

## Correspondence

(The Editors do not hold themselves responsible for opinions expressed by correspondents)

### Contrast media, endothelin, angioplasty and restenosis

The Editor—Sir,

A causal relationship between contrast media (CM), endothelin (ET) and restenosis after angioplasty may exist. *In vivo* and *in vitro* studies have shown that CM can stimulate the production of ET, a very potent vasoconstrictor peptide synthesized by the vascular endothelium [1]. In addition to its vasoactive properties ET has mitogenic effects on mesangial and smooth muscle cells [2]. ET can also stimulate the production of growth factors such as the platelet's derived growth factor (PDGF) which is a potent mitogen of smooth muscle and connective tissue cells [3]. A role for PDGF has been proposed in the pathogenesis of restenosis following angioplasty and perhaps in atherogenesis as well [4].

Restenosis following a technically successful angioplasty remains a challenging problem in clinical practice. The trauma which is inflicted on the endothelium during angioplasty has been suggested to be the stimulus for the process of restenosis which involves smooth muscle cells proliferation, migration of these cells from the media to the intima and synthesis of extracellular matrix [4]. However, the biological mediators of these events remain uncertain. It is more than likely that the level of ET in the wall of the blood vessels at the site of the angioplasty is significantly increased in response to shear stress on the vascular endothelium and the presence of CM. A recent study using an animal model has supported the hypothesis of a causal relationship between ET and restenosis after angioplasty. Pre-treatment with the antiendothelin agent SB209670 attenuated the neointima formation and the narrowing of the carotid arteries of rats following an angioplasty of these vessels [5]. Orally active endothelin receptor antagonists such as SB209670 and Bosentan are currently under evaluation and may become available for clinical use in the near future [5,6]. These developments are exciting and perhaps it will not be too long before we can overcome the problem of restenosis simply by the oral administration of an endothelin receptors antagonist for a few days pre- and post-angioplasty. However, extensive research work will be required before this proposition becomes a clinical reality.

Yours etc.,  
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(Received 11 January 1995 and accepted 19 January 1995)

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### Potential gonadal dose from leakage radiation?

The Editor—Sir,

The Guidance Notes [1] allow leakage radiation air kerma rates of up to 1 mGy h<sup>-1</sup> at a distance of 1 m, through the housing of X-ray tubes; though it is recommended that leakage radiation should not exceed one-tenth of this value in practice. There is no dispute that for overhead tubes the existing limits are acceptable, particularly as leakage dose rates from most of these tubes are orders of magnitude below the required level. In my own experience, however, the highest leakage radiation measurements are to be found in mobile image intensifier (II) units. Bearing in mind some of the uses to which these theatre II units are put, the question of whether the limits for leakage radiation are really adequate should be raised.

In interventional urological procedures the urologist is commonly seated close to the beam. In this position, radiation originating from below the knee (*e.g.* transmitted through the tube housing or scattered from the spacer cone) may irradiate the male gonads without being intercepted by the protective apron. This will not be fully detected by personal radiation monitors worn in any of the usual places. For this reason ionization chamber measurements were carried out to establish the relationship between potential gonadal doses to the operator, and doses registered in the position of the personal dosimeters.

A Shimatzu WHA-10 mobile II was set up to simulate a typical urological examination using a standard pelvic phantom. Using an mdh 2025-180 ionization chamber, the radiation dose rate was measured at the approximate position of the male gonads (about 50 cm from the tube housing), with the front of a protective apron (equivalent to 0.35 mm lead) resting over simulated "knees" and the back of the apron reaching up to the front edge of the stool. This was compared with measurements made behind the 0.35 mm lead equivalent shielding at waist level, and in front of the shielding at collar level. The II operated at 82 kV/0.5 mA with the phantom in place. As the operating kV is typically higher than this with real patients, extra Perspex was added so that it operated at 100 kV/0.5 mA and then at its maximum output of 100 kV/1.6 mA.

Table I shows that it is possible for gonadal radiation dose levels to be comparable with those assumed for the eyes rather than those assumed for the body. This is particularly true as leakage radiation

**Table I.** Dose rates measured in the position of the male gonads were compared with dose rates at waist level behind 0.35 mm lead equivalent shielding and dose rates at collar level outside the lead apron

Dose rate at	82 kV/0.5 mA ( $\mu\text{Gy min}^{-1}$ )	100 kV/0.5 mA ( $\mu\text{Gy min}^{-1}$ )	100 kV/1.6 mA ( $\mu\text{Gy min}^{-1}$ )
Collar level over apron	5.0	5.8	9.8 1.6
Waist level under 0.14 0.35 mm Pb		0.56	15.7
Position of male gonads	2.0	5.2	

(unlike scattered radiation) is not affected by reducing field size, while the waist dosimeter may well lie behind several folds of protective apron. As leakage radiation has passed through the X-ray tube housing it is also more penetrating than the scattered radiation detected at collar level.

Table II shows the effect of first adding 0.7 mm extra lead shielding to the tube, and then adding the shielding and removing the spacer cone. The results suggest that potential "gonadal" dose originates from both leakage radiation and scatter from the spacer cone, and that both these contributions may be largely unnecessary. The scatter contribution in the Shimatzu WHA-10 could have been virtually eliminated by using an open spacer cone while leakage radiation can be substantially reduced by 0.7 mm lead supplementary shielding to the tube housing. If the tube housing is supplemented by 1 mm lead where the protection is weakest, leakage radiation from these areas will be reduced by a factor of ten when the tube is operating at 150 kVp [2].

Direct measurements of radiation dose to individuals have not been made because, among other things, interventional urological techniques are not carried out in theatre at St Mary's Hospital and so operator doses are low. At my previous hospital, however, large numbers of these procedures were carried out in theatre, resulting in lengthy screening times. In addition, the unit was operating at a higher II input dose rate than that set for the machine referred to in

**Table II.** The effect on "gonadal" dose of (a) adding 0.7 mm lead shielding to the tube housing and (b) adding 0.7 mm lead and removing the spacer cone to reduce scatter

Gonadal dose rate	82 kV/0.5 mA ( $\mu\text{Gy min}^{-1}$ )	100 kV/0.5 mA ( $\mu\text{Gy min}^{-1}$ )	100 kV/1.6 mA ( $\mu\text{Gy min}^{-1}$ )
No further shielding	2.0	5.2	15.7
0.7 mm extra Pb shielding	1.4	2.3	6.8
Extra shielding, no cone	0.3	0.9	2.7

this study (which operates at 20  $\mu\text{Gy min}^{-1}$  incident to the grid). As a consequence the urologist carrying out these procedures received radiation doses at collar level which would have required him to be classified had he not been wearing eye protection. These procedures are being carried out in other hospitals, and this work indicates the need to assess the radiation dose distribution around this type of equipment.

Yours etc.,

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(Received 30 November 1994 and in revised form 4 January 1995, accepted 16 January 1995)

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