



# The Advancement of Radiology on Cancer Diagnosis and Early-Stage Prevention

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## Abstract

**Background:** Cancer is the most multifaceted situation in a biological system when abnormal cellular events take over the normal cell division. Not only the patho-physiology of cancer is complex but the detection is also complicated due to not having any particular sign or symptom in the earlier phase. New technologies such as MRI, CT-scan and X-rays, on the other hand, are performing quite well to investigate the size and stage of tumor.

**Purpose:** Collecting biological samples from the patients and then investigating different cancer markers are expensive and do not provide the actual size and location of the tumors. Therefore, the study was aimed to gather the current radiology advancement of the prevalence and trends to identify tumors in human subjects. The investigation can also help the health care professionals from all over the world to interpret and utilize radiology methods to identify carcinoma and related patho-physiology.

**Methods:** We basically followed up one hundred cancer patients and their various radiological investigations especially on lungs, brains, kidneys, bones and alimentary tracts. Our study also involved going through hospital database system to gather more radiological evidences and understanding proper use of these technologies among different stage cancers.

**Results:** Major advancement in the field of medical imaging now allows healthcare professional to have a clear view towards an effective therapeutic approach. Our investigations suggested radiological diagnostics would be the most appropriate technique to identify and possibly treat the cancers. This technology is also being suggested for early detection of various cancers in a modern health care setting.

**Conclusion:** This study may be helpful toward health care settings where radiation technology is the only option to identify and diagnose various stages of cancers. Furthermore, this investigation would also show a correlation among the early stage cancer and metastasis.

**Keywords:** Cancer biology; Cancer markers; Cancer diagnosis; Radiology

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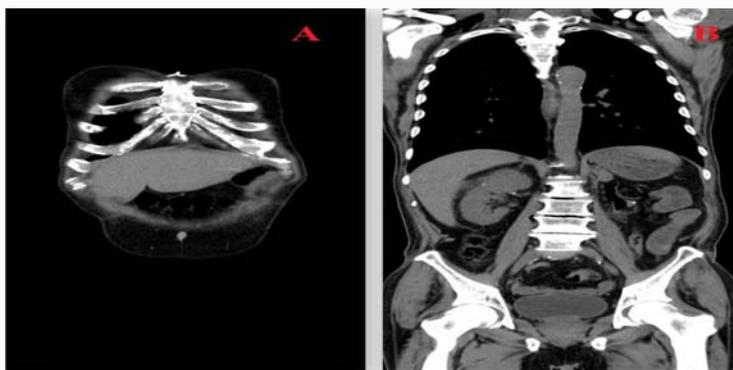
## Introduction

The world nowadays is experiencing different and complex diseases which make the treatment protocol very critical. While finding the prime causes, several possible reasons can be observed including food habit, chronic diseases, sedentary life style, living in an unhealthy and unhygienic surrounding and genetic pre-disposition [1,2]. Besides, exposure of excess sunlight, pesticides, herbicides especially Glyphosate and harmful microorganisms can play a major role to intervene in a biological system. Altogether, harmful organisms and individual abuse may trigger our own cells to mutate, thereby, making cells lose their normal functions and start replicating abnormally which can initiate either benign or malignant tumors [3-5].

In the recent time, the incidence of cancer has increased dramatically in both developed and under developing countries which makes it one of the pivotal reasons for death worldwide. Non-communicable diseases are now blamed for majority of the global deaths, and cancer is expected to rank as the prime cause of death and the single most important barrier towards increasing life



**Figure 1:** (A) Shows normal chest X-ray, (B) shows central type neoplastic lesion with pleural effusion.



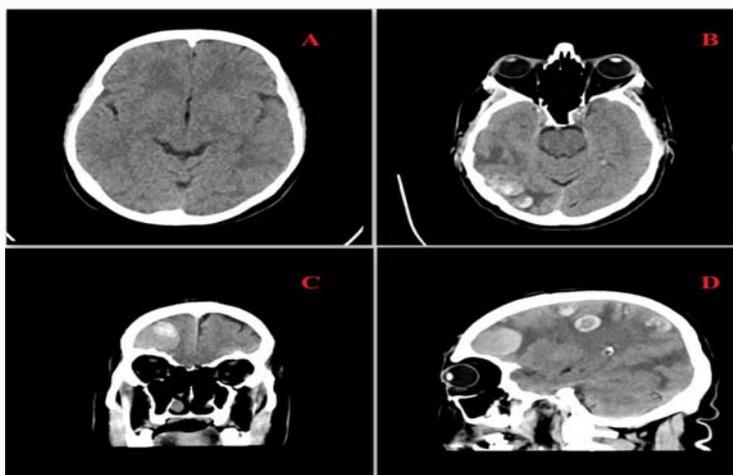
**Figure 2:** (A) The figure legends show possible carcinoma in the bony metastases and (B) Right supra renal metastasis.

expectancy in every country of the world in the Twenty-first century. Health care professionals are in tremendous pressure as both the diagnosis and treatment are expensive which puts a financial strain, if not mentioned, on the sufferers in the longer run [6]. The real number of cancer subjects continues to increase because of the advances in early detection and treatment and also the longevity of the population. According to GLOBOCAN 2018, it was estimated that there were 18.1 million new cancer investigations (17.0 million without non-melanoma skin cancer) and 9.6 million cancer deaths (9.5 million apart from non-melanoma skin cancers) in 2018 only. In both sexes combined, pulmonary cancer is the most commonly diagnosed cancer (11.6% of the total cases) and the leading cause of cancer death (18.4% of the total cancer deaths); narrowly followed by female breast cancer (11.6%), prostate cancer (7.1%), and colorectal cancer (6.1%) for prevalence; and colorectal cancer (9.2%), stomach cancer (8.2%), and liver cancer (8.2%) for mortality and morbidity [7].

Cancer is a complex phenomenon to diagnose as many variables are involved within the patho-physiology. So far several methods and techniques have been discovered to detect cancer stages and metastasis including histology, cancer blood markers and most importantly radiology. In the recent times, electrode-based enzymatic and non-enzymatic assay is becoming quite popular as these methods only require blood samples and interestingly the patients don't have to visit in the hospital for the diagnostic tests. Similarly, nano-particle-based electrochemical technology is often being considered to detect cancer-specific cancer microRNA [8,9]. A recent investigation suggested that tumor microemboli such as tumor heterogeneity, clonal evolution, distinct phenotypic and stochastic events within the metastatic cascade. Collecting cancer blood markers can be an alternative approach to identify the type of tumor using specific electrodes [10]. Magnetophoresis-based

micro-magnetofluidics and microfluidic technology have also drawn significant attention to detect cancer cells and related markers [11]. However, all these methods are still at their developing stages and accurate purposes for these methods are yet to be determined. In addition, most of these techniques are not available all over the world and might not be certified by World Health Organization or Food and Drug Administration for the aforementioned purposes.

As the general principle, the treatment of any illness increases with the observer's capability to detect the abnormalities associated with the pathology, physiology and pharmacology. In the instance of medical diagnostic imaging, the ability to identify an anatomical aberrance is strongly related to the size and stage of the abnormality. Hence, technological advance increases the number and possibility for imaging technologies to investigate sophisticated and minor abnormalities which consequently makes it easier to connect the diagnosis to the disease [12]. In this current study, we would elucidate how advances in medical diagnostic imaging create blessing in two crucial areas of medical decision making: concluding the progression and extremity of the disease and defining how well the treatment would work. Although others have described these effects in the narrow context of mass screening and in a few clinical cases, such as the staging of pulmonary and brain cancer, these consequences of contemporary imaging increasingly spread through everyday medicine and clinical practices. Besides describing the proper perceptions of therapeutic effectiveness and disease prevalence, we explained how the rising use of sophisticated medical diagnostic imaging enhances a cycle of improving intervention that often show enough benefit. Finally, we suggest clinical investigations that may maximize the approach toward a therapeutic approach [13]. Therefore, this study may create some buzz in the recent advancement of the Radiology techniques but would accelerate the process of identifying tumor stage and places where carcinoma spreads. It would also help



**Figure 3:** (A) Shows normal CT scan of brain, (B), (C) and (D) show possible brain metastases.



**Figure 4:** (A), (B) and (C) Show normal CT scan of abdomen in different sections; (D) shows possible lower caliceal stone of both kidneys.

the oncologists and radiologists to have idea about the current clinical practices especially in Bangladesh.

## Methods

Our aim was to make effective correlations between the uses of radiological advancement in the cancer diagnosis and to find out the tumor size for treatment strategies. We also intended to establish more focus on radiology rather than investigating histology and/or blood markers, especially in under developed countries. In this study, we have followed One hundred patients in the department of Radiology and Imaging at Apollo Hospitals Dhaka and Khwaja Yunus Ali Medical College Hospital, Bangladesh. We critically observed those patients more than a year on those who visited the respective hospitals for diagnosis or got admitted for taking chemotherapy. We have closely gone through their investigations in the Radiology and Imaging department such as X-ray, MRI and CT-scan result. All the one hundred subjects were gone through radiological investigations and we used only the Figure legends which would be important for this study and related health care professionals. In the beginning, we observed, took socio-demographic data and gathered the pictures where possible carcinoma was reported. At times we followed several cancer patients to investigate whether there was any metastasis which led to using finding multiple metastasis subjects who had the cancer

spreading either in the same organ or to other organs. Finally, we observed some normal subjects to compare our findings, cancer stages and metastasis. We also gathered some figure legends from the hospital databases which explained the size of the carcinoma more accurately while comparing normal and carcinoma stages. In this study, more emphasis was given on the subjects who went through X-ray and CT-scan for detecting possible tumor. After collecting all the representative figure legends, we used Image J for analyzing and finalizing the pictures to be utilized in this study (Figures 1-4).

## Results

This study was performed during January' 18 to December' 19 and by this time we reported our investigations. Some of the initial subjects were excluded who were not matched for this study guideline. We have investigated the patient history asking to the direct patients and reported several socio-demographic outcomes that may be correlated as possible reasons for initiating carcinoma (Table 1). We have also noticed that the number of patients have dramatically decreased after every visit (Table 2).

## Discussion

Since the beginning of 2000, a vast new armamentarium of diagnostic methods had revolutionized the practice of chemotherapy.

The complete human body can now be seen and imaged in exquisite anatomical details. Computed Tomography (CT), Magnetic Resonance Imaging (MRI), X-ray and ultrasonography routinely "section" patients into slices less than a centimeter thick. Abnormalities can be reported well before they produce any particular clinical signs or symptoms. Undoubtedly, these technological advances have enhanced the physician's potential for understanding disease and at the same time have accelerated the approaches for treating patients. However, in this study, we focused on how Radiology as a diagnostic tool may help in detecting various types of cancers and help the oncologists to take a decision for either initiating chemotherapy or having a surgery. We have gone through several patients' investigations and collected different pictures which would help in detecting cancer and possible metastasis (Figures 1-4) [14].

Lungs are one of the most essential organs in pulmonary system and contain many housekeeping genes for cellular respiration and survival. Unfortunately, lung cancer is the leading cause of cancer death among the all cancers (18.4%) and the rate and number are really high. Most subjects are diagnosed in their advanced stages, resulting in a very low, and survival rate of approximately five-years. Radiological screening may reduce the risk of death from pulmonary cancer. Our observations showed several connections between effective investigation and proper detection of the tumor via Radiological advancement. This study suggested that CT screening may benefit individuals at an elevated risk for lung cancer unless metastasis has already occurred. Our investigation also showed (Figure 1A, 1B) proper diagnosis in pulmonary organs found significant tumor which might help the oncologists have a clear view for therapeutic approach. Several related studies also reported that CT-scan screening may be beneficial in reducing lung cancer [14,15].

Bone cancer, on the other hand, found to be less in clinical investigations, however, the situation can be worsen when bone metastasis is reported. Special consideration can be taken in these cases. We have reported that bone cancer and metastasis can be diagnosed by using CT-scan (Figure 2A). A study has recently found a correlation between bone cancer and lung cancer. It was likely to be reported that bone cancers are quite expected in newly diagnosed lung cancer subjects. The study also found several bone cancer markers in newly diagnosed lung cancer subjects [16]. Renal cell carcinoma is the commonly occurring tumor of the kidney, with more than 30,000 new investigations diagnosed in the United States every year. With the extensive use of cross-sectional imaging, many cancer cells and metastasis are detected incidentally. Single- and multi-detector CT-scanners have helped refine the diagnostic work-up of renal masses by allowing image achievement in various stages of renal enhancement after intravenous administration of a single bolus of contrast drug. The scanning protocol involve sun enhanced CT followed by imaging throughout the nephrographic and corticomedullary phases of enhancement. The nephrographic phase is the most sensitive and critical stage for tumor detection, while the corticomedullary phase is vital for imaging the renal arteries and veins for possible tumor extension and the parenchymal organs for potential metastasis [17]. Our investigation followed the same principle explained in the above reference. We have scanned whole abdomen and found to have renal tumor in patients in our study (Figure 2B).

Brain cancer is the collection, or mass, of abnormal cells in central nervous system. Brain is the most critical and sophisticated area in the human body, therefore, any growth inside such a restricted space can

**Table 1:** Shows the socio-demographical data of the subjects whose investigations were observed.

Socio-demographical Data	Outcomes
Number of Subjects	N=100 (63 males and 37 females)
Mean Age	61.32 ± 17.89 in Males and 53.18 ± 16.51 in Females
Family History of Cancer	N=19
Presence of Chronic Diseases	N=89
Presence of Infection	N=51
Presence of COPD	N=19
Presence of IBS	N=08
Previous Alcoholism	N=21
Previous Smokers	N=37
Previous Tobacco Chewers	N=11

**Table 2:** Shows the subjects who started the therapy and their therapy details monthly.

Monthly Visit	Number of Patients	Monthly Visit	Number of Patients
January	100	July	38
February	89	August	21
March	74	September	9
April	63	October	7
May	54	November	3
June	49	December	2

cause serious problems. Brain tumors can be cancerous (malignant) or non cancerous (benign) and most of the cases the sign and symptoms are not shown at the earlier stages. CT-scan imaging has been used to study various diseases in the normal brain and tumor diagnosis. The advancement of techniques capable of accurately portraying tumor grades *in vivo* is significant for detection of the most appropriate treatment for glioma and neoplastic cells. In malignant gliomas, and peritumoral edema, which can be rendered with either CT or MR imaging, has often been reported to have infiltrating neoplastic cells. Thereby, the tumor border is still inaccurately represented even with good imaging techniques [18]. Our primary observations of identifying tumors revealed a relatively good correlation between metastasized brain tumors and tumor cellularity; however we made some extra effort to observe from elsewhere and meningiomas in various portion of tumor growth. Our findings revealed that tumor cells shown metastasis in several cases and can be clearly seen in (Figure 3B-3D).

In the recent time, the occurrence of colon cancer has been really high which is a rather concerning matter for the healthcare professional. Computed Tomography (CT) colonography or colonoscopy is a noninvasive option in investigating colorectal cancer [19]. However, the accuracy of this method as a screening tool in asymptomatic adults has not been well explained, thereby, we tried to make an effort to use CT-scan in detecting various parts of a cancer subject. Our investigation suggested that we have successfully found the tumor (Figure 4A-4D) using CT-scan which might be beneficial for doctors to decide to go for a surgery or start chemotherapy.

The most frequently diagnosed cancer and the leading cause of cancer death, however, substantially vary across countries and within each county depending on the degree of economic development along with associated social and life style factors. It is noteworthy that high-

quality cancer registry data, the basis for planning and implementing evidence-based cancer control programs, is not available in most low and middle income countries [7-20].

### Limitations of this Study

We did not report any other investigations such as histology or cancer blood marker assay as this study was solely dependent on Radiology investigations and related findings. We also haven't disclosed any particular patient history especially the time when they were diagnosed. Our study did have some limitation especially when talking about decision making regarding therapeutic approach by the physicians for example, it does not explain the types of cancers from the figure legends. This investigation also does not precisely suggest which therapy should be taken based on the type of tumor. Our investigations were underpowered and of insufficient duration to evaluate screening effectiveness for many patients.

### Contraindications

Some reports suggested that Radiology is not always a good option especially for the children and older patients as radiation damages tissues therefore MRI or CT-scan or X-ray cannot be considered in many cases. Hence, direct histology or tissue biopsy may be an alternative option. Our observations also reported that several patients who undergo radiation may have difficulties in defecation and urination, altered BP, vomiting and rash [14]. These technological advances, unfortunately, show several confusions that may ultimately be harmful to patients. Reports suggested that Radiation therapy is contraindicated for the diagnosis of Prostate cancers. Although the prevalence of clinically apparent prostate cancer in men 60 to 70 years of age is about only 1 percent, 1 over 40 percent of men in their 60s with normal rectal examinations have been found to have histological evidence of the disease [21,22]. It has been also reported that exposure of CT-scan radiation during childhood may increase the risk of leukemia and brain tumors in the adulthood [23]. CT colonographic depiction identified 90% of subjects with adenomas or cancers measuring 10 mm or more in diameter, therefore, an augment published data on the role of CT colonography in reporting patients with an average risk of colorectal cancer which can be prevented at the earlier stage if possible diagnosis measure is taken as a regular health care check-up [24].

### Authors Observations

We have observed several patients more than a year to collect different investigated data. We have found that some patients were nervous while entering into the CT-scan which increased their blood pressure. Many patients came for regular check-up and were diagnosed with early stage of cancer. Later they conducted chemotherapy and got cured. Several patients came with advanced stage cancers and metastasis resulted in their deaths after more than a year of chemotherapy. Some of the subjects did not come for the treatment after taking some initial cycles (Table 2).

### Conclusion

This study showed possible diagnostic techniques especially used in Bangladeshi setups. Our observation showed that Radiation technique is one of the most effective approach in detecting the exact size and location of the tumor. In addition, it also reported that metastasis can also be found out by this technology. Besides, our investigation correlated a good connection between the effective diagnosis and patient non-compliance. Moreover, this study has

also drawn an attention about the superiority of using Radiation technology over histology or blood markers. Furthermore, it may help in cancer diagnosis where same set-up is present especially for developing countries. Development and more advancement in this technology can participate more accurately in tumor identification and also to prevent early cancer stages.

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