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Assessment of Patients Radiation Dose for Hystrosalpingography Investigation in Taif

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Abstract: Hysterosalpingography (HSG) is the most frequently used diagnostic tool to evaluate the endometrial cavity and Fallopian tubes. The aims of this study were to measure the patients' Entrance Surface Doses (ESDs), effective doses and to compare practices between different hospitals. This study was conducted in the three major hospitals in Taif, KSA. Namely, King Abdul Aziz specialist Hospital, Althaea Military Hospital and King Faisal Hospital. A total of 100 Female patients (aged 23–44 years) were examined for a period of 6 months. ESDs in the study was calculated using Dose Cal software , which need to record the exposure factors (tube current time product (mAs) ,tube voltage (kVp), focus to skin distance (FSD) and tube output. The X-ray tube output was measured using Unfors Xi Dosimeter (Unfors Inc., Ballad, Sweden) with accuracy better than 5%. The mean ESD was 20.1, 28.9, and 13.6 mGy, for hospitals *A,B and C* respectively. The study showed wide variations in the ESDs among hospitals under study. Hospital B having values above the internationally reported values. Number of X-ray images, operator skills, and X-ray machine type were shown to be a major contributor to the variations reported. Results demonstrated the need for standardization of technique throughout the hospital and suggested the need to optimize these procedures.
Keywords: HSG, Radiation Dose, Patient Dosimetry

INTRODUCTION

Hysterosalpingography (HSG) or uterosalpingography is the most frequently used diagnostic tool to evaluate the endometrial cavity and fallopian tube by using conventional x-ray or fluoroscopy since it emergence in 1910 [1]. Despite of the development of the imaging tools such as computed tomography (CT), Magnetic resonance imaging (MRI), laparoscopy, hysteroscopy and ultrasound (US), HSG plays an extremely crucial role in the diagnostic assessment and treatment of infertility in female patients [2,3].

During the procedure, patients are subjected to fluoroscopic and radiographic exposures in genitourinary area which is very sensitive to radiation since it include the ovaries and uterus which impose radiation risks to patients. The partial exposure of patient results in a heterogeneous dose distribution; therefore the organ dose and effective dose values are more appropriate descriptors of patient dose and related risks. In the literature, still few studies were published regarding the radiation doses received by the patients [4-6]. These studies showed wide differences in terms of dose, fluoroscopic time, number of radiographic images, equipment and inter-examiners variability. In addition, there is a need for continuous evaluation of patient dose because some data were outdated due to advancement in X ray generators and image receptor.

In Kingdom of Saudi Arabia, still few data are available in the field of patient doses and its related risks. Therefore, quantification of radiation dose, organ dose and effective dose is important. The aims of this study were to measure the patients' Entrance Surface Doses (ESDs) and to compare practices between different hospitals.

MATERIALS AND METHODS

Patient dose measurement

A total of 100 patients (aged 23–44 y) were examined for a period of 6 months in the three major hospitals in Taif, KSA. King Abdul Aziz Hospital (60 patients), Aldada Military Hospital (20 Patients) and King Faisal Hospital (20 Patients). For the study the hospitals was named Hosptial A, B and C respectively.

ESDs in this study were calculated using Dose Cal software developed by the Radiological Protection Centre of Saint George' Hospital, London. The ESD was measured using the exposure factors (tube current time product (mAs), tube voltage (kVp), focus to skin distance (FSD) and tube output. The X-ray tube output was measured in (mGy/mAs) using Unfors Xi Dosimeter (Unfors Inc., Billdal, Sweden) with accuracy better than 5%. ESD was calculated according to the following formula:

$$ESD = OPx\left(\frac{kV}{80}\right)^2 xmAsx\left(\frac{100}{FSD}\right)^2 xBSF$$

Where (OP) is the output in mGy/ (mAs) of the X-ray tube at 80 kV at a focus distance of 1 m and will be normalized to 10 mA s, (kV) the tube potential, (mA s) the product of the tube current in (mA) and the exposure time in (s), (FSD) the focus-to-skin distance in (cm) and (BSF) the backscatter factor. BSF was calculated automatically by the Dose Cal software after all input data were entered manually in the software. The tube output, the patient anthropometrical data and the radiographic parameters (kVp, mAs, FSD and filtration) were initially inserted in the software. The kinds of examination and projection were selected afterwards. ESD was used to estimate the organ equivalent dose (H) using software provided by the National Radiological Protection Board (NRPB-SR262) [7].

HSG technique

At the beginning of the procedure patient lied supine on the table in lithotomic position bends her knees and place her feet at the end of the table .A vaginal speculum was inserted into the vagina ,the vaginal walls and cervix were cleaned with antiseptic solution. A canula was inserted into cervical canal, which attached with syringe fill with contrast medium (CM). After the injection of the CM, a minimum four films were obtained during conventional radiography by using 10x12 inch films with vertical center rays 5cm superior to symphysis pubis which include the followings: Antro posterior AP plain radiograph, AP film with CM to show the uterus, AP film with CM to show the uterine tubes and an AP film with CM to show spill of CM in the peritoneal cavity. The technologist was performing the investigations as their daily practice. Demographic data: (age, height, weight and body mass index (BMI (kg/m2)) and exposure factors: (kVp and tube current-time product (mAs)) were obtained for all patients.

Radiographic equipment

Three X ray machines were used in this study from different manufacturers and tube characteristics. Table-1 shows the X-ray machines characteristics.

Table-1: x-ray machine characteristic and technical data

Hospital	Machine type	Filtration mm Al and Al equivalent	Last Qc check
A	Digital	2.3	9/2014
B	Digital	2.4	6/2014
C	Digital	2.7	7/2014

RESULTS AND DISCUSSION

Patient's body characteristics are presented in Table-2. Minor variations were observed among patient populations in terms of weight and BMI. The mean exposure factors used during image acquisition for all groups are shown in Table 3. The patient characteristics and exposure factors are comparable for both groups.

The ESD, effective dose values and number of films for all patients groups are presented in the same table. The results show asymmetry in the dose distribution. This can be attributed to different factors: patient pathology, X ray machine characteristics, inter-operator differences.

This study investigated the patient doses during HSG in three hospitals in Taif KSA. The main factors affecting patient's dose in HSG are: exposure factors, filtration, and source to surface distance (SSD), collimation, pathology and patient size. There were no significant differences between the two patients groups in terms of height, weight, BMI (Table-2). The tube voltage was comparable while tube current time product showed wide variations due to use of different exposure time. The quality of the radiation depends on the tube voltage and the total filtration of x ray beam. X ray beam filtration in Hospital C and hospital B were higher compared with Hospital a (Table-1).This result indicates that the patient dose and effective doses are higher compared to previous studies as illustrated in Figure 2. In comparison between ESD doses from previous studies, this value is higher more than previous studies, except the study of Clicchia *et al.* [11]. A survey of radiation dose was made in this study for the different imaging techniques and radiological examinations performed in patients in child bearing age. The study revealed that there should be urgent need for dose reduction techniques. Regular quality control may help to limit variations which are due to equipment related factors.

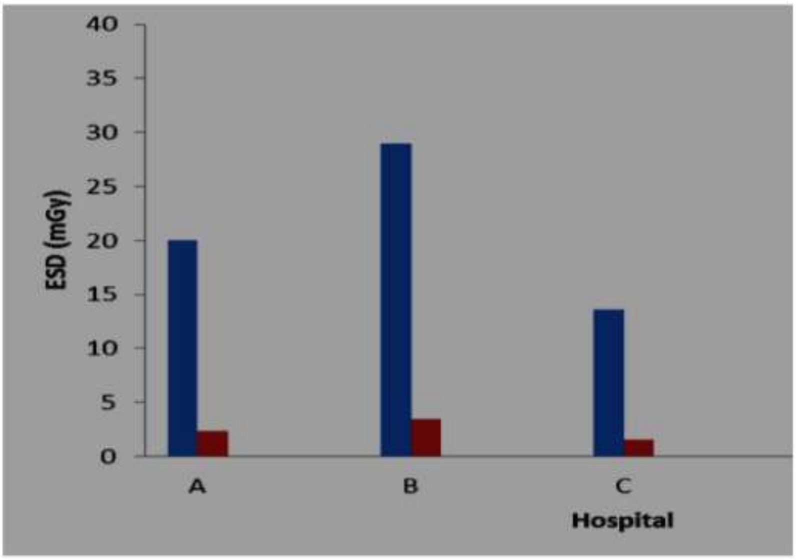

Fig-1: The mean ESD during HSG procedures in various hospitals

Table-2: Patient characteristic, mean and ±Sd, Range in the parenthesis

Hospital	No.	Patient age (year)	Weight (Kg)	BMI Kg/m^2
A	**60**	32.75±6.21 (24-40)	72.9±13.0 (50-95)	27.6±5.2 (18.65-35.08)
B	**20**	32.56±5.1 (25-41)	73.3±13.0 (60-105)	26.21±6.61 (14.46-41.01)
C	**20**	34.4±5.25 (27-44)	74.3±13.9 (52-97)	28±4.4 (20.31-34.03)

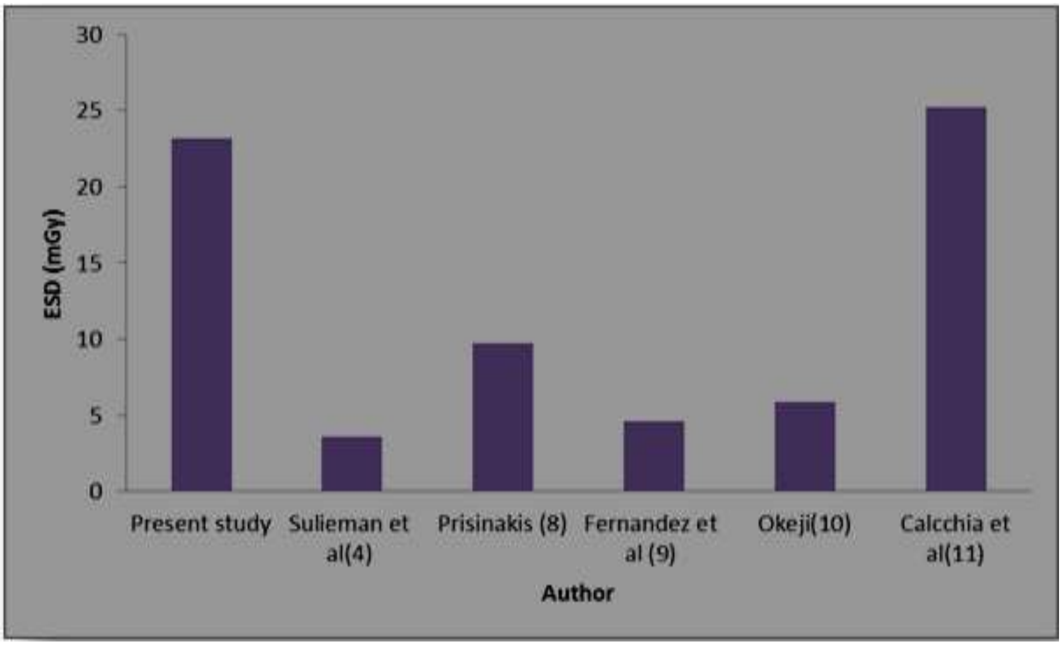

Fig-2: The mean ESD during HSG procedures in various studies and the current study

CONCLUSION

This study investigated the patient doses during HSG in three hospitals in Taif city. The mean ESD results for all patients were higher than previous studies. The dose values showed wide variations attributed to the machine characteristics, technique and operator experiences. In addition, vital organs, i.e ovaries and uterus exposed to high dose which increase the probability of cancer and heritable effects which suggest the need for dose optimization.

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