Radiation Protection Dosimetry (2009), Vol. 132, No. 4, pp. 395–402
Advance Access publication 6 January 2009
doi:10.1093/rpd/ncn317

ESTIMATION OF PATIENTS' ORGAN DOSES AND CONCEPTUS DOSES FROM SELECTED X-RAY EXAMINATIONS IN TWO NIGERIA X-RAY CENTRES

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Received September 10 2008, revised December 5 2008, accepted December 14 2008

In this study, organ and conceptus doses of patients undergoing chest, abdomen and skull radiograph examinations at two Nigeria X-ray centres, Niger State General Hospital (NGH) and Two-Tees (TTX), are reported. Air kerma was measured, and entrance surface dose (ESD) and half-value layer estimated for each set of tube potential (kV_p), focus to skin distance and current–time product (mAs) used for each of the patients included in this study. Results show that the mean air kerma in the two centres are similar for the three projections considered in this study. Organ doses ranged from <0.01 to 2.18 mGy in NGH and from <0.01 to 1.29 mGy in TTX for examinations of the abdomen, from <0.01 to 0.20 mGy in NGH and from <0.01 to 0.13 mGy in TTX for examinations of the skull and from <0.01 to 3.90 mGy in NGH and from <0.01 to 1.96 mGy in TTX for examinations of the chest. Generally, no significant difference is seen between the organ doses of male and female patients. In NGH, organ doses are generally greater than those from TTX for the three examinations. The mean ESDs for examinations of the chest postero-anterior, abdomen antero-posterior (AP) and skull AP are, respectively, 5.37, 6.28 and 4.24 mGy in NGH, and 5.82, 5.33 and 4.76 mGy in TTX. The ESDs reported in this study, except for examinations of the chest, are generally lower than comparable values published in the literature. Conceptus doses were also estimated for female patients using normalised published conceptus dose data for abdomen examinations. The estimated conceptus doses were >1 mGy even when the conceptus was located 12 cm below the surface of the abdomen.

INTRODUCTION

The increasing use of X-ray facilities and equipment in hospital practice has made medical exposure an important source of radiation in the population collective dose[1]. Medical X-ray examinations are the largest contributor to the collective effective dose to the population from man-made ionising radiation sources[2]. In medicine, ionising radiation is used for two main purposes: diagnosis and therapy[3]. The use of ionising radiations for these purposes has been found to have benefits, but also detriments associated with the radiation doses incurred by patients being examined.

In view of the significant benefits from properly conducted medical exposures, the principal concern in radiological protection is how to reduce examinations that are either unlikely to be helpful to patient management or involve doses that are not as low as reasonably achievable (ALARA) in order to meet the specified clinical objectives. Therefore, there is a need to optimise X-ray equipment and radiological techniques[4]. Patient dose measurement, which usually reveals X-ray facilities with high doses, is an integral part of this optimisation procedure. The quantities that have been suggested for the assessment of patient doses include entrance surface dose (ESD), organ dose and effective dose. Most of the past patients' dose assessments in radiography have been based on ESD measurements[3,5–8]. ESD, however, cannot be directly used to assess the risk associated with diagnostic examinations. For the purpose of risk assessment, International Commission on Radiological Protection (ICRP) in 1977[9] recommended the determination of effective dose equivalent. In 1990, ICRP further recommended that patient exposures in diagnostic radiology be denoted by organ dose and effective dose; however, the preferred and most complete approach for risk estimation is accurate knowledge of all pertinent organ doses. Nevertheless, measurements of organ doses are complex, and it is often regarded as a troublesome job in diagnostic centres[10]. This may explain why there is scant information about organ doses of patients in diagnostic radiology.

In routine radiological examinations, it is not practical to conduct *in vivo* measurement of organ doses. Traditional methods used to calculate patient organ doses are based on implanting thermoluminescent dosemeters (TLDs) in tissues and organs positions' within a phantom consisting of tissue equivalent materials[11,12]. Monte Carlo simulation of photon interactions using computational models of the human body is another way by which organ doses can be obtained. The development of computational models started with the formulation of

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