Radiobiology and Epidemiology associated with exposure to tritium

Radiobiology

Uptake and retention in oocytes

Issues concerning the RBE:

Transmutation to helium

Accumulation of tritium in the hydration shell of DNA

Uptake and retention in Oocytes

Tritium can be taken up into foetal oocytes

If this results in DNA labelling the tritium could be retained until the oocyte is ovulated, fertilised [or lost by atresia] – this could be more than 30 + years

Animal expts. suggest labelling of DNA is likely to be small

Does DNA turnover ?

Effects not likely to be significant

Assessment of tritium RBE

Many studies (> 45) – endpoints include cell transformation and mutation, cell death, developmental changes, chromosome damage and carcinogenesis

Reference radiation – recommend gamma

Dose and dose rate – should match (seldom do)

Recommend concurrent reference radiation controls

In vitro studies preferred

Carcinogenesis studies theoretically best

RBE values

Straume and Carsten (1993) 2 - 3

Kocher et al (2005) 2.4 ± 1.4 (95% CI 1.2-5)

Animal carcinogenesis studies

Re: chronic X-rays 1.2 (0.8 – 1.5)

chronic gamma 2.5 (2 – 3)

Little and Lambert (2007):

Re: chronic X-rays 1.2 (1 – 1.4)

chronic gamma 2.2 (2 – 2.3)

Overall – recommend a value of 2 for radiation protection purposes

Tritium Epidemiology

Several studies of workers and the public in which there was potential for exposure

UKAEA workers
AWE workers
UK classified radiation workers *
Savannah River and other US nuclear workers *
Capenhurst uranium enrichment workers *
Sellafield workers *
Canadian nuclear workers and their offspring *
Children in the vicinity of Kruemmel and Savannah River
Children near Canadian NPP
Birth defects and infant mortality near Pickering NPP

No reliable tritium doses in any study – therefore no useful conclusions

Some studies* have potential when tritium doses evaluated