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IMPLICATIONS OF A SINGLE CENTRE AUDIT OF DOSES OF IONISING RADIATION GIVEN DURING VIDEO URODYNAMICS

Hypothesis / aims of study

The use of ionising radiation in urodynamic investigations is an accepted part of clinical practice. Each investigation should provide clear benefits to the patient in terms of their diagnosis, management and final outcome. These benefits should outweigh the risks from radiation. However even small radiation doses carry some risk and care is required to ensure that these are minimised, without compromising the diagnostic efficacy of the examination.

The International Commission on Radiological Protection (ICRP) states that the basic principles of radiation protection of the patient are justification of practice and optimisation of protection [1]. Although guidance on referral criteria exists for many common clinical problems, it is limited for adult urodynamics. Guidance is also lacking on the optimal use of ionising radiation in the urodynamic imaging process.

This work aims to set out local referral criteria that can be discussed and possibly extended to national guidelines. It also aims to set out local criteria for image quality and radiation dose, again with the hope that these provide a starting point for discussion. It further looks at the fluoroscopic technique required to achieve the required image quality at as low a radiation dose as is reasonably practicable.

Study design, materials and methods

Published indications for video urodynamics [2] were adopted as a starting point. For each clinical indication, the anatomical structures deemed to be important for imaging were further identified by current departmental protocols and consultant level interview. European Guidelines exist for common radiographic examinations [3]. These specify the diagnostic requirements and the radiation dose to the patient for each examination, together with an example of good radiographic technique. This format was used in this work.

Image criteria refer to characteristic X-ray features of anatomical structures with a specific degree of visibility. Each structure was assigned to one of three levels of image quality: visualisation, reproduction or visually sharp reproduction. Visualisation was defined as “characteristic features are detectable but details are not fully reproduced”, reproduction as “details of anatomical structures are visible but not necessarily clearly defined” and visually sharp reproduction as “anatomical details are clearly defined” [3].

Dose limits are not applied to medical exposures, but ICRP recommends the use of dose reference levels as an aid to optimisation. This concept is incorporated into UK law which requires that Diagnostic Reference Levels (DRLs) are set for typical examinations for standard-sized patients. However, no European or UK DRLs currently exist for urodynamics.

In the absence of such guidance, the third quartile dose-area product (DAP) values from a patient dose survey were used to set Local DRLs. Doses can therefore be expected to exceed this DRL at times, but the reason should be recorded (for example large patient with complex pathology). Separate DRLs were set for adult male and female patients due to the very different imaging geometry used for each gender. There was insufficient data to set meaningful paediatric DRLs. The first survey was carried out in 2001, followed by further surveys in 2005 and 2007.

Results

Clinical indications for adult patients are given with the corresponding image criteria in Table 1. In patients where additional information concerning anatomical structure is needed, visually sharp reproduction of the region of interest is required.

Table 1

Clinical indication	Anatomical structures	Image criteria
Men <55 years with voiding symptoms	Urethra Sphincter Ureter	Visually sharp reproduction Visually sharp reproduction Reproduction
Women with previous surgery for USI but with recurrent USI	Bladder base Pelvic floor	Reproduction Reproduction
Patients with neurological disease	Full urinary tract	Visually sharp reproduction
Post-prostatectomy incontinence prior to artificial sphincter implantation	Urethra Prostate	Visually sharp reproduction Visually sharp reproduction
Impaired renal function without renal disease	Ureter	Reproduction

A mobile C-arm image intensifier with a 23 cm field of view was used with continuous fluoroscopy under automatic dose control. DAP values found for samples (n=50 in each case) of patients in the first and subsequent surveys are given in Table 2.

Table 2

Group	DAP ($cGycm^2$)	2001	2005	2007
Adult male	Median	358	323	154
	3rd quartile	577	429	268
Adult female	Median	421	250	167
	3rd quartile	591	345	272

Interpretation of results

It is clear that the doses given in even one department can vary greatly. The major determining factor will be the type and extent of the image required by the referring clinician. Matching the required image quality to the clinical presentation will help to prevent unnecessarily high doses. As well as splitting the DRLs by gender, it may be appropriate to assign separate DRLs to different clinical indications.

Operator expertise and familiarity with the equipment used will also affect the dose given. During this audit, there were no significant staff changes and the same imaging equipment was used throughout. There was measurable variation in performance of the automatic dose control system of the image intensifier that explains some of the decline in dose seen here. However, assuming that the general spectrum of patient conditions has not greatly changed over the period covered, we infer that clinical practice alone can generate a wide variation of doses given, potentially resulting in a dose higher than is actually necessary.

Concluding message

A valid clinical indication is required to justify any diagnostic radiation exposure. Setting clear referral criteria will help to prevent inappropriate investigations leading to unnecessary irradiation. Moreover, there is a need to ensure that departments are minimising doses given while maintaining diagnostic efficacy. Refresher training and careful induction is necessary in addition to the legally required equipment checks. Further study is planned to determine what factors may contribute to doses given, potentially requiring guidelines on good clinical practice and DRLs to be developed. Similar work is also required for paediatric patients.

References

1 ICRP Publication 60 (1990), 21(1-3)
2. Urodynamics; London, Springer 2006 (93-94)
3. EUR 16260 EN, European Commission 1996

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HUMAN SUBJECTS: This study did not need ethical approval because it was a regular audit of doses given, part of standard hospital clinical governance and did not follow the Declaration of Helsinki - with approval by the ethics committee - in the sense that the work is not a clinical research study Informed consent was not obtained from the patients.