are manufactured from an antimony and bismuth rubber compound which aims to take advantage of the light-weight nature and lower K-edge binding energy of antimony for weight-efficient attenuation of photons [3]. Antimony and bismuth rubber compounds have been shown to offer near lead equivalence per thickness in radioprotective aprons with the additional benefits of having a less environmental impact and being less brittle than equivalent lead compounds. Other commercially available drapes are primarily lead based [4], however there have been recent developments with tungsten powder being considered as a potential alternative [5]. In theory, these drapes should decrease the radiation dose to the commonly unprotected regions of the operator, such as the hands and head.

The use of such drapes has been well explored in the literature for angiographic procedures, particularly in the

cardiac catheterisation laboratory setting [6–8]. The research suggests there is a significant reduction of scattered radiation to staff in the vicinity of the patient [6–11]. However, it is essential to note that the torso of occupationally exposed staff is already protected from a radioprotective apron. The literature is inconclusive if the additional scatter reduction results in a significant decrease of radiation dose to already protected areas. Additionally, not all studies have appropriately blinded the participants by the use of a sham drape, which may impact the findings as the radiation safety practice of the participants may have been altered due to enrollment in the study. Where the drapes do provide a significant dose reduction is in the unshielded areas. The radiation dose to the fingers and the eyes is significantly reduced while using patient drapes. Although it is becoming more commonplace to use radioprotective eyewear in procedures, it is still not mandated in all practices. The use of radioprotective gloves is less common, and as such drapes may prove useful in lowering hand dose.

The use of patient drapes in CT Fluoroscopy is not well explored with only two studies being conducted. The results have indicated a dose reduction during lung-biopsy procedures to the unshielded areas of the operator. However, for the torso and eyes, the operator was better protected by standard personal protective equipment such as radioprotective aprons and eyewear [12, 13]. The use of a patient drape in conjunction with standard radioprotective tools did not significantly lower the radiation exposure further [12].

The use of patient drapes in all settings should be carefully considered and adequate training of the staff using the drapes is paramount. If the radioprotective drape is inadvertently placed within the primary beam, fluoroscopic systems may automatically increase the dose rate to compensate for the attenuation provided by the drapes. This boost would significantly increase the patient dose and degrading image quality.

While there is no doubt that the radiation dose to staff is reduced through the use of patient drapes, does this

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reduction result in a significant reduction of radiation risks? Without exploring the effects of patient drapes directly on the incidence of cataract formation or radiation-induced cancers, it is difficult to comment on the usefulness and cost-effectiveness of these products. Although it is acknowledged that most radiation protection principles are based on a linear no-threshold model, economic factors need to be considered for single-use patient drapes. Future research must consider not only the overall dose reduction but comments on the risk reduction to allow for cost-effectiveness analysis.

It is essential to consider the impact of these drapes on patient exposure. The use of drapes could give a fall sense of security to operators. Some operators may feel better protected and thus use radiation more freely, which will increase their overall exposure as well as the total radiation dose to the patient [14]. Other studies have found the patient dose is minimally reduced [12]. Not all studies analysed the effect on patient dose, and this should be considered in future studies.

For specific high dose situations, such as large patients undergoing complex interventional procedures where it is difficult to make use of all provided radioprotective equipment such as ceiling-mounted shields, the use of drapes may be appropriate. However, for day to day use, resources should be reallocated to fund different protection strategies which may be simpler to implement, more efficient and cost-effective, such as providing more education to exposed staff and ensuring the use of radioprotective aprons, ceiling-mounted shields, table skirts and eyewear where required.

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