First Five Years Performance of FDG PET-CT in Institute of Nuclear Medical Physics, Savar

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ABSTRACT

Background: In an effort to improve Bangladesh's molecular imaging capabilities, the Institute of Nuclear Medical Physics (INMP), Savar, which is governed by the Bangladesh Atomic Energy Commission (BAEC), inaugurated its first FDG PET CT scan in September 2018. We will take a look at the first five years of FDG PET CT services provided to cancer patients at INMP in this article.

Patients and Methods: The patients were advised to fast overnight before the day of the scan. A whole-body PET-CT scan was acquired with Philips 128-slice Ingenuity TF, one hour after intravenous injection of 18F FDG. Patients who had undergone FDG PET CT scans at INMP, Savar, from September 2018 to December 2023 were retrospectively included, and INMP report databases were reviewed for demographic analyses.

Results: A total of 2879 patients underwent FDG PET CT scans for various clinical oncological and non-oncological indications from September 2018 to December 2023. In 2018, a total of 27 patients were scanned in the first year of the inauguration of FDG PET CT at INMP, Savar. Thereafter, 332 in 2019, 469 in 2020, 399 in 2021, 716 in 2022, and 936 in 2023 were scanned subsequently. A total of 12 patients underwent PET-CT scans for non-oncological indications; among them, tuberculosis was 75%. The top five most common primary malignancies were lymphoma (26.4%), carcinoma breast (21%), gastrointestinal carcinoma (9.6%), carcinoma lung (8.8%), and carcinoma ovary (4.6%). Among 762 lymphoma patients, non-Hodgkin's lymphoma was 58.5%. The majority of patients were more than 61 years of age, with male predominance (52%). The percentage of DM was 34.0%, and dyslipidemia was 27%. Among 980 diabetic cancer patients, 78 had fasting hyperglycemia and required insulin injections before a PET-CT scan.

Conclusions: Despite the COVID-19 pandemic and initial uncertainty about FDG availability, there has been a notable increase in FDG PET-CT scanning in INMP from 2018 to 2023. This considerable upsurge is extremely rewarding and plays a critical role in cancer management nationally.

Keywords: FDG PET-CT, Oncology, Cancer patients, Institute of Nuclear Medical Physics

INTRODUCTION

The leading cause of death worldwide is cancer. Early diagnosis, pre-therapeutic baseline staging, restaging, treatment response, follow-up, and detection of unknown primary factors are essential for optimum clinical management. Fluorodeoxyglucose Positron Emission Tomography Computed Tomography (FDG PET-CT) gives metabolic information because cancer cells take in a lot of glucose before their anatomical change occurs.

An FDG PET scan can find abnormal tumors because cancer cells use a lot of glucose. This is because of the Warburg effect, which says that an injected radioactive glucose analog called FDG is found in higher concentrations in malignant cancers than in healthy other tissues (1). The first PET-CT scan in Bangladesh was started in a private hospital in 2012. At present, there are three centers under the Bangladesh Atomic Energy Commission (BAEC) that have FDG PET-CT facilities. In an effort to improve Bangladesh's molecular imaging capabilities, the Institute of Nuclear Medical Physics (INMP), Savar, which is governed by BAEC, inaugurated its first FDG PET CT scan in September 2018 with the Philips Ingenuity TF machine. Over the last five years, patient referral into INMP for FDG PET-CT has been increasing and thus plays a pivotal role in patient management across the country and contributing to the national health care upgrading system.

PATIENTS AND METHODS

The patients were advised to fast overnight before the day of the scan. A whole-body PET-CT scan was acquired

with a Philips 128-slice Ingenuity TF one hour after intravenous injection of 18F-FDG. Patients who had undergone FDG PET CT scans at INMP, Savar, from September 2018 to December 2023 were retrospectively included, and INMP report databases were reviewed for demographic analyses.

RESULTS

A total of 2879 patients underwent FDG PET CT scans for various clinical oncological and non-oncological indications from September 2018 to December 2023. In 2018, a total of 27 patients were scanned in the first year
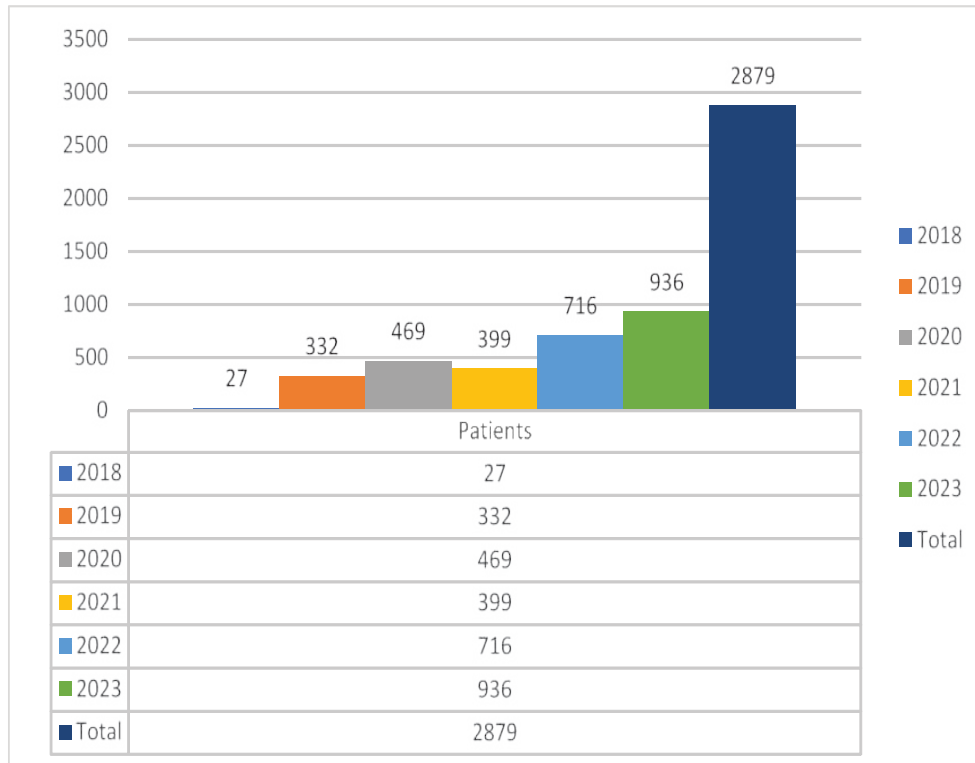

	Patients
■2018	27
■2019	332
■2020	469
■2021	399
■2022	716
■2023	936
■Total	2879

Figure 1: The demographic distribution of the oncological patients attending at INMP from 2018 to 2023

of the inauguration of FDG PET CT at INMP, Savar. Thereafter, 332 in 2019, 469 in 2020, 399 in 2021, 716 in 2022, and 936 in 2023 were scanned, as subsequently shown in Figure 1.

A total of 12 patients underwent PET-CT scans for non-oncological indications, which included tuberculosis 75% (09), Cushing disease 17% (2), and recurrent ascites 8% (1), as shown in Figure-2
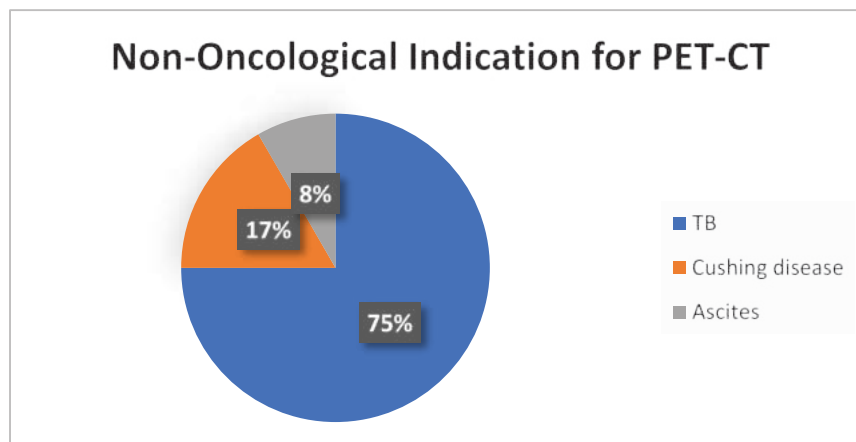

Figure 2: The distribution of non-oncological indications of PET-CT scan at INMP

The age distribution of the study patients is shown in Figure 3. It was observed that the majority (44.2%) of patients belonged to > 61 years old, followed by 41-60 years old (29.5%).
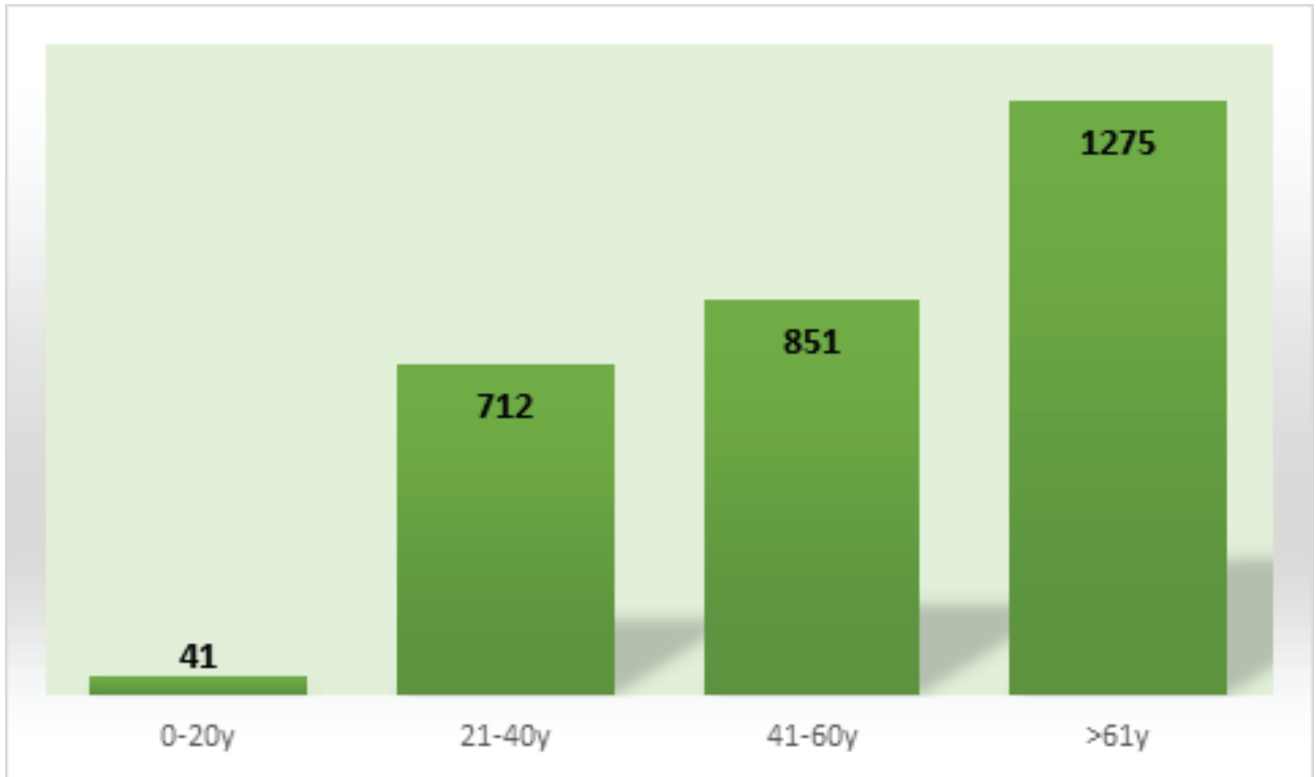

Figure 3: Bar chart diagram showing the total patients referred to INMP according to age.

The gender distribution of the study population is shown in Figure 4, with a male predominance 52% (1497).
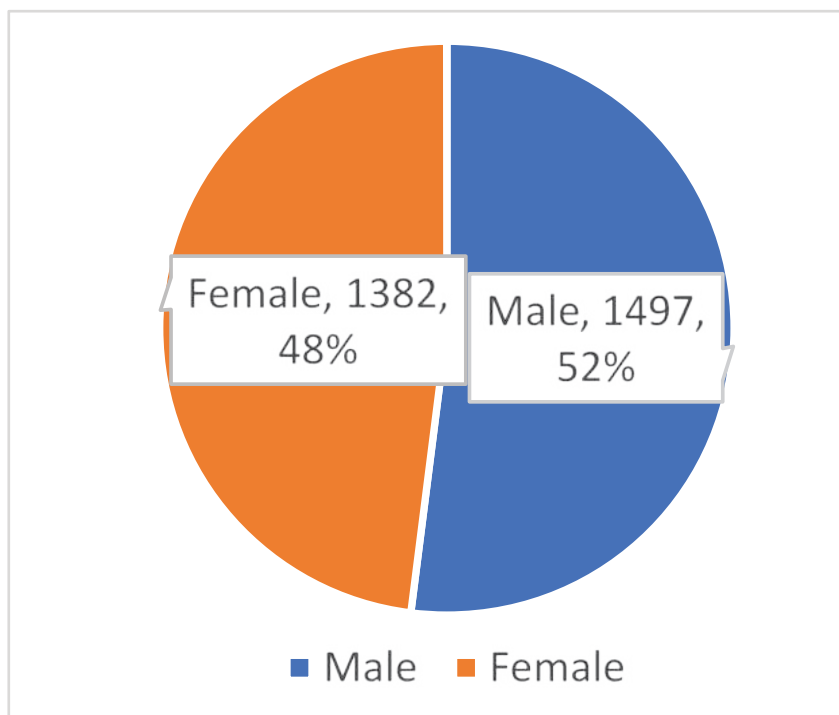

Figure 3: Bar chart diagram showing the total patients referred to INMP according to age.

The distribution of the different carcinoma patients is shown in Figure 5. It was observed that lymphoma was the most prevalent carcinoma (26.4%). Following lymphoma, the other four most common primary malignancies were carcinoma breast (21%), gastrointestinal carcinoma (9.6%), carcinoma lung (8.8%), and carcinoma ovary (4.6%). Other malignancies were carcinoma of unknown primary (CUP), prostate, testis, cervix, sarcoma, melanoma, hepatobiliary, head-neck, and thyroid.
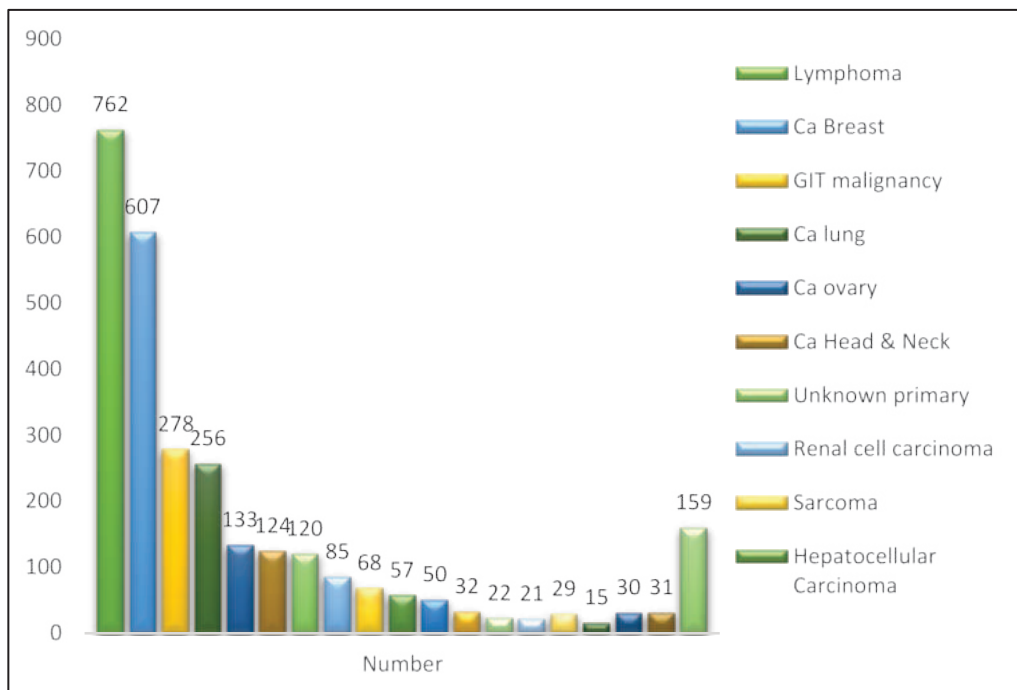

Figure 5: Frequency distribution of total referred patients to INMP according to indications

Figure 6 shows the distribution of lymphoma patients according to type. Among 762 lymphoma patients, non-Hodgkin's lymphoma (NHL) was 58.5% (446).
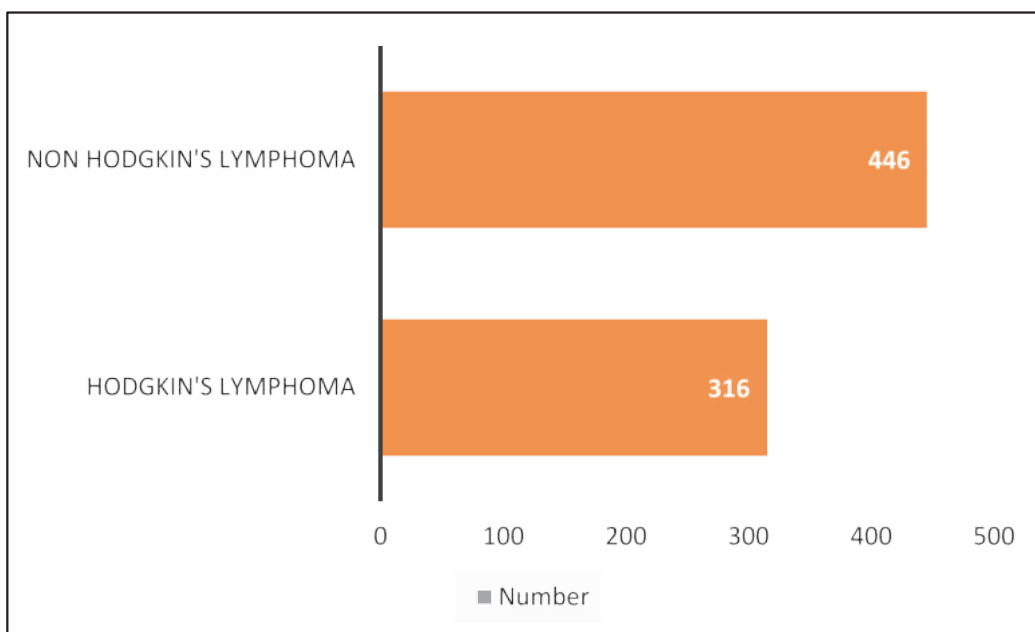

Figure 6: Lymphoma patients with types attending INMP

Figure 7 shows the distribution of co-morbidity among carcinoma patients. It was observed that the majority of 980 (34.0%) patients had diabetes, followed by dyslipidemia 780 (27.0%). The distribution of hypertension, hypothyroidism, coronary artery disease, and chronic kidney disease (CKD) was also given in Figure 7.
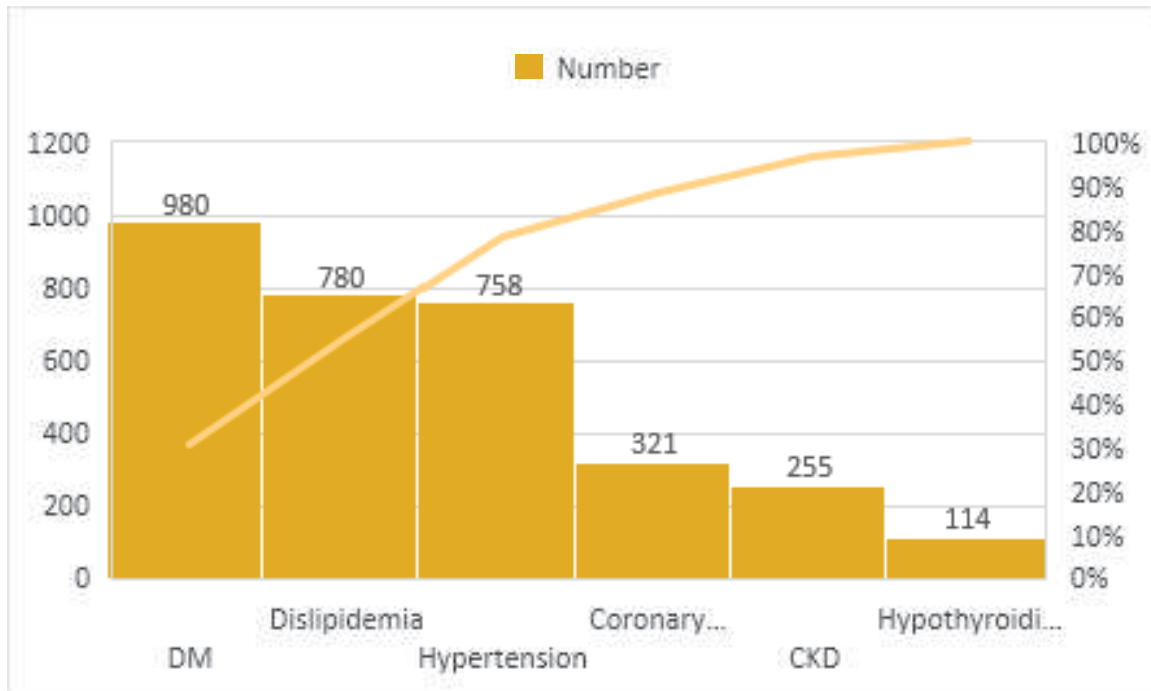

Figure 7: Total number of oncological patients according to co-morbidity

Figure 8 shows the distribution of diabetic patients according to fasting hyperglycemia. Among 980 diabetic cancer patients, 78 had fasting hyperglycemia and required insulin injections before a PET-CT scan.
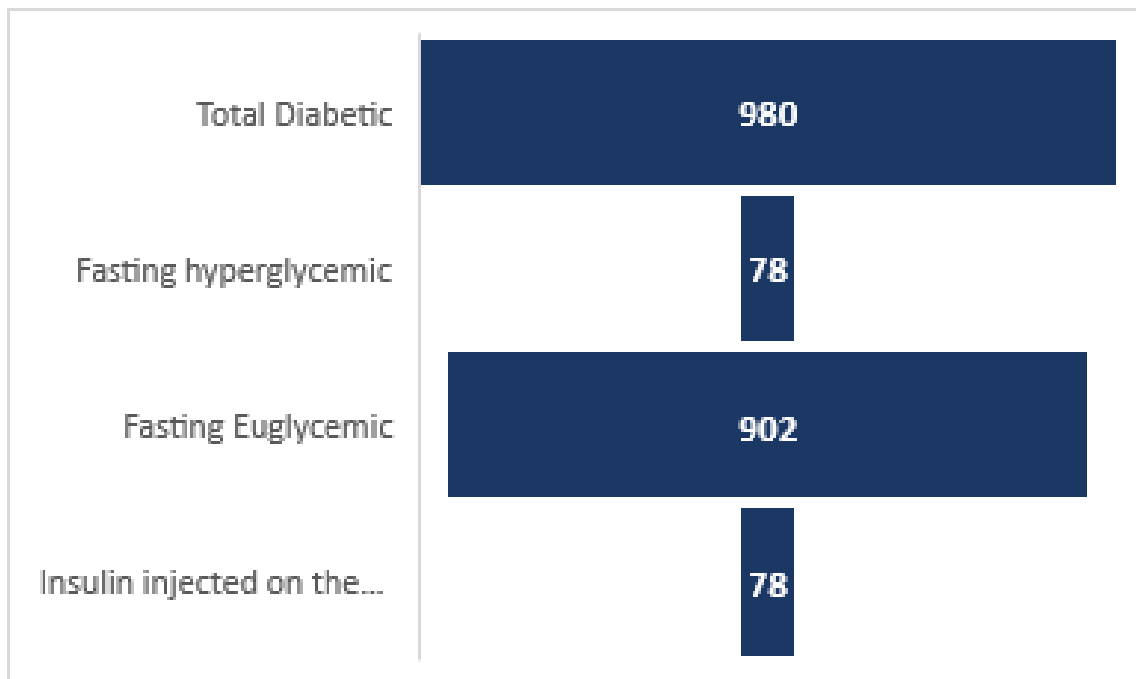

Figure 8: Total diabatic patients according to hyperglycemia requiring insulin injection

Performance of FDG PET-CT at INMP

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DISCUSSION

In this study, we found cancer patients for PET-CT scans were rising from 2018 to 2023 (Figure 1), showing 27 in 2018 and 936 in 2023. Worldwide, cancer incidence and mortality are rapidly growing. The reasons for this rising cancer are complex and may be due to changes in the prevalence and distribution of the main risk factors, several of which are associated with socioeconomic development (1, 2). Global Cancer Statistics 2018 also showed the rising incidence of cancer in 185 countries (3), which also resembled our current study. It is also to be noted that the stability of the FDG PET-CT scans conducted during the COVID-19 pandemic year (2020–2022) further attests to the dependability and superior quality of the services that INMP provides to cancer patients.

In this current study, it was observed that PET-CT scans were done at INMP for non-oncological purposes (Figure 2), predominantly for TB (75%). FDG uptake by tuberculous lesions is a significant sign of active TB. A study showed that FDG PET-CT scans can play an important role in the localization, extension, and differentiation between active and latent TB and can evaluate the disease status and modification of treatment regimes in non-responders cost-effectively (4). Another study showed that FDG PET-CT allows an easy evaluation of early therapeutic responses in patients with TB, particularly extra-pulmonary TB (5).

The results of this study showed that the majority (44.2%) of patients were >61 years old, with 41 to 60 years old coming in second (Figure 3). Cancer risk increases with advancing age, with individuals aged 65 years and older making up 58% of newly diagnosed cancers in developed countries and 40% in developing countries (6). A study proposed that the high prevalence of cancer in older individuals simply reflects a more prolonged exposure to carcinogens (7). Our study's findings align with those studies as well.

There were a total of 2879 patients in this study, and 52% of them were men (Figure 4). This was similar to other recent studies (8, 9) that found the risk of cancer is much higher in men than in women. This is because of differences in hormones, body mass index, viral infections, cancer susceptibility, and access to and use of health care (9).

In the current study, it was observed that the commonest carcinoma in patients was lymphoma (Figure 5), and NHL patients were predominant (58.5%) among lymphoma patients (Figure 6). NHL is the most prevalent kind of lymphoma, accounting for about 85% of all lymphomas (10). In 2020, an estimated 544,000 new cases of NHL were diagnosed worldwide, and approximately 260,000 people died from the disease (11). FDG PET-CT is now widely used to evaluate baseline staging, re-staging and to see the treatment response (12). The trend in the increased prevalence of NHL is also reflected in the INMP patient database.

In this study, 34% (980) of patients had diabetes and among total diabetic cancer patients, 78 patients were found with fasting hyperglycemia who required insulin injection before the PET-CT scan (Figures 7 and 8). A systematic review and meta-analysis of population-based observational reports of worldwide epidemiologic data showed that diabetes is associated with a moderately increased risk of all-cancer incidence and mortality (13). Insulin resistance and secondary hyperinsulinemia are thought to play a role in the higher risk of cancer in people with diabetes. This is because insulin may have a mitogenic effect and promote carcinogenesis by increasing oxidative stress (13, 14). Another study showed intravenous short-acting insulin can be safely used to obtain optimal-quality FDG PET-CT scan images in hyperglycemic diabetic patients on the day of the scan (15).

CONCLUSION

Despite the COVID-19 pandemic and initial uncertainty about FDG availability, there has been a notable increase in FDG PET-CT scanning in INMP from 2018 to 2023. This considerable upsurge is extremely rewarding and plays a critical role in cancer management nationally.

REFERENCES

1. Gersten, O. and Wilmoth, J.R., 2002. The cancer transition in Japan since 1951. Demographic Research, 7, pp.271-306.

2. Omram, A.R., 2001. The epidemiologic transition: a theory of the epidemiology of population change. Bulletin of the World Health Organization, 79(2), pp.161-170.

3. Bray, F., Ferlay, J., Soerjomataram, I., Siegel, R.L., Torre, L.A. and Jemal, A., 2018. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA: a cancer journal for clinicians, 68(6), pp.394-424.

4.   Zohra, F.T., Begum, S.M., Akram, A.F., Khan, M.A.S. and Begum, F., 2019. 18F FDG PET-CT Imaging in the Evaluation of Diagnosed Extra Pulmonary Tuberculosis. Bangladesh Journal of Nuclear Medicine, 22(1), pp.9-14. Available from: https://asiajol.info/index.php/BJNM/article/view/40496

5.   Martinez, V., Castilla-Lievre, M.A., Guillet-Caruba, C., Grenier, G., Fior, R., Desarnaud, S., Doucet-Populaire, F. and Boué, F., 2012. 18F-FDG PET/CT in tuberculosis: an early non-invasive marker of therapeutic response. The International journal of tuberculosis and lung disease, 16(9), pp.1180-1185.

6.   Nolen, S.C., Evans, M.A., Fischer, A., Corrada, M.M., Kawas, C.H. and Bota, D.A., 2017. Cancer—incidence, prevalence and mortality in the oldest-old. A comprehensive review. Mechanisms of ageing and development, 164, pp.113-126.

7.   Dix, D., Cohen, P. and Flannery, J., 1980. On the role of aging in cancer incidence. Journal of theoretical biology, 83(1), pp.163-173.

8.   Kim, H.I., Lim, H. and Moon, A., 2018. Sex differences in cancer: epidemiology, genetics and therapy. Biomolecules & therapeutics, 26(4), p.335.

9.   Cook, M.B., McGlynn, K.A., Devesa, S.S., Freedman, N.D. and Anderson, W.F., 2011. Sex disparities in cancer mortality and survival. Cancer epidemiology, biomarkers & prevention, 20(8), pp.1629-1637.

10.   Lu, P., 2005, July. Staging and classification of lymphoma. In Seminars in nuclear medicine (Vol. 35, No. 3, pp. 160-164). WB Saunders.

11.   Miranda-Filho, A., Piñeros, M., Znaor, A., Marcos-Gragera, R., Steliarova-Foucher, E. and Bray, F., 2019. Global patterns and trends in the incidence of non-Hodgkin lymphoma. Cancer causes & control, 30, pp.489-499.

12.   D'souza, M.M., Jaimini, A., Bansal, A., Tripathi, M., Sharma, R., Mondal, A. and Tripathi, R.P., 2013. Fdg-pet/ct in lymphoma. The Indian journal of radiology & imaging, 23(4), p.354.

13.   Noto, H., Tsujimoto, T., Sasazuki, T. and Noda, M., 2011. Significantly increased risk of cancer in patients with diabetes mellitus: a systematic review and meta-analysis. Endocrine Practice, 17(4), pp.616-628.

14.   Barclay, A.W., Petocz, P., McMillan-Price, J., Flood, V.M., Prvan, T., Mitchell, P. and Brand-Miller, J.C., 2008. Glycemic index, glycemic load, and chronic disease risk—a meta-analysis of observational studies. The American journal of clinical nutrition, 87(3), pp.627-637.

15.   Rallapeta, R.P., Manthri, R.G., Kalawat, T., Sachan, A., Lakshmi, A.Y. and Hulikal, N., 2020. Utility of short-acting intravenous insulin therapy in preparation of F-18 fluorodeoxyglucose positron emission tomography computed tomography scan in cancer patients incidentally detected with high blood glucose levels on the day of test. Indian Journal of Nuclear Medicine: IJNM: the Official Journal of the Society of Nuclear Medicine, India, 35(2), p.110.