Journal of Chitwan Medical College 2022;12(40):6-9
Available online at: www.jcmc.com.np

ORIGINAL RESEARCH ARTICLE

ROLE OF PET-CT IN EVALUATION OF DIFFERENT TYPES OF CANCER: A RETROSPECTIVE STUDY OF CANCER PATIENTS AT A DIAGNOSTIC CENTER IN NEPAL

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Received: 16 May, 2022

Accepted: 16 Jun, 2022

Published: 30 Jun, 2022

Key words: Computed Tomography; Disease Progression; F-18 Fluorodeoxyglucose; Gastrointestinal Neoplasms; Positron Emission Tomography.

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*DOI:*https://doi.org/10.54530/jcmc.1099

Citation

Shahi RR, Bhattarai B, Khadka S, Rijal T, Lamichhane B, Yadav M, Shah R, Yadav GK, Basnet B. Role of PET-CT in evaluation of different types of cancer: a retrospective study of cancer patients at a diagnostic center in Nepal. Journal of Chitwan Medical College.2022;12(40):6-9.

Peer Reviewed

ABSTRACT

Background: Fluorodeoxyglucose (FDG) PET (Positron Emission Tomography) is used for the evaluation of different solid cancers as well as characterization of solitary pulmonary nodules. This study was conducted with objectives to determine the prevalence of various types of cancer; to assess the status of cancer in terms of progression, regression, or static; and for metastatic workup by PET-CT scan.

Methods: A retrospective cross-sectional study involving 545 patients of different cancers from all over Nepal was performed at Kundalini Diagnostic Center from July 2019 to March 2020. The data were analyzed using IBM SPSS version 22.

Results: The mean age of study participants was 53.91±16.63 years. Out of total 545 participants, (499, 91.56%) tested positive for cancer with PET-CT scan with a higher proportion belonging to 50-59 years age group. Half of the participants (275, 50.46%) had disease progression and one-fifth of the participants (144, 26.42%) had static disease. Majority of the patients (139, 27.85%) were diagnosed with some form of gastrointestinal tumor. Though the data was statistically insignificant, participants with age 40-60 years were 1.18 times more likely to have cancer detected (OR 1.188, 95%CI 0.46-3.02).

Conclusions: PET-CT scan is a valuable tool for assessment of characteristics of different types of cancer although differentiation of primary or a second primary or metastasis may not be possible. There is no significant association between various age groups or gender with overall cancer predisposition.

INTRODUCTION

Cancer is a prominent cause of death around the globe. Out of total deaths due to cancer, nearly 70% occur in low- and middle-income countries (LMICs).[1] Among total population of Nepal (2,91,36,808), 20,508 new cases of cancer and 36906 prevalent cases of cancer for five years have been reported by the World Health Organization (WHO) as of 2020.[2] Late-stage presentation and delay in diagnosis and treatment are the problems mainly in LMICs. Cancer mortality can be decreased by early diagnosis and treatment. Substantial improvements in cancer care can be assured in this way.[3] Radiological examinations like Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) only identify the anatomy and morphology of tumors. Positron emission tomography/computed tomography (PET-CT), on the other hand, has the additional advantage of revealing biochemical and physiological variation in tumors, before other markers of response.[4] It is probable to image the entire body in a single session, increasing the chances for the discovery of unanticipated diseases or cancers.[5] Fluorodeoxyglucose (FDG) PET-CT has become a routine tool in the investigative part for the accurate staging, restaging, assessment of response to therapy, assessment of cancer recurrence, surveillance, and follow-up for numerous primary malignancies.[6] Although PET scan an expensive investigation, it helps avoid several unnecessary investigations and guides the treating clinicians for making optimal treatment decisions.[7]

This study was conducted with the objectives to determine the prevalence of various types of cancers in relation to age and gender; to assess the status of cancer in terms of progression, regression, or static; and to assess metastasis of different types of cancers by PET-CT scan.

METHODS

A retrospective cross-sectional study was conducted at Kundalini Diagnostic Center (KDC), Kathmandu, Nepal from July 2019 to March 2020. A total of 545 participants referred to KDC for whole-body PET-CT scan from various hospitals all over Nepal was selected for the study using a convenience sampling technique.

The ethical approval was obtained from the Nepal Health Research Council (NHRC) (Ref No: 1840). Administrative

clearance was also received from the KDC. Informed consent to participate in the study was obtained from all participants. All procedures performed in studies involving human participants followed the Declaration of Helsinki, 1964, and its later amendments or comparable ethical standards. Patient visting KDC irrespective of age and sex and willing to give informed consent were included in the study. Patients with incomplete data and those who refused to give consent were excluded from the study.

Data were analyzed using IBM SPSS® v21 (IBM, Armonk, NY). Demographic and clinical characteristics were calculated in frequency and proportion. The distribution of cancer by age group was shown using line graph. The frequency and proportion of different types of cancer were calculated. Finally, the association of demographic characteristics and cancer defined by PET-CT was shown with a univariable model. A P-value of <0.05 was considered statistically significant.

RESULTS

The mean age of study participants was 53.91±16.63 years with the minimum age of 2 years and maximum at 97 years. A greater proportion of the participants belong to the age group 40-60 years (241, 44.22%). More than half of the participants (281, 51.56%) were female (Table 1).

Table 1: Demographic characteristics of participants (N=545)

Characteristics	Frequency (%)
Age	
Mean± SD (Range)	53.91±16.63 (2-97)
<40 years	103 (18.90)
40-60 years	241(44.22)
>60 years	201(36.88)
Gender	
Female	281(51.56)
Male	264(48.44)

Although majority of the participants (91.56%, 499) tested positive, about one-tenth (46, 8.44%) of the participants were tested negative with a PET-CT scan. The cancer status was progressive in half of the participants (275 50.46%) and static in one-fifth of the participants (144, 26.42%) (Table 2).

Table 2: Clinical characteristics of participants (N=545)

Characteristics	Frequency (%)
Cancer (PET-CT)	
No	46(8.44)
Yes	499(91.56)
Status of cancer	
Not defined/unknown	70(12.54)
Static	144(26.42)
Progressive	275(50.46)
Regressive	56(10.28)

A greater proportion of participants diagnosed with cancer belong to the age group 50-59 years followed by 60-69 years (Figure 1).

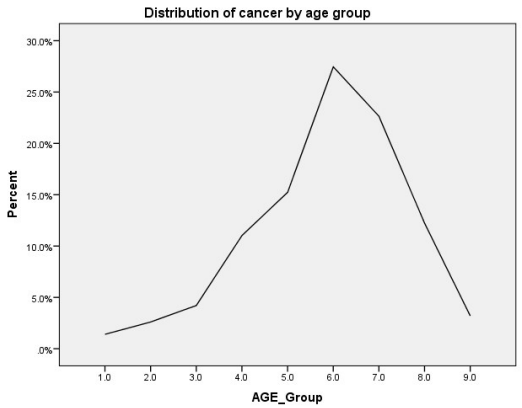

Figure 1: Distribution of cancer by age group (n=499)

Age group [<10 years=1, 10-19=2, 20—29=3, 30-39=4, 40-49=5, 50-59=6, 60-69=7, 70-79=8, >80 years=9]

More than one-fourth of the participants (139, 27.85%) were diagnosed with some form of gastrointestinal tumors (Table 3).

Table 3: Categorization of types of cancer based on system (n=499)

S.N.	Types of cancer	Frequency (%)
1	Head and neck	42(8.42)
2	Lung/Respiratory	74(14.82)
3	Breast	69(13.83)
4	Gastrointestinal	139(27.85)
5	Urinary tract	16(3.21)
6	Genital organs	66(13.23)
7	Musculoskeletal	20(4.01)
8	Others	73(14.63)

Participants with age 40-60 years were 1.18 times more likely to have cancer detected with PET-CT (OR 1.188, 95%CI 0.46-3.02), but the data was statistically insignificant. The gender of the participants did not have statistical significance with cancer detected with a PET-CT scan.

Table 4: Association of demographic factors with cancer defined by PET-CT

Factors	Cancer		OR	Univariable model[1]	
	No	Yes			
	Frequency (%)	Frequency (%)		95% CI	p-value
Age					
<40	7(6.80)	96(93.20)	1		0.726
40-60	14(5.81)	227(94.19)	1.18	0.46-3.02	0.135
>60	25(12.44)	176(87.56)	0.51	0.21-1.23	0.825
Gender					
Female	23(8.19)	258(91.81	1		
Male	23(8.71)	241(91.29)	0.93	0.51-1.71	0.825

[1] *Binary logistic regression; OR=Odd's ratio*

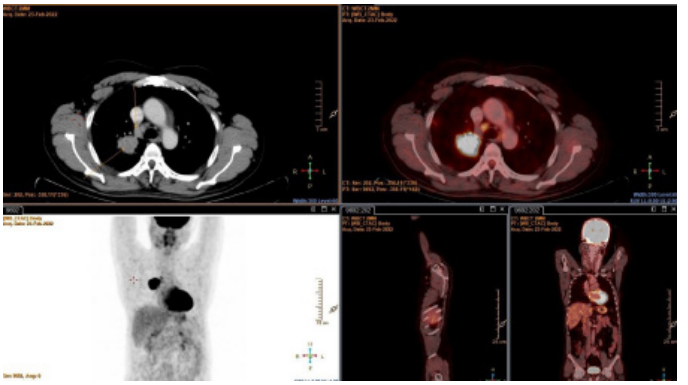

Figure 2: Ca Lung (Rt) (CT scan; Lung mass seen, suspicious for primary lung malignancy with the paratracheal lymph node considered normal by CT size criteria. PET-CT scan; Hypermetabolic lung mass with paratracheal nodal metastasis)

DISCUSSION

PET-CT is a hybrid imaging modality that fuses the functional information of PET with the structural details of the CT scan. Although it has a history of many decades, its real growth in clinical applications in oncology, cardiology, neurology, and psychiatry has occurred in the last two decades. In oncologic imaging, PET scan has a major advantage in that whole-body imaging is possible that aids in accurate diagnosis, staging, restaging, response evaluation, follow-up, radiotherapy planning, and initial detection of recurrent disease.[8]

PET enables imaging and quantification of cellular function based on the uptake and metabolism of FDG in the cell.[9] In cancerous cells, metabolic changes occur much earlier than structural changes. Thus PET scan detects the disease at the metabolic level earlier than CT or MRI (Figure 1).[10] The mean age of patients undergoing PET-CT scan in our study was 53.91±16.63 years with an age range from 2-97 years with 44.2% patients in the age group of 40-60 years. This is similar to a study by Ishi et al and Meyerhoefer et al where the mean ages of patients were 59.6 years and 56.4 years respectively.[11,12] The predilection to this age group may be due to the presentation of malignancies towards the later half of life. In this study, the female to male ratio was 1.06:1. Among the 545 patients scanned, the status of cancer was progressive in 50.46%, static in 26.42%,and regressive in 10.28%. Whereas, 8.44% of patients were tested negative for cancer and 12.84% cases were of not-defined /unknown status. The negative tests might be attributed to the complete remission of the disease by treatment.

Among 499 patients diagnosed with cancer, 50-59 years age group had the highest prevalence followed by the age group of 60-69 years while the findings of a study by White et al showed the highest incidence in the age range of 65-69 years.[13] There was an inclining trend of the disease incidence in the age group of 65-69 years followed by a declining tendency as age advances further.[13] Patients in the age group of 40-60 years had odds of 1.18 to have viable cancer in this study. The present study also showed a similar trend. The increasing propensity of the disease with age might be the reason for the inclining trend whereas the various factors such as socio-economic condition, unwillingness for therapy with increasing age, and physical condition thereof may contribute to the declining trend of the disease in our study.

In this study, the majority of the patients were diagnosed with gastrointestinal (GI) malignancy (27.85%) followed by lung malignancy (14.82%), breast (13.83%), genital organs (13.23%), and head and neck tumor (8.42%) by PET-CT scan. This data contrasts the findings of a study by Catalano et al, where patients undergoing PET-CT most commonly had breast cancer (26.1%) followed by lymphoma (13.4%), colorectal (11.19%), and lung cancers (7.4%).[14] In a study by Sung et al, the highest incidence of cancer reported were those of breast, lung, and prostate in 11.7%, 11.4%, and 7.3% respectively.[15] Unlike the above studies, the highest incidence of GI cancer in our study may be related to the accessibility to the PET-CT scan and awareness of the people about the disease. Since we included all GI cancers in one frame while other studies separated them into gastric cancers, colon cancers, rectal cancers, etc and thus reported a lower incidence of separate cancers while our study combining all these in gastrointestinal cancer revealed a higher incidence of 27.85 %. The incidence of cancer in Nepal in decreasing order of frequency were lung (14.7%), cervix (11.2%), and breast (7.9%). However, the incidence of gall bladder, stomach, and colorectal cancers are 6.2%, 5.9%, and 5.5% respectively. This accounts for a cumulative incidence of GI cancer at 17.6%.[16] In this meaning, the findings of our study match with the national data of cancer incidence where GI cancers had higher incidence when diagnosed collectively. In terms of the incidence of other cancers, our data were consistent with the national data on cancer incidence.

Worldwide cancer data from the American Institute for Cancer Research showed the highest incidence of cancer in decreasing order of frequencies as breast followed by lung, colorectal, and prostate cancers.[17] This is also shown by the findings of our study. However, a significantly lower risk of prostate cancer in our study might be related to referral bias because for prostate cancer most extensively performed prostate-specific membrane antigen (PSMA) PET scan is not available in Nepal and bone scan is also not available in KDC.

To our knowledge, this is the first study in Nepal showing the role of PET-CT scans for the assessment of different types of cancer. Since PET-CT is available only in two places in Nepal as of 2022, this data is likely representative of the entire population of Nepal although people residing in rural areas are unlikely to be involved because of economic and accessibility issues.

Since PET-CT scan was used for identification of various types of cancers rather than tissue diagnosis, cancer shown could be either primary cancer or a second primary or even metastasis. Thus further studies confirming the primary with tissue diagnosis are warranted in the future for a more

accurate assessment of different types of cancer. Since PET-CT scan is not indicated routinely in all kinds of cancers like prostate cancer, thyroid cancer, neuroendocrine tumors, pheochromocytomas, paragangliomas,etc, data may not be representative of all kinds of cancer. Thus referral biases are likely because several cancers may be missed.

CONCLUSION

PET-CT helps in precise diagnosis, staging, restaging, response assessment, follow-up, radiotherapy planning, and early detection of recurrent disease. The prevalence of gastrointestinal cancer was found highest followed by lung, breast, and genito-urinary cancers. There is no significant association between various age groups or gender on overall cancer predisposition. Since PET-CT scan may not differentiate primary or a second primary or metastasis, additional confirmatory diagnostic techniques like tissue biopsy are essential. Though being a precise diagnostic technique, its availability and affordability remain an issue for the countries with low and middle-income economies like Nepal.

CONFLICT OF INTEREST: None

FINANCIAL DISCLOSURE: None

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