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Re-evaluation of cancer incidence for gender in Iraq

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Abstract:

There has been a rapid increase in the number of computed tomography (CT) scans which utilized for the purpose of disease diagnosis. The radiation exposure can increase the probability of developing different type of cancers. This prospective study was carried out in the Computed Tomography Unit of Al-Imamain Al-Kadhimain Medical City and Al-yarmok teaching hospital in Baghdad Iraq in the period from 1 January to 31 October2018. About 3,758 adult patients (1743 male and 2015 female) with their age ranging from (10-79) who received a CT scan for different site of the body participate in this study. The main results obtained showing that the CT radiation correlated with the age and sex of the patient, with higher risks be expected of thyroid cancer among patients who were younger and female.

Key words; *Cancer in Iraq, CT scan, Thyroid cancer.*

Introduction:

Thyroid cancer developing when the cells of thyroid gland grow abnormally. The characteristic of thyroid cancer involve swelling or a tumor in the neck. Many types of growths and tumors can develop in the thyroid gland. Tumors may be benign or malignant. Cancer cells can break away from a malignant tumor and enter the lymphatic system or the bloodstream, by which the cancer can spread to other parts of the body. The three types of thyroid cancer are differentiated thyroid cancer (DTC), medullary and anaplastic types [1]. DTC are mild tumors with good prognosis and long-term survival. Differentiated thyroid cancer are including papillary, follicular and Hürthle cells. These cancers arise from thyroid follicular cells. There are several factors for the emergence of thyroid cancer (DTC), such as sex, age, family history, exposure to radiation and other factors [2]. This type of cancer represents about (90%) of all types of thyroid cancer [3]. The second type of thyroid cancer is medullary thyroid cancer (MTC) that arises from the C cells of the thyroid gland; these cells ordinarily produce calcitonin, a hormone that helps to regulate the level of calcium in the blood. Occasionally this cancer can extend to lymph nodes, the lungs, or liver before a thyroid nodule is detected [4]. It accounts 5-8 % of all types of cancers [5].There are two types of MTC (sporadic and hereditary carcinomas). Sporadic carcinomas is account 48–86% of patients while hereditary carcinomas is about 14–52% of patients with MTC [6]. The third type of thyroid cancer is an Anaplastic carcinoma (also called undifferentiated carcinoma) which is a rare form of thyroid cancer, representing about 2% of all thyroid cancers. It is believed that this type of cancer can develop from a present papillary or follicular cancer [7]. With the improvement of medical technology, thyroid cancer incidence is increasing all over the world [8].

Computerized tomography (CT) allows for scanning any part of the body as it used a combination of X-rays and a computer to create images of organs, bones and other tissues. CT scan shows more detail than regular X-rays. When the body is exposed to CT radiation, it will be exposed to an amount of radiation between 150 and 1100 times of the traditional X-ray, which is equal to exposure to sunlight for a period of seven years [9]. Computed tomography has been increasingly use over the past few decades because it does not take a long time, and it is painless [10]. The using of CT scan can be classified due to the type of patients and the aim of imaging. Different

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measurements are utilized to determine the radiation dose of CT scan which included the effective dose, the absorbed dose and the organ dose. The radiation doses of CT scan for specific organs depending on a number of factors such as number of scans [11], the scanning time, the volume of the patients [12], and other factors related to the CT scan machine [13]. Present guide for appreciation ancer risk as a result of exposure to low-dose radiation is predominantly derived from atomic bomb survivors or from workers in the nuclear industry, could serve as a source of cancer risk, while others claim that there is no data to support the risk of developing cancer through the use of multiple CTs or a single multiphasic CT scan [14, 15]. The main purpose of this study is to evaluate the incidence of cancer risk following exposure to ionizing radiation from diagnostic computed tomography (CT) scans.

Summary of the study:

This prospective study was carried out in the Computed Tomography Unit of Al-Imamain Al-Kadhimain Medical City and Al-yarmok teaching hospital in Baghdad Iraq in the period from 1 January 2018 to 31 October 2018. About 3,758 adult patients (1743 male and 2015 female) with their age ranging from (10-79) who received a CT scan for different site of the body are participate in this study. The CT examination was performed by multi-detector CT (Somatom definition edge, SIEMENS medical system, Germany (256 slices). All patients were examined in supine position in caudo-cranial direction during breath holding period of 5-10 sec. with slice thickness 5mm, KVp 100-120, mA 200-300.

Statistical analysis:

Each patient assigned a serial identification number. The data were analyzed using Statistical Package for Social Sciences (SPSS) version 20. The continuous data were represented by mean, and standard deviation and frequencies as percentages. A logistical regression pattern was build to estimate the odds ratio and 95% confidence interval. The Chi square was used to assess the association between categorical variables. P value less than 0.05 was used as the alpha level of significance.

Results:

Yearly, the Iraqi Cancer Society appreciates the numbers of new cancer cases that will occur in Iraq and collects the latest data on cancer incidence, death rate, and survival. As shown in table (1), the results showed increased rate of cancer from 7785 to 25269 cases during 22 years. In 1994 the rate of cancer 45.6 % for female and 54.4 % for male with ratio of M/F 1.2 while in 2015 the rate of cancer increase to 55.6% for female and decrease to 44.4 % for male with M/F ratio 0.7.

Table (1): Distribution of cancer cases by gender in Iraq 1994-2015.

Year	Male		Female		Total	
	No	%	No	%	No	%
1994	4320	54.4	3.555	45.6	7785	100%
1995	4033	54.7	3604	45.3	7948	100%
1996	4466	53.5	3894	46.5	8360	100%
1997	4521	52.7	4071	47.3	8592	100%
1998	4774	52.9	4259	47.1	9033	100%
1999	4556	50.9	4380	49.1	8936	100%
2000	5376	49.4	5512	50.6	10888	100%
2001	6758	50.6	6574	49.4	13332	100%
2002	6964	49.8	7021	50.2	13985	100%
2003	5698	50.6	5550	49.4	11248	100%
2004	7525	51.8	6995	48.2	14520	100%
2005	7505	49.5	7667	50.5	15172	100%
2006	7377	48.5	7849	51.5	15226	100%
2007	6656	46.8	7557	53.2	14213	100%
2008	6589	46.5	7591	53.5	14180	100%
2009	7201	47.3	8050	52.7	15251	100%
2010	8544	46.3	9938	53.7	18482	100%
2011	9352	46.2	10926	53.8	20278	100%
2012	9268	43.9	11833	56.1	21101	100%
2013	10568	45.4	12740	54.6	23308	100%
2014	11411	44.5	14187	55.5	25598	100%
2015	11205	44.4	14064	55.6	25269	100%

Distribution of CT scans according to the body part for males

In figure 1, the abdomen results were shown that the differences among age categories are significant (P<0.0001). The highest percentage (20%) was reported in the category group 30-39 years whereas the lowest (7%) in the category group 10-19 years. For chest the results showed that the differences among age categories are significant (P<0.0001). The highest percentage (28%) was reported in the category group 60-69 years whereas the lowest (7%) in the category group 10-19 years. For head and neck the results manifested that the differences among age categories were significant (P<0.0001). The highest percentage (20%) was reported in the category group 50-59 years whereas the lowest (6%) in the category group 70-79 years. For upper limbs the results revealed that the differences among age categories were not significant (P=0.08). The highest percentage (27%) was reported in the category group 20-29 years whereas the lowest (4%) in the category group 40-49 years. For lower limbs the results revealed that the differences among age categories were significant (P<0.0001). The highest percentage (31%) was reported in the category group 20-29 years whereas the lowest percentage (2%) was reported in the category group 50-59 years. In figure (2) the results of CT scan among different age categories for male revealed that the differences were significant (P<0.0001). The highest percentage(17%) was reported in the category group 30-39 years, 40-49 years and 50-59 years whereas the lowest (10%) in the category group 70-79 years. The CT scan revealed that the differences among different body parts categories were significant (P<0.0001). The highest percentage (49%) was reported in the category head and neck whereas the lowest (1%) was in the category of lower limbs. This figure showed that the highest Computerized tomography scan was to the head and neck at age 30-59 years.

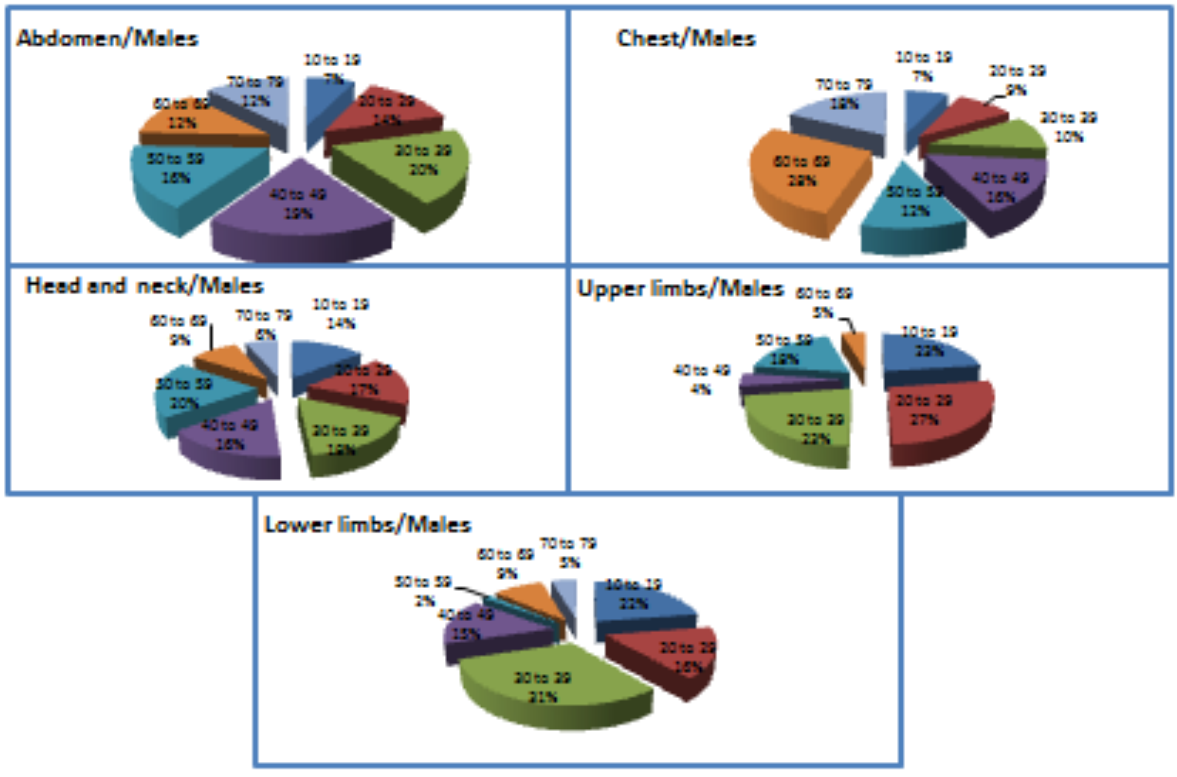

Figure (1): Distribution of CT scans according to the different body parts for males

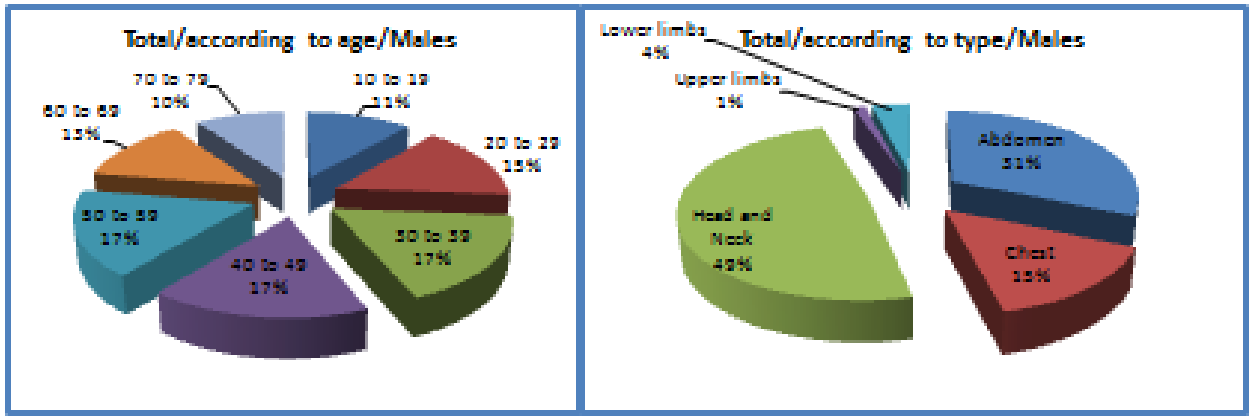

Figure (2): Distribution of CT scans according to the different body parts and different ages for males

Distribution of CT scans according to the different body parts for females

The CT scan results for females were shown in figure (3). The results for abdomen revealed that the differences among age categories were significant (P<0.0001). The highest percentage (22%) was reported in the category group 40-49 years whereas the lowest (4%) in the category group 10-19 years. For chest the results showed that the differences among age categories were significant (P<0.0001). The highest percentage (22%) was reported in the category group 40-49 years whereas the lowest (8%) in the category group 10-19 years. For head and neck the results manifested that the differences among age categories were significant (P<0.0001). The highest percentage (22%) was reported in the category group 30-39 years whereas the lowest (5%) in the category group 70-79 years. For upper limbs the results revealed that the differences among age categories were not significant (P=0.20). The highest percentage (25%) was reported in the category group 20-29 years whereas the lowest (6%) in the category group 40-49 years and 50-59 years. For lower limbs the results revealed that the differences among age categories were not significant (P=0.002). The highest percentage (27%) was reported in the category group 50-59 years whereas the lowest (2%) in the category group 60-69 years. In figure (4) the results of CT scan among different age categories for female revealed that the differences were significant (P<0.0001). The highest percentage (20%) was reported in the category group 40-49 years whereas the lowest (6%) in the category group 70-79 years. The CT scan revealed that the differences among different body parts categories for females were significant (P<0.0001). The highest percentage(52%) was reported in the category of head and neck whereas the lowest (1%) was in the category of upper limbs. This figure indicate that the highest CT scan for females was to the head and neck in the age 40-49 years.

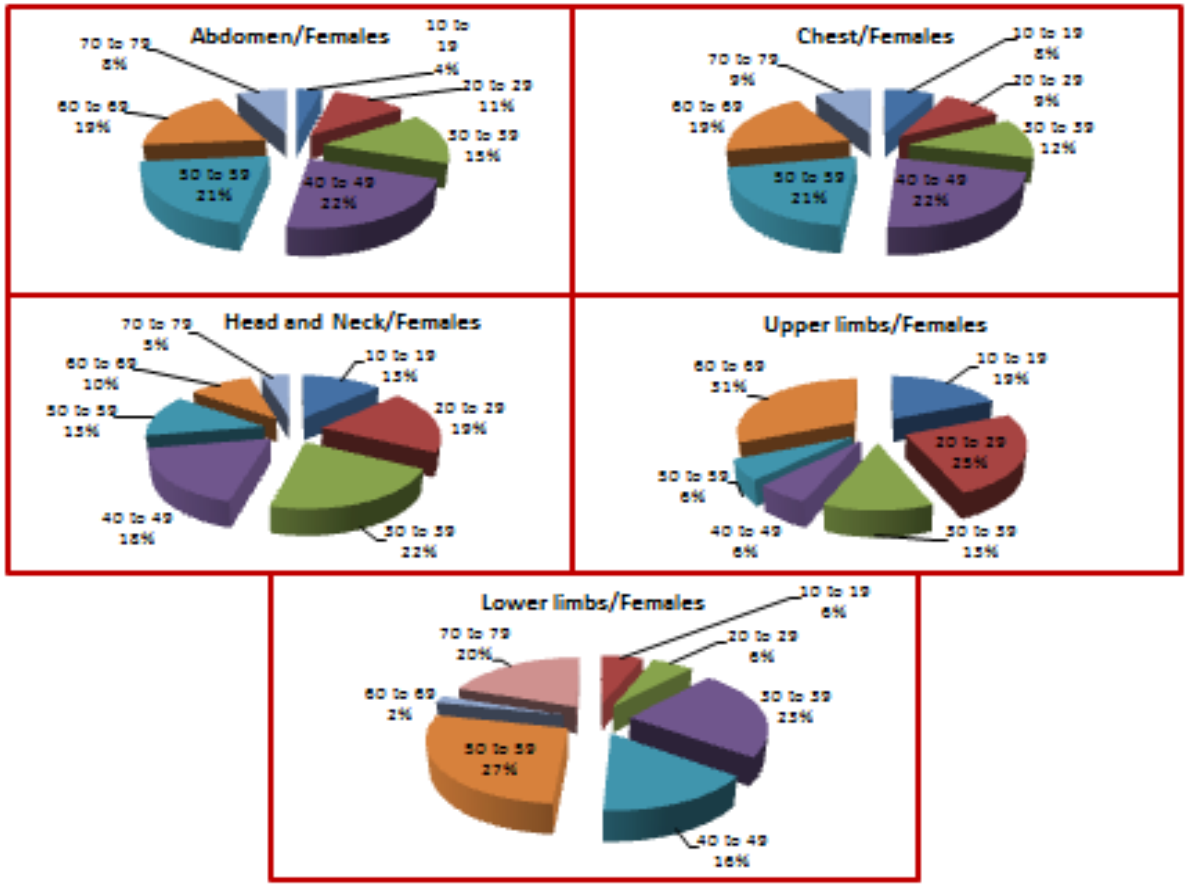

Figure (3): Distribution of CT scans according to the different body parts for females

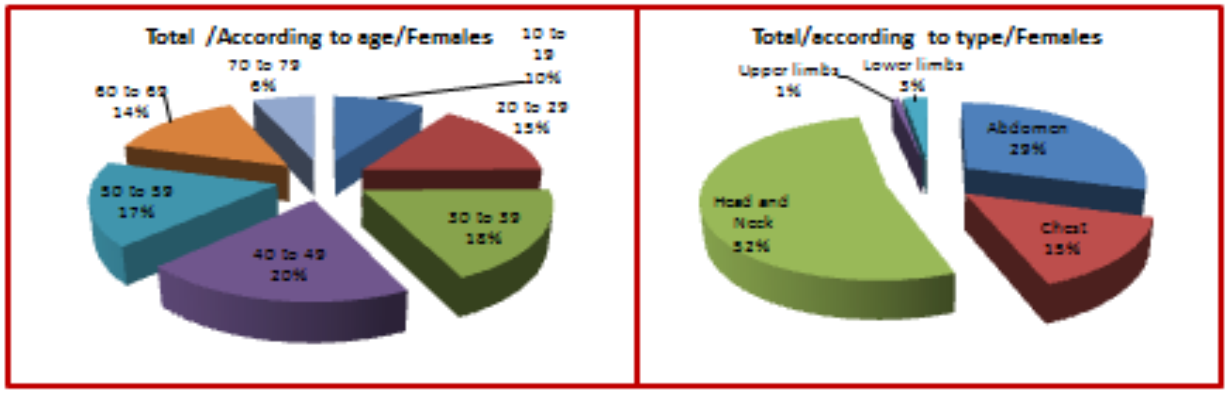

Figure (4): Distribution of CT scans according to the different body parts and different ages for females

In table (2) the ratio of male/female CT scan for abdomen was 0.93 (95% confidence interval 0.81to 1.06); P=0.30 then the ratio increase to 1.00 for chest (95% confidence interval 0.84-1.20) P=0.93.The ratio of head and neck was (1.07) the highest (95% confidence interval 0.96—1.20) P=0.18 while the lowest ratio was(0.62) of upper limbs(95% confidence interval 0.32-1.20) P=0.02.

Table (2): male/female ratio, confidence interval and p value for different body part.

CT scan	Odds Ratio	95% CI	P value
Abdomen/Male Female	0.93	0.81- 1.06	0.30
Chest/Male Female	1.00	0.84 - 1.20	0.93
Head and Neck/Male Female	1.07	0.96 - 1.20	0.18
Upper limbs/Male Female	0.62	0.32 - 1.20	0.16
Lower limbs/Male Female	0.65	0.45 - 0.95	0.02

Distribution of thyroid cancer

According to the Iraqi Cancer Society, the distribution of thyroid cancer according to top ten cancers through 5 years (2012-2016) indicate that the rank of thyroid cancer increase from 10 to 8 (table3) excepted in 2013 the thyroid cancer was outside of top ten ranking. The incidence rate (per 100,000 population by gender) of thyroid cancer was rising from 2.24 in use with years 2013 to 2.96 in 2016 (table 4). The rank of thyroid cancer for females was rising from 8 in 2012 to 2 in 2016. While the rank of thyroid cancer for male was outside of top ten cancers during 2012-2016 (table5).

Table (3): Distribution of thyroid cancer according to top ten cancers in Iraq (2012-2016)

	Rank of cancer	Numbers	% of total
2012	10	580	2.75
2013	-----	-----	------
2014	10	561	2.92
2015	8	972	3.80
2016	8	1,123	4.39

Table (4): Distribution of thyroid cancer and incidence rate (per 100,000 populations by gender in Iraq.

	Total	Male	Female	Incidence rate
2013	521	117	404	2.24
2014	748	187	561	2.92
2015	972	264	708	2.63
2016	1,123	259	864	2.96

Table (5): Distribution of thyroid cancer according top ten cancers in males and females in Iraq.

	Rank of cancer		total	%
	Male	Female		
2012	0	8	446	3.76
2013	0	7	404	3.17
2014	0	8	561	3.95
2015	0	3	708	5.1
2016	0	2	864	6.02

Discussion:

The inequality in the incidence of cancer between males and females led to change in sex ratio among them. This change in ratio is attributed to several reasons such as smoking, infections, sex hormones and other factors. Smoking is one of the most dangerous factors that cause cancer. Continued smoking by people with cancer increasing the frequency of secondary cancer risk [16]. One of the most dangerous factors that cause cancer in humans is caused by some bacteria, viruses and parasites [17]. Various type of cancer also effect negatively or positively by sex hormones [18]. The levels of endocrine hormones play a significant role in the development of cancers for several organs (breast, prostate and lung) that are linked with the sex hormones receptor [19] The other environmental factors are Low exposure to sunlight [20] and lack of physical exercises [21].

There is a great attention to the increased use of CT scans. The benefits of CT scan using are the faster scanning and easy disease detection, but with increased using its defects have been estimated through different studies [22]. The electromagnetic radiation uses in CT scan are more vulnerable when compared to a simple X-ray radiation. This exposure to radiation leading to genetic change of DNA strand either by breaking in the single or double strand or changing in the sequence of the base in the DNA. These changes will leading to the development of cancer [23].As a results, the increased incidence of different types of cancer has been linked to the ionizing radiation doses received by the patient during a computerized tomography scan [24,25]. The frequent use of computerized x-rays and any other procedures that use ionizing radiation to create images of the body has increased fears that the lower probability of developing cancer will increase expansively, increasing the possibility of developing cancer [26, 27].

The combination among ionizing radiation exposed and an elevated risk of cancers has been densely studied. Various studies were generally performed in animals, radiation workers (28), Japanese atomic bomb survivors (29), and patients that treated with radio-therapy (30). There were several studies linking cancer and CT scan. One study linked between dose received from neck CT scans and thyroid cancer [31]. Another study conducted for a number of patients who had undergo of chest or abdomen CT scan. These patients were more likely to die from cancer compare with the general population [32]. In another study a dose-dependent head CT scans raises incidence of brain tumor [33].

In our study there was a greater use of CT scan for head and neck when compared with other CT scan examinations. These results were close agreement to the previous studies in the United States [34], United Kingdom [35], and the Netherlands [36]. In the present study we expected that there was increasing incidence in thyroid cancer following medical radiation for head and neck CT scans. We noticed an influence of age and sex with elevated risk of cancer after radiation exposure. Investigator have detected that sex and age differences in DNA damage and gene reposition or blend combined with radiation exposure may share to the variation in the cancer happened [37, 38]. Like to the previous studies that evaluated the cancer risk and related with radiation, we combined an intense effect of age and sex in growing the risk of cancer after radiation exposure.

According to Iraqi cancer registry the risk for thyroid cancer is one to three times more frequent in females than in males. Indeed, all types of thyroid disease are more popular in women than in men. This capability of women to thyroid disease generally is assumed to have a genetic causing but does not display to any particular phenotype. The link between reproductive factors and menstrual cycle with thyroid cancer has been studied widely, but studies have displayed mixed results [39]. It has been suggested that estrogen may participate to the difference in the occurrence of thyroid cancer even though there stays no strong proof for this except the existence of estrogen receptors in thyroid cells [40, 41]. Estrogen has the ability to start cell proliferation and this has been demonstrated even in stem cells. However, there has been no direct combination with oral contraceptive use, menarche and pregnancy. Thyroid cancer in

pregnancy has been noticed to have both a worse prediction than in non-pregnant women and the same prognosis [42, 43].

Conclusions

Female more than male exposure to radiation by CT examinations. The increased incidence of cancer after CT scan exposure was mostly due to irradiation.

References:

1. T. F. Heston and R. L. Wahl, Molecular imaging in thyroid cancer (2010). Cancer Imaging: vol. 10; no. 1, pp. 1–7.
2. Hegedüs L. Clinical practice the thyroid nodule (2004). N. Engl. J. Med.; 351:1764–1771.
3. Sherman S.I. Thyroid carcinoma (2003). Lancet.; 361:501–511.
4. Machens A, Dralle H. Biological relevance of medullary thyroid microcarcinoma (2012). J Clin Endocrinol Metab ; 97(5):1547–53.
5. Pacini F1, Castagna MG, Cipri C, Schlumberger M. Medullary thyroid carcinoma (2010). Clin Oncol (R Coll Radiol .;22(6):475-85
6. Engelbach M, Gorges R, Forst T, et al: Improved diagnostic methods in the follow-up of medullary thyroid carcinoma by highly specific calcitonin measurements (2000). J Clin Endocrinol Metab. 85(5):1890-4.
7. Kazaure HS, Roman SA, Sosa JA. Medullary thyroid microcarcinoma (2011). Cancer ;118 (3):620–7.
8. A. Y. Chen, A. Jemal, and E. M. Ward, "Increasing incidence of differentiated thyroid cancer in the United States, 1988–2005 (2009). Cancer: vol (115) 16, pp. 3801–3807.
9. Cathy Vakil, Radiation and medical procedures (2017). Can Fam Physician ; 63(10): 774–775.
10. Medicare Payment Advisory Commission. [accessed 15 November 2008];A Data Book: Healthcare Spending and the Medicare Progra.
11. Mettler FA Jr, Wiest PW, Locken JA, Kelsey CA. CT scanning: patterns of use and dose (2000). J Radiol Prot ;20:353-9.
12. Paterson A, Frush DP, Donnelly LF. Helical CT of the body: are settings adjusted for pediatric patients?(2001). AJR Am J Roentgenol ;176: 297-301.
13. McNitt-Gray MF. AAPM/RSNA physics tutorial for residents-topics in CT: radiation dose in CT (2002). Radiographics; 22:1541-53.
14. Brady Z, Cain TM, Johnston PN. Pediatric CT imaging trends in Australia (2011). J Med Imaging Radiat Oncol ; 55: 132-42.
15. Kim KP, Berrington de González A, Pearce MS, Salotti JA, Parker L, McHugh K, et al (2012). Development of a database of organ doses for pediatric and young adult CT scans in the United Kingdom. Radiat Prot Dosimetry ; 150:415-26.
16. Sobus SL Warren GW The biologic effects of cigarette smoke on cancer cells (2014). Cancer 1; 120 (23) :3617-26.
17. Parkin DM. 11. Cancers attributable to infection in the UK in 2010 (2011). Br J Cancer; 105 (S2):S49-S56
18. Siegel RL, Miller KD, Jemal A (2016). Cancer statistics. Cancer J Clin. ; 66:7–30.
19. Lukits J, Remenár E, Rásó E, Ladányi A, Kásler M, Tímár J (2011). Molecular identification, expression and prognostic role of estrogen- and progesterone receptors in head and neck cancer. Int J Oncol.; 30(1):155-60
20. Parkin DM, Mesher D, Sasieni P. 13. Cancers attributable to solar (ultraviolet) radiation exposure in the UK in 2010 (2011). Br J Cancer; 105(S2):S66-S9.
21. Parkin DM. 9. Cancers attributable to inadequate physical exercise in the UK in 2010 (2011). Br J Cancer; 105 (S2):S38-S41.
22. Ginat, D. T., & Gupta, R. (2014). Advances in computed tomography imaging technology. Annual review of biomedical engineering, 16, 431-453.
23. Brenner, D. J., & Hall, E. J. (2007). Computed tomography—an increasing source of radiation exposure. New England Journal of Medicine, 357(22), 2277-2284
24. Metayer C, Lynch CF, Clarke EA, et al. (2000). Second cancers among long-term survivors of Hodgkin's disease diagnosed in childhood and adolescence. J Clin Oncol.; 18(12):2435–2443.
25. Boice JDJ, Day NE, Andersen A, et al. (1985). Second cancers following radiation treatment for cervical cancer. An international collaboration among cancer registries. J Natl Cancer Inst.; 74:955–975.
26. Berrington de González A, Mahesh M, Kim K-P, et al (2009). Projected cancer risks from computed tomographic scans performed in the United States in 2007. Archives of Internal Medicine; 169(22):2071–2077.
27. Smith-Bindman R, Lipson J, Marcus R, et al (2009). Radiation dose associated with common computed tomography examinations and the associated lifetime attributable risk of cancer. Archives of Internal Medicine; 169(22):2078–2086.
28. Cardis E, VrijheidM, Blettner M, et al. (2005). Risk of cancer after low doses of ionising radiation: retrospective cohort study in 15 countries.BMJ ;331; (7508):77.
29. Ron E, Preston DL, Mabuchi K, et al. (1994). Cancer incidence in atomic bomb survivors. Part IV: comparison of cancer incidence and mortality. Radiat Res.; 137(2 suppl):S98–112
30. Roychoudhuri R, Evans H, Robinson D, et al. (2004). Radiation-induced malignancies following radiotherapy for breast cancer. Br J Cancer; 91(5):868–872.
31. Tipnis SV, Spampinato MV, Hungerford J, et al. (2015). Thyroid doses and risks to adult patients undergoing neck CT examinations. AJR Am J Roentgenol; 204(5):1064–1068.
32. Zondervan RL, Hahn PF, Sadow CA, et al. . Body CT scanning in young adults: examination indications, patient outcomes, and risk of radiation-induced cancer. Radiology.2013;267(2):460–469.
33. Huang WY, Muo CH, Lin CY, et al. (2014). Paediatric head CT scan and subsequent risk of malignancy and benign brain tumour: a nation-wide population-based cohort study. Br J Cancer; 110:2354-60.
34. Miglioretti DL, Johnson E, Williams A, et al.(2014). The use of computed tomography in pediatrics and the associated radiation exposure and estimated cancer risk. JAMA Pediatr. ; 167:700–707.
35. Pearce MS, Salotti JA, McHugh K, et al.(2011). CT scans in young people in Northern England: trends and patterns 1993–2002. Pediatr Radiol. ; 41:832–838.
36. Meulepas JM, Ronckers CM, Smets AMJB, et al. (2014). Leukemia and brain tumors among children after radiation exposure from CT scans: design and methodological opportunities of the Dutch Pediatric CT Study. Eur J Epidemiol. ; 29:293–301.
37. Su X, Li Z, He C, et al. (2016). Radiation exposure, young age, and female gender are associated with high prevalence of RET/PTC1 and RET/PTC3 in papillary thyroid cancer: a meta-analysis. Oncotarget. ; 7(13):16716–16730.
38. Hernández L, Terradas M, Camps J, et al. (2016). Aging and radiation: bad companions. Aging Cell; 14 (2):153–161.
39. Zamora-Ros R, Rinaldi S, Biessy C, et al. (2016). Reproductive and menstrual factors and risk of differentiated thyroid carcinoma: The EPIC study, Int J Cancer.
40. Yane K, Kitahori Y, Konishi N, et al.(1994). Expression of the estrogen receptor in human thyroid neoplasms, Cancer Lett ; 84:59–66
41. akeichi N, Ito H, Haruta R, et al., Relation between estrogen receptor and malignancy of thyroid cancer, Jpn J Cancer Res, 1991;82:19–22.
42. Messuti I, Corvisieri S, Bardesono F, et al. (2014). Impact of pregnancy on prognosis of differentiated thyroid cancer: clinical and molecular features ;170:659–66.
43. Yasmeen S, Cress R, Romano PS, et al.(2009). Thyroid cancer in pregnancy, Int J Gynaecol Obstet. ;91:15–20