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Original Research Article

Consultants knowledge and awareness about radiation exposure in diagnostic radiology in Central India

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Abstract

Objective: To assess the knowledge, awareness and attitude of consultants about radiation hazards in diagnostic radiology and to describe their practice with regard to informing patients at risk.

Methods: Prospective questionnaire based observational study performed between July and December 2013, conducted in two different university education and research centres, two private research hospitals and four outpatients' clinics of Central India. The questionnaire was administered to 220 consultants. Data was analysed using EPI INFO 2007

Results: 205 consultants (93%) completed the questionnaire. The overall mean knowledge score was 59.3%. Mean knowledge score was 60.23% for senior doctors and 56.89% for junior doctors, but this was not found to be significant (P=0.2107). Almost more than three-quarters of consultants (91.2%) underestimated the radiation dose in CT scan of abdomen. Most doctors (75%) though that one CT scan increase the life time risk of developing cancer and 25% consultants said that there was no increased cancer risk. MRI and Ultrasound was wrongly associated with ionizing radiation by 24.39% and 26.83% of consultants respectively. The frequency at which doctors would inform patients of the risk of radiation varied greatly depending on the clinical scenario.

Conclusions: There was lack of awareness and relatively poor knowledge among the consultants which may lead them to request more tests and thus increasing the radiation exposure load on the patients. Consultants should receive education, and the request form should display radiation dose and associated risk.

Keywords: Knowledge, Diagnostic Radiology, Radiation exposure, Attitude

1.Introduction

Radiation has been proven to have adverse biological effects on living organisms. The cancer causing biological effects of ionising radiation, including low doses received during medical diagnostic imaging, are well documented[1][2]. The US National Council on Radiation Protection and Measurement had reported that medical x-rays and nuclear medicine account for 15% of all radiation exposures[3][4].

Similarly, in the UK, estimated 100-250 deaths occur each year from cancers directly related to medical exposure to radiation[3][4].

The number of patients undergoing diagnostic radiology, in particular computed tomography(CT) scanning, is increasing every year[5][6]. Above doses of 50-100 mSv (protracted exposure) or 10-50 mSv (acute exposure), direct epidemiological evidence of human populations demonstrates that exposure to ionizing radiation increases the risk of some cancers[7].

Over the past decade many studies have investigated physicians from varying specialities on their knowledge of radiation dose and associated risks, and most studies have disappointing results[8][9][10]. It is important that the consultants who request imaging are well trained in deciding whether diagnostic imaging is indicated, but also have an accurate knowledge of the associated risks.

There have been no studies done in central India so far to our knowledge regarding this issue.

This study aimed to assess the knowledge and awareness of consultants about radiation hazards in diagnostic radiology and to know the attitude of doctors regarding the risks of radiation exposure.

2. Material and Methods

This prospective observational study was conducted in two different university educations and research centres. This study also included consultants from two private research hospitals and from four outpatient's clinics. Our study was a descriptive investigation performed between July and December 2013. The study was approved by the institutional ethics committee.

This questionnaire was reviewed and validated by ten experts in radiology. A pilot survey of ten consultants was done. Small alterations were made as a result. The questionnaire was distributed to all the consultants working and informed consent was taken. These questionnaires were distributed without the prior knowledge of the doctors to rule out the possibility of any prior preparation. Questionnaires were collected immediately after completion and were anonymous. We excluded ourselves and the consultants who had been involved in testing the pilot study.

2.1 Questionnaire

The questionnaire that was administered to the study participants was composed of demographic questions concerning age, gender, institution, department or speciality, years in practice as a consultant, speciality of medical practice and estimates of the number of diagnostic investigations ordered per month.

The second section of the questionnaire assessed their knowledge of radiation exposure. This part aimed at assessing the consultant's knowledge of radiation exposure in a 14-item multiple choice section that included the concepts of lifetime risk, background environmental radiation and effective dose.

The knowledge component of the questionnaire was modeled on previous studies conducted on physicians in Germany[11]. The score out of a possible 14 was converted to a percentage. Unanswered questions were scored as incorrect.

The third part of the questionnaire included few questions to study the attitude of the consultants. Using three common clinical scenarios and marking their response on data analysis procedure i.e. Liekert type data[12], consultants were asked "in the following scenarios please indicate how often you would discuss any risk due to radiation exposure with patients/relatives prior to them undergoing imaging requested".

Again to assess the attitude of the consultants, three questions were about giving further education regarding the risks of radiation exposure, discussing the risks of radiation with patients and family members and about the display of doses of specific imaging test. Lastly consultants were asked if they feel a need for further education about radiation awareness.

2.2 Statistical Methods

Analyses were evaluated with EPI INFO 2007. P <0.05 was accepted as statistically significant.

3. Results

Questionnaires were distributed to 220 consultants working during the study period and 205 were returned (93% response rate).

Analysis of the results was performed using EPI INFO 2007.

3.1 Consultants demographic and practice characteristics

The mean age of participating consultants was 39.2 years with a range of 27 to 65 years, 78(38 %) were females and 127(62%) were male .The number of years in practice ranged from one to forty. 26.8 % of consultants worked in surgery and its sub specialities, 17.07% in medicine, 10.73% in orthopaedics, 12.68% in obstetrics and gynaecology,16.09% in paediatrics,7.80% in superspeciality branches, 8.78% as general practitioners.

About 42% of consultants ordered less than one x-ray test per day (0 or 1-25 per month). Consultants reported ordering less than one test per day for each of US, CT and MRI examinations were 46%, 70% and 65.36% respectively.

About 50 % of consultants indicated that they would discuss the risks due to radiation exposure with the parent of a six year old boy with a closed head injury prior to CT **frequently**. In the second scenario of a 23 year old pregnant female with abdominal pain after a low speed road traffic accident for a CT abdomen, almost 80% (78.1%) of consultants reported that they would discuss the risks prior to the CT scan **very frequently**. In the third scenario 65.4% consultants said that they would discuss the risks associated with an abdominal CT with a 76 year old lady with acute abdominal pain **rarely**.

About 95.7% agree that it is important to discuss the risks of radiation with patients and family

members. About 93.2 % agree that the dose of radiation exposure associated with specific imaging tests should be displayed. Almost 98.5 % feel, it is important to give further education regarding the risks of patients with radiation exposure. About 80 % prefer the combination of lectures, tutorials and workshops as a method of teaching for further radiation awareness.

3.2 Knowledge of radiation and imaging

The mean knowledge score for all respondents was 59.3%.Mean knowledge scores were 60.23% for senior doctors and 56.89% for junior doctors, but this was not found to be statistically significant(P=0.2107).

Some doctors wrongly associated ultrasound and MRI with ionising radiation (24.39% and 26.83%, respectively).The radiation dose associated with MRI was correctly quantified by 79.5% of men and 71.8% of women(P=0.204 but this was not statistically significant).

Of the total 205 consultants, 139 (91.2%) of consultants underestimated the radiation dose in CT scan of abdomen.

156 (76.10%) consultants correctly answered that children are most sensitive to radiation as compared to adolescents, adults and elderly while 59% knew that kidney is least sensitive to radiation as compared to thyroid, gonads and breast tissue.

133 consultants(64.88%) were aware that plain X ray abdomen involves the highest number of radiation exposure to the patient. 154 (75.1 %) of doctors think that one CT scan increase the life time risk of developing cancer and 51(24.9%) responding that there was no increased cancer risk.

The average natural background environmental radiation exposure to an individual per year in mSv was overestimated by 34 consultants (16.6%), correctly estimated by 32 consultants (15.6%) and underestimated by 139(67.8%) number of consultants.

The number of days of normal background environmental radiation exposure equating to the dose given by a single chest X-Ray is correctly estimated by 16 consultants (7.8%) and overestimated by 189 consultants (92.2%).

The average amount of radiation absorbed by a patient during a single chest X-Ray in mSv was overestimated by 137 consultants (66.9%), correctly estimated by 50 consultants (24.4%) and underestimated by 18 (8.7%) number of consultants.

4. Discussion

Our study found that consultant's knowledge about radiation exposure in diagnostic radiology is relatively poor .These consultants underestimated the radiation exposure of frequently used diagnostic imaging procedures and associated risks. This underestimation of doses may lead the consultants to request more tests than what is actually required. So because of lack of accurate knowledge, consultants may request more tests.

Other studies[8][9][11][13]-[16] also indicate that overall knowledge of this area is poor and consultants often underestimate the radiation dose[8].

In our study, 24.4% and 23.1% associated ultrasound and MRI respectively with ionising radiation. The finding of ultrasound association with ionising radiation is slightly higher than the findings in the literature on physicians. Prior studies on physicians report a 4- 14% incorrect association for ultrasound[8]-[11][17]. This indicates lack of knowledge likely resulting in requesting less number of ultrasound(almost 59.5% consultants request ultrasound ordering less than one test per day) Had they been known about the lack of ionising radiation in ultrasound they could request more number of ultrasound wherever needed thus reducing the load of radiation exposure on patient.

In our study, 23.1% associated MRI with ionising radiation. This finding is consistent with previous studies which reported 7-28% incorrect association[8]-[11].

Significantly more men than women (64.3% and 35.7% respectively)consultants accurately recognised that MRI is not associated with ionising radiation which is consistent with previous findings among consultants[9][11][17] .

In a study by Rice *et al*[15] for pediatric surgeons, 47% respondents said that there was no increased cancer risk because of radiation from one CT scan. In our study, 51(24.9%) consultants said that there was no increased cancer risk. In comparison, our study reveals higher state of awareness of potential cancer risks related to CT.

In a study by Sullivan[18], 80% of the study group correctly answered that children were more sensitive to the effects of ionising radiation than adolescents, adults or the elderly. In our study about 76% of the consultants answered correctly. This again reflects poor knowledge of our consultants as in the Sullivan [18] study the subjects were first to five year medical students.

51% answered correctly that kidney was less sensitive to radiation than the thyroid, breast or gonads[18]. In our study, 59% answered correctly. In comparison our consultants has greater awareness regarding the radiation sensitivity of different tissues.

In our study, 29.8% did not appreciate the relative high radio sensitivity of breast tissue. This finding is consistent with previous study [18] in which 26% did not appreciate.

The underestimation of average natural background environmental radiation exposure to an individual per year in mSv by 67.8% of consultants and the gross overestimation of number of days of normal background environmental radiation exposure equating to the dose of single chest X-ray by 92.2% consultants may indicate the unfamiliarity with units of radiation.

Similarly the significant overestimation of radiation dose associated with single chest x ray in mSv by 66.9% of consultants and gross underestimation of radiation dose associated with CT Scans by 91.2% of consultants are consistent with previous studies done[8][9][11][17]. This indicates unfamiliarity with units of radiation as reported in prior studies.

The varied responses in consultant's practices of discussing potential risks involved with ionizing radiation may have many causes. It may be due to difference in clinical picture i.e. the risk to a small child or a pregnant female may be greater than the risk to a 76 year old lady. It also depends on the consultant's confidence and knowledge of risks associated with radiation exposure. They were more likely to discuss the risks if they were more knowledgeable about the subject. It is also possible that different specialities may have more exposure to specific types of imaging modalities i.e. Ultrasound in Obstetrics, MRI in orthopedics and thus have more knowledge about some tests than others and thereby affecting the likelihood of informing patients of the risks involved with different imaging modalities. Sometimes the consultants may discuss the risks only when it is justified.

In our study, 95.7% agree to discuss the risks of radiation, 93.2 % agree that the dose of radiation exposure associated with specific imaging tests should be displayed and 98.5 % feel important to give further education regarding the risks. This indicates the positive attitude of the consultants. They are ready to receive more knowledge about radiation exposure.

In conclusion, this study demonstrates poor knowledge and less awareness of the consultants about radiation hazards in diagnostic radiology consistent with published literature on consultants. Although positive attitude of the consultants is noted at few instances.

We recommend continued collaboration between radiologists and other speciality consultants in creating local protocols. It is suggested that continued medical education is to be imparted to the consultants. The requisition form should provide radiation doses and associated risks which will allow the requesting consultant to consider the information and discuss the risks with the patient. This may increase general awareness and overall knowledge and behaviour of the consultant. It is also suggested that the patient's personal total accumulated dose of radiation could also be included on the formal imaging report.

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References

[1] Ron E. Cancer risks from medical radiation. *Health Phys* 2003; 85:47-59.

[2] Mather R. The physics of CT dose. *Toshiba America Medical systems Inc*.

[3] Radman.co.uk. Radman Associates; 2007.Available from: http://www.radman.co.uk/training/RPS Courses.pdf [Accessed 10 June 2008].

[4] Bury B. X ray dose training are we exposed to enough. *Clin Radiol* 2004; 59:926.

[5] Brenner DJ, Hall EJ. Computed tomography: an increasing source of radiation exposure. *N Engl J Med* 2007; 357:2277-2284.

[6] Broder J, Warshauer DM. Increasing utilization of computed tomography in the adult emergency department. *Emerg Radiol* 2006; 13: 25-30.

[7] Brenner DJ, Doll R, DT Goodhead, Hall EJ, Land CE, Little JB, *et al*. Cancer risks attributable to low doses of ionizing radiation: Assessing what we really know. *PNAS* 2003; 100(24): 13761-13766.

[8] Shiralkar S, Rennie A, Snow M, *et al*. Doctor's knowledge of radiation exposure: questionnaire study. *BMJ* 2003; 327: 371-372.

[9] Arslanoglu A, Bilgin S, Kubal Z, *et al*. Doctors' and intern doctors' knowledge about patients' ionizing radiation exposure doses during common radiological examinations. *Diagn Interv Radiol* 2007;13;53-55

[10] Zewdneh D, Dellie ST, Ayele T. A study of knowledge and awareness of Medical Doctors towards radiation exposure risk at Tikur Anbessa Specialised Referral and Teaching Hospial, Addis Ababa, Ethiopia. *IOSR Journal of Pharmacy and Biological Sciences* 2012; 2(4); 01-05.

[11] Keitzers G B and C.J. Britton. Doctors knowledge of patient radiation exposure from diagnostic imaging requested in the emergency department. *Medical journal of Australia 2010:* 193(8):450-453.

[12] Boone HN, Boone DA. Analysing Likert Data. *Journal of Extension* .2012 .50(2) Article no 2TOT2. Available at: http://www.joe.org/joe/2012 April /tt2p.shtml

[13] Jacob K, Vivian G, Steel JR. X-ray dose training: are we exposed to enough? *Clinical Radiology*, 2004, 59:928-934.

[14] Lee CI, Haims AH, Monico EP, *et al*. Diagnostic CT scans: assessment of patient, physician and radiologist awareness of radiation dose and possible risks. Radiology 2004; 231:393-398.

[15] Rice HE, Frush DP, Harker MJ, *et al* .Peer assessment of pediatric surgeons for potential risks of radiation exposure from computed tomography scans. *Journal of Pediatric Surg* 2007; 42:1157-1164.

[16] Soye JA, Paterson A. A survey of awareness of radiation dose among health professionals in Northern Ireland. *British Journal of Radiology*, 2008; 81: 725 -729.

[17] Illian, Stephanie Lynn, "Physician assistant knowledge of patient radiation exposure from diagnostic imaging modalities" (2011). *Master's and Doctoral Projects* Paper 337.

[18] Sullivan JO, Owen J, Connor O, Regan KO, Clarke B, Burgoyne LN ,*et al*. *European society of Radiology, Insights Imaging* 2010; 1 : 86- 92.