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Original Research Article

Radiation exposure in pregnancy: need for awareness

Priyanka P. K. Belaguthi[1], Shylaja Prashanth[1]*, Giridhar Dasegowda[1], Salma Sadaf[2], Sanjiti Mirmire[3]

[1]Department of Radiology, [2]Department of Anatomy, [3]Employees State Insurance Medical College and PGIMSR, Bengaluru, Karnataka, India

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***Correspondence:**
Dr. Shylaja Prashanth,
E-mail: shaila_prashanth@yahoo.com

ABSTRACT

Background: Although radiation has become an integral part of modern medicine, as both a diagnostic and a therapeutic tool, the emphasis on the teratogenic effects of radiation in pregnancy cannot be belittled.
Methods: A total of 404 pregnant women at ESIC Model hospital, Rajajinagar, Bengaluru were enrolled over a period of 3 months (December 2020 to February 2021) in the interventional study. Statistical analysis was done by SPSS version 23 package.
Results: On analyzing the data obtained in the study, it was noted that most patients in the study were aged 25-30 years 175 (43.32%), belonged to the upper-lower class (241 (59.65%), were multiparous 216 (53.46%), and in their third trimester 192 (47.52%). It was seen that 133 (32.92%) women had some knowledge about the ill effects of radiation during pregnancy and 110 (27.33%) were educated about the same during their antenatal visits. While only 96 (29.54%) of 325 women below 30 had some familiarity with the same, this proportion significantly increased ($p<0.05$) to 39 (46.84%) of 79 in those above 30. The study showed no significant difference ($p>0.05$) in insight among women based on socioeconomic levels, parity, or week of gestation. A short session was conducted to educate women about different imaging modalities, the benefits of ultrasonography, and the risk of radiation exposure during pregnancy. A post-education survey revealed a significant increase ($p<0.0001$) in awareness among pregnant women.
Conclusions: This study reiterates the importance of health education among pregnant women to ensure adequate protection from the teratogenic effects of radiation exposure.

Keywords: Radiation education, Pregnancy, Health education

INTRODUCTION

After the invention of the x-ray by Roentgen, modern medicine has come a long way in using radiation for the diagnosis and treatment of medical conditions.[1] Diagnosis in healthcare has seen a dramatic change in recent decades because of evidence-based practice. Growth in the utilization of non-invasive diagnostic imaging was seen from the mid to late 2000s followed by a reversal and flattening of growth after 2010.[2]

Radiation can be quantified using radioactivity, exposure, absorbed dose, and effective dose. Biological hazards can be of two types-deterministic effect, where dose above threshold causes cell death; stochastic effect, in which damage to cells occurs at any level of doses and no determined dose has been identified. Both deterministic and stochastic effects are seen in high-dose ionizing radiation, but low-dose has been shown to have mostly stochastic effects.[3,4]

Ionizing radiation can cause serious consequences in the fetus like malformations, growth restrictions, neurological deficiencies, or cancer depending on the stage of fetal development.[5] Spontaneous abortion of fetus occurs when exposed to radiation during the first two weeks of pregnancy while the mother is unaware of her pregnancy.[6] A high done in the 2nd trimester can lead to

malignancy of childhood (1% increase in congenital abnormalities with every 10 rads increase). Hence, it is better to keep these radiation exposures to the bare minimum in pregnant women.[6]

Awareness about sources of radiation exposure among medical professionals can curtail needless imaging and its consequences in their patients.[7] Studies have concluded that most of the public is not concerned about ionizing radiation from radiological procedures because of trust in doctors and their broad training in radiation protection.[8]

Patient awareness and knowledge of ionizing radiation exposure in recent studies report a lack of knowledge in the Indian population.[9,10]

There are hardly any studies in India that assess the knowledge of pregnant women regarding radiation exposure and its ill effects on the fetus. We believe this study will highlight the awareness of women in our study sample and the need for an initiative by the government, hospital administration and doctors to increase health education regarding this in patients and the general public. Hence, aim to assess education level of pregnant women about radiation exposure during pregnancy.

Objective

The objectives of the study were to assess awareness about the ill effects of radiation exposure amongst pregnant women across socio-demographic parameters and to assess improvement in the awareness level post health education.

METHODS

A questionnaire-and interview-based interventional-sectional study was conducted for a period of three months on 404 pregnant women visiting the radiology department for antenatal ultrasound examination in a tertiary hospital-ESIC Model hospital, Rajajinagar, Bengaluru. The sample size was after assuming 50% of subjects were aware with relative precision of 5%, confidence interval 95% and keeping a 5% error margin. Ethical committee approval was obtained. Ethical committee approval no: No.532/L/11/12/Ethics/ESICMC &PGIMSR/Estt.Vol..IV.

Inclusion criteria

Subjects equal/ more than 18 years of age, self-reporting of pregnancy confirmed with results of a urine pregnancy test or previous scans and subjects who volunteered to provide informed consent included in study.

Exclusion criteria

Subjects lesser than 18 years of age and subjects who declined to participate in the study were excluded from the study.

Using a pre-designed questionnaire drafted by the authors, the subjects were assessed for awareness of risks of radiation exposure (x-ray, CT scan, ultrasonography, MRI) on the fetus. The questionnaire was framed by the authors as well as validated by experts in the particular field.

The questionnaire included that age, weeks of gestation, order of baby, number of antenatal visits, presence of any anomaly in previous baby, education of head of family, occupation, family income, history of previous abortions, if health education regarding radiation exposure was received during any antenatal visit, presence of any radiation exposure during previous pregnancies? presence of any radiation exposure during current pregnancy? presence of any knowledge on why radiation exposure should be avoided during pregnancy and if yes to the above question, what knowledge do they have? (Skin lesions, limb defects, cardiac or brain malformations, miscarriage, others).

Education of subjects varied from demographic data, antenatal history of previous and present pregnancy was collected. Detailed health education was imparted by the author about the ill-effects of radiation exposure on growing fetuses and their understanding was reassessed using the same questionnaire after 1 month.

Post health education questionnaire- 1. Presence of any knowledge on why radiation exposure should be avoided during pregnancy, 2. If yes to the above question, what knowledge do they have? (Skin lesions, limb defects, cardiac or brain malformations, miscarriage, others), 3. What precaution will they take in present and future pregnancy?

The data was analyzed to evaluate the influence of socioeconomic status on their knowledge. Modified Kuppuswamy system of classification was used to classify the participants based on their level of education, income, and occupation.[11] This helped to gauge the knowledge regarding radiation exposure among pregnant women before and after health education. Using Chi square, t test and ANOVA both qualitative and quantitative data was analyzed and the $p<0.05$ was considered significant.

RESULTS

A total of 404 pregnant women were interviewed for the study. Among them, most participants belonged to the age group 25-30 years (n=175) which is 43.32%, whereas only one was from the age group 40-45 years (Table 1).

Considering socioeconomic status, around 60% of them belonged to upper-lower socioeconomic status. It was observed that almost negligible subjects were from the upper or lower class (Table 1). The socio-demographic distribution of the study population is represented in Table 1.

Table 1: Profile of patient demographics socio-economic distribution.

Variables	N (%)
Age (Years)	
15-20	28 (6.93)
21-25	122 (30.20)
26-30	175 (43.32)
31-35	66 (16.34)
36-40	12 (2.97)
41-45	1 (0.25)
Class	
Lower	2 (0.5)
Upper lower	241 (59.65)
Lower middle	134 (33.15)
Upper middle	27 (6.68)
Upper	0 (0)

The details of antenatal history are represented in Table 2. It shows that the nearly same number of the participants (Table 2) had the order of baby 1 (46.5%) and 2 (47.7%). Most (47.5%) of them belonged to the 3rd trimester and least (12.8%) from the 1st trimester (Table 2). About 1% of the study group had radiation exposure in the present or previous pregnancy due to various reasons (Table2). It was observed that only n=110 of the study population received health education regarding radiation exposure from the health care professional (Table 2).

Table 2: Antenatal history.

Variables	N (%)	
Parity		
0	188 (46.53)	
1	193 (47.77)	
2	21 (5.2)	
3	2 (0.5)	
Weeks of gestation (weeks)		
0-13	52 (12.87)	
14-26	160 (39.60)	
27-40	192 (47.52)	
Presence of any radiation exposure in prev pregnancy		
Yes, n (%)	No, n (%)	Not applicable, n (%)
2 (0.5)	220 (54.46)	188 (46.53)
Presence of any radiation exposure in the current pregnancy		
Yes, n (%)	No, (%)	
4 (0.99)	400 (99.01)	
Was health education regarding radiation given during antenatal period?		
Yes, n (%)	No, n (%)	
110 (27.23)	294 (72.77)	

Assessment of the factors affecting the awareness of radiation exposure among pregnant women is shown in Table 3. It can be observed that a significantly higher number of pregnant women belonging to the age group above 30 (46.8%) had awareness compared to their counterparts (29.5%). Most of the women who had awareness were either having their 1st (n=59) or 2nd (n=69) child. Although the number of women who had awareness about radiation exposure increased from 1st to 2nd and 2nd to 3rd trimester, it was statistically insignificant. Around 26.5%, 35%, 81.4% of the pregnant women belonging to upper lower, lower-middle, and upper-middle-class had awareness regarding the matter respectively. But this was not statistically significant for consideration.

Table 3: Socio-demographic factors affecting the knowledge status of radiation exposure.

Variables	Awareness of radiation exposure present, n	Percentage of participants with radiation awareness in each category, n (%)=N/ total population in each category*100
Age group (p<0.05) (Years)		
15-20	6	(6/28)*100=21.42%
21-25	36	(36/122)*100=29.50%
26-30	54	(54/175)*100=30.85%
31-35	32	(32/66)*100=48.48%
36-40	4	(4/12)*100=33.33%
41-45	1	(1/1)*100=100%
Socio-economic class (p>0.05)		
Lower	0	(0/2)*100=0%
Upper lower	64	(64/241)*100=26.55%
Lower middle	47	(47/134)*100=35.07%
Upper middle	22	(22/27)*100=48%
Upper	0	(0/0)*100=0%
Order of the baby (p>0.05)		
1	59	(59/188)*100=31.38%
2	69	(69/193)*100=35.75%
3	5	(5/21)*100=23.8%
4	0	(0/2)*100=0%
Week of gestation (p>0.05)		
0-13 (1st trimester)	17	(17/52)*100=32.69%
14-26 (2nd trimester)	49	(49/160)*100=30.62%
27-40 (3rd trimester)	67	(67/192)*100=34.90%

Table 4: Awareness among pregnant women about ill effects of radiation during pregnancy, (p<0.0001).

Variables	Yes, n (%)	No, n (%)
Awareness among pregnant women about ill effects of radiation before health education	133 (32.92)	271 (67.08)
Awareness among pregnant women about ill effects of radiation after health education	403 (99.75)	1 (0.25)

Health education had a major impact on the awareness of radiation exposure in study groups as shown in Table 4. A total of n=133 subjects had some knowledge about the matter before health education, whereas n=403 of them knew a health talk. This change was found to be statistically significant.

DISCUSSION

Ionizing radiation can damage the living tissue at a cellular level and can cause structural impairment to the DNA.[1] The conceptus, during its early stages of development, is considerably more vulnerable to radiation.[12] Although studies have shown that risk to the fetus by radiographic, fluoroscopic examination is minimal, it is still advisable to avoid unnecessary and unintended radiation exposure in pregnancy.[13,14] When significantly higher radiation (>500 mGy) has been exposed to the conceptus, it could lead to childhood malignancies, growth retardation, severe mental retardation, microcephalus, seizures, and intrauterine death.[12,14-16] Therefore, the knowledge of radiation exposure in pregnancy is vital.

The present study aimed at assessing the knowledge regarding radiation exposure in pregnant women and educating them regarding the same. Our study pointed out the inadequacy of health education regarding radiation exposure. The absence of significant difference in the awareness regarding radiation exposure between the parity and weeks of gestation was probably due to the lack of health education during the antenatal visits in previous or present pregnancy. The results of the present study could not be compared to the previous studies due to lack of literature. Though, a previous study on awareness of dental imaging in pregnancy conducted on women across all age groups pointed out that 91% had poor knowledge.[17]

This raises a question as to who must provide awareness and education on the radiation exposure and risks to pregnant women. Previous studies have shown that there is no consensus on the subject if radiologists, radiographers/ technologists, or referring physicians must provide health education.[18] Some studies have also reported the lack of knowledge among healthcare professionals.[19,20] But attending health education programs has shown increased awareness levels in them.[21] However, all of them agree that education and awareness must take place.[18] Healthcare professionals must inform the patients on the benefits and risks of radiation exposure based on evidence-based guidelines.[18,22] Both the referring physician and the imaging personnel must strive to educate pregnant women on this issue. Although radiation is essential for certain lifesaving diagnostics, conservative management is proven to be the ideal way.[14] Hence authors believe that as soon as the woman is deemed pregnant, this knowledge on radiological modalities can help in safe pregnancy.

In this study, after assessing the knowledge and awareness of radiation exposure, the pregnant women were educated regarding the same. They were made aware of the differences in various modalities of imaging and the radiation exposure concerning each modality. They were educated that (a) ultrasound was a must to assess the growth and development of the conceptus and was harmless during pregnancy; (b) the risk of high radiation exposure and its sequelae concerning the gestational age; (c) to consult the physician before undergoing x-ray for conditions such as toothache, cough or fracture during pregnancy; (d) emphasis on disease prevention to avoid the need for imaging modalities such as x-ray and CT scan; (e) to avoid accidental radiation exposure when visiting the hospital or accompanying others for procedures; (f) imaging with radiation exposure may be required when it plays a crucial role for the survival of mother or baby.

The participants were reassessed after the education. It was observed that there was a significant increase in awareness of the issue after the intervention ($p<0.0001$). A post health education assessment revealed that 99.75% (n=403) of participants were aware of the impact of radiation exposure in pregnancy and had the insight to avoid unnecessary radiation exposure. Therefore, a simple intervention regarding the issue during antenatal visits could bring about a significant improvement in the well-being of both pregnant women and conceptus.

Limitations

There is a need for constant monitoring and audit to ensure the knowledge being imparted to the pregnant women on their antenatal visits. Without this continued effort, the purpose can be not relevant. Hence, doctors in the radiology department need to take active participation in taking the project ahead. The education level of the participants was not taken into consideration for the study, instead Socioeconomic status was measured.

CONCLUSION

There is a lack of knowledge in pregnant women regarding the radiation, imaging modality, and its impact on the conceptus. There is a need for better communication regarding the issue between health professionals and pregnant women. Educating pregnant women on potential sequelae of radiation exposure helps them make informed decisions and avoid accidental exposure, thereby improving the quality of health care.

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