RESEARCH COMMUNICATION

# The First Cross Sectional Survey on Intracranial Malignancy in Kolkata, India: Reflection of the State of the Art in Southern West Bengal

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## Abstract

**Recent increase in the occurrence of intracranial malignancies and poor performance of therapeutic measures have established the disease as an important concern of medical sciences. The lack of information about the disease pattern throughout India creates problems for maintaining community health for prevention. The present study on the hospital population of Kolkata was conducted to determine the incidence pattern of the disease in the population of southern West Bengal, focusing on distribution with age, sex, occupation and religion in different districts of the region, and characterizing diagnostic and therapeutic measures. Among a total of 39,509 cancer patients from 21 health centers of Kolkata, 2.4% had brain cancers and among these more than 60% are gliomas. A cross-sectional study for a period of 3 years reported the occurrence of 15 types of intracranial malignancy, which demonstrated astrocytomas (36.8%), glioblastoma multiforme (GBM) (7.9%) and meningiomas (11.6%) to be predominant. Brain tumors occur more frequently in males with few exceptions and the incidence was found to be highest among the 40-49 year old group (20.2%). No specific trend for religion and occupation was apparent. However, the district wise distribution showed maximum incidences among industrial areas, namely, Kolkata (33.1%), North 24-Parganas (18.2%), Howrah (9.3%) and Hoogly (7.6%). Diagnosis of the disease was by CT scan, MRI and histological identification (pre and post operative). Therapeutic procedures rely mainly on surgery and radiotherapy, whereas chemotherapy was used as an adjuvant for about 10% of the cases. Evaluation of the scenario regarding intracranial malignancy in this region was a long awaited requirement which should ultimately serve an important function in pointing to risk zones within the population and allow better control measures to be introduced for the disease.**

**Key Words**: Intracranial malignancy - Cross-sectional survey - Incidence pattern - Diagnosis - Therapeutic approach - Community health

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## Introduction

Proper registration of a population based data on cancer pattern in a particular region is important for determining the etiology, risk factors, vulnerable patches in demographic contour of the community and priority zones to control the disease. India is a developing country with second largest population of the world. In this subcontinent an attempt of keeping a planned record of the cancer patients was started with National Cancer Registry Program (NCRP) of the Indian Council of Medical Research (ICMR) from 1982. However, there was no organized cancer registry in eastern India till 1997, when a Kolkata (Calcutta) based regional cancer center started to collect incidence data from different hospitals and clinics of the city (Sen et al, 2002). Kolkata, previously named Calcutta, is the largest city in Eastern

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India, the capital of West Bengal and located at latitude $22.34^0$ N and longitude $88.35^0$ E. The city is the economic hotspot of Eastern India attracting people of different parts of the region. This highly urbanized and densely populated metropolis consists of many industrial belts and commercial centers, which are also scattered in the adjacent districts. Therefore a partial cosmopolitan nature of the population is observed predominantly with Bengali speaking, followed by Hindi and other language speaking people. The available medical facilities particularly for the highly specialized cancer treatment being centralized in the city, caters a large number of patients of the region for treatment.

The previously established population-based cancer registry (PBCR) in Kolkata attempted to reveal the general mode of incidence of different types of cancer within the community. An extensive study of the occurrence of the disease within the community is essential to specifically establish the nature of a particular type of cancer. As malignant brain tumor is one of the toughest challenges in the field of the medical sciences, the nature of occurrence of the disease in this region is a long awaiting requirement. A recent boom in the occurrence of brain tumor and resulting mortality preferentially in elderly has drawn the attention of concerned people (Yancik et al, 1996; The Brain Tumor Society, 2002). Despite multimodal therapeutic efforts mean survival is only 9-12 months for grade IV and 2 years for grade III brain tumors (Prados et al, 1998). Different countries of Europe and North America pursued a number of epidemiological studies to determine the community determinants of the disease for developing better prognostic measures (Sant et al, 1996; Riggs, 2000; Johannesen et al, 2003). However, the epidemiology of malignant brain tumor in India is neglected so far except few minor attempts restricted only to the gradation of tumor types (Roy et al, 2002). At this juncture a hospital population based survey in Kolkata was performed concentrating on the malignant brain tumor cases for the period of three years. The approach was cross-sectional depending on prolective data with demographic, diagnostic and therapeutic detailing of the disease acquired from every possible source. This study was the first attempt to rationalize the understanding of incidence of different types of malignancy of the brain, their diagnostic and treatment strategies in this region. As there was no specific record regarding the epidemiology of malignant brain tumor in the medical registry of the region, this unprecedented data will reflect a new insight about the problem and play a crucial role in Community Oriented Primary Care (COPC) (Kark and Abramson, 1981).

## Material and Methods

The data of malignant brain tumor cases were collected from the hospitals, multispeciality clinics and nursing homes having the facilities to diagnose and treat brain tumors. All the medical centers are under the jurisdiction of Kolkata Municipal Corporation (KMC) and Kolkata Metropolitan Development Authority (KMDA). 4 government sponsored medical college hospitals and 1 specialized nodal center of neurological diseases in the region, 2 specialized cancer hospitals, different multispeciality private hospitals having Oncology department with surgical, radiation and chemotherapeutic facilities and few private nursing homes were the potential source of data. The data collection period was for 3 years from 1st February 2000 to 31st January 2003.

A set of 10 highly qualified (Masters in Science) and locally trained, young (25-30 years of age) registrars were employed for data collection. Registrars visited 21 potential data sources thrice in a week dividing in groups of two during the period of 2000-2003. Additional routine visits were there to note the cases from outdoor patient department. The mode of study was cross-sectional, depending on the data collected after the beginning of the study emphasizing on prolective data, which provided information of the situation that exists at a single time (Feinstein, 1981; Abramson and Abramson, 1999). The patient record books and medical registries were thoroughly searched for every minute detail of all malignant brain tumor patients. Registrars also interviewed the admitted patients, outdoor patients and their relatives depending on the specific set of questionnaire to collect additional information wherever possible. About 46% of patients and their relatives were interviewed during the period.

Experienced pathologists in different hospitals, clinics and diagnostic centers, determined the types and gradation of malignant brain tumors. Every case with detailed information including type of tumor, age, sex, religion, mother tongue, occupation and economic status, district wise residence, method of diagnosis, clinical symptoms, family history and treatment details were entered in the data base. After careful scrutiny to avoid any repetition and overlap, the data were sorted out into different demographic parameters to analyze the mode of incidence of the disease. As it was a cross-sectional study depending on the hospital population, only the death cases (DCN) recorded in the hospital medical registry were counted which comprise about 14.38% of the total patients admitted during the period of 2000-2003.

The data obtained from potential data sources (n=21) registered a total of 36,509 cancer patients of which 758 were malignant brain tumor cases. About 41.16% brain tumor cases were from government sponsored medical college hospitals and neurological center, 35.75% of cases were from the two specialized cancer hospitals from the region and rest 23.09% were from different multispeciality private hospitals and nursing homes.

## Results

A total number of 36,509 cancer patients registered during the period of 3 years from 1st February 2000 to 31st January 2003, of which 2.39% cases were found to be malignant brain tumor. When intracranial malignancies were considered in respect to neurological disorders, they showed 7.59% incidence.

Present study revealed the occurrence of 15 different

types of intracranial malignancies, which were identified in the representative hospital population of the community. They were primary tumors and broadly divided into two major categories depending on their origin i.e. tumors of glial origin namely glioma and tumors of non-glial origin. Gliomas were the most prevalent type occupying 60.03% of the total spectrum of neoplasm in brain while non-glial tumors occupying 39.97% of the cases. Among glioma, the incidence of astrocytoma and among non-glial tumors the incidence of meningioma were most frequent. Table-1 represents the detailed incidence of different types of malignant brain tumors among the population. The occurrence of total brain tumor in male was found to be comprehensively high with a male to female ratio of 2.15. For glial and non-glial tumors the ratios were 2.7 and 1.57 respectively. Except meningioma, pineal body tumor and neuroblastoma all other brain tumor types were found to be dominated by males (Table-1).

When age specific distribution of the incidence of intracranial malignancy was considered, a gradual increase was found up to the age of 50 years. The age group of 40-49 years showed 20.16% incidence of the disease, which then gradually decreased with increasing age. The male to female ratio in different age groups showed male preponderance. As a single case over 80 years and relatively small number of cases (20 cases) were identified for the age group 70-79 years, no definite trend could be deduced for older age groups (above 70 years) in both male and female patients. However a gradual decrease of inflow of patients above the age of 60 years is evident from the data. When the total incidence of brain tumors, incidence between male and female were considered separately for different age groups, a general age specific trend of incidence was found with some deviations. An increased incidence of brain tumor in male was found within the age group 20-29 years than their female counter part, whereas, incidence of the disease was found greater in around 45 years of age for females. After that a gradual decrease of the patients was found with increasing age groups (Fig-1).

By religion West Bengal is a Hindu dominated state in India where according to the 'Census of India 2001' conducted by Government of India revealed 80% Hindu and 17.5% Muslim population in the state. Therefore the study showing 80.87% brain tumor incidence among Hindus and 18.21% among Muslims were in accordance with the

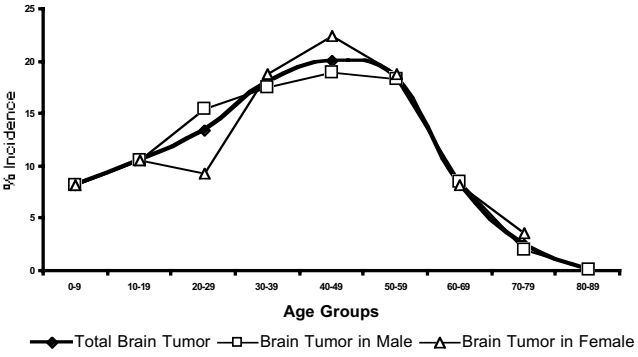


**Figure 1. Age specific distribution of Brain Cancer and its distribution among different age groups of male and female separately**

**Table 1. Relative Frequencies (%) of Different Types of Intracranial Malignancies Reported to be Occurred Among the Hospital Population of Kolkata. Distribution of Occurrence of Different Tumors Among Glial and Non-glial Type and Their Sex Specific Ratio for the Year 2000-2003**

| TYPES OF MALIGNANT BRAIN TUMOR | % INCIDENCES | | MALE TO FEMALE RATIO |
|---|---|---|---|
| | | Among total Brain Tumor | 1.71 |
| Gliomas | | 60.03 | 2.7 |
| Astrocytoma (I-IV) | 58.89 | 36.76 | 2.77 |
| Glioblastoma Multiforme | 12.63 | 7.89 | 3.9 |
| Oligodendroglioma | 7.92 | 4.95 | 2.08 |
| Mixed Glioma | 15.42 | 9.63 | 2.27 |
| Ependymoma | 5.14 | 3.21 | 2.43 |
| Non-Glial Tumors | | 39.97 | 1.57 |
| Meningioma | 30.96 | 11.63 | 0.74 |
| Craniopharingioma | 14.59 | 5.48 | 2.15 |
| Pituitary Tumor | 11.03 | 4.14 | 1.21 |
| Brain Tumor (Non-specific) | 22.06 | 8.29 | 2.87 |
| Pineal Body Tumor | 0.71 | 0.27 | 1 |
| Medulloblastoma | 4.27 | 1.6 | 2 |
| Neuroblastoma | 1.07 | 0.4 | 0.5 |
| Brain SOL | 13.17 | 4.95 | 2.36 |
| PNET | 1.42 | 0.53 | 1.86 |
| Germinoma | 0.72 | 0.26 | 1 |

population bias of the community with a negligible amount of patients from other religions. Information showed no bias of the occurrence of the intracranial malignancy on vegetarian and non-vegetarian food habits. 21% of the brain tumor patients were found to have addiction on tobacco in different forms. Occupation varied very widely among the patients coming from different social strata. In this study it is clear that, occurrence of brain tumor could not be attributed

**Table 2. District wise Distribution of Hospital Population of Intracranial Malignancy in Kolkata for the year 2000-2003, Their Distance, Communication Facilities, Industries and Pollutant Level Indicating the Major Incidence Among Population of Industrial Regions**

| District | %Incidence of Brain Tumors | Distance From Kolkata (Growth Centers of the Districts) | Communication with Kolkata | | Industries | Industrial Pollution |
|---|---|---|---|---|---|---|
| | | | By Road | By Rail | | |
| Kolkata | 33.08 | 0 | - | - | Electronic & Electrical, Leather, Ceramic, Pharmaceutical, Printing | High CO, $CO_2$, $SO_2$, $SO_3$, PAN, $CC_{l4}$, CFC, $NO_2$, $N_2O$, Organic & Inorganic Toxins, Heavy Metals |
| North 24 Parganas | 18.2 | ~50-60 kms | +++ | +++ | Electronic, Engineering, Chemical, Textile, Leather, Jute, Agro, Pharmaceutical | High CO, $CO_2$, $SO_2$, $SO_3$, PAN, $CC_{l4}$, CFC, $NO_2$, $N_2O$, Organic & Inorganic Toxins, Heavy Metals |
| Howrah | 9.32 | 60 kms | +++ | +++ | Metal, Textile, Polymers, Agro, Ceramic | High CO, $CO_2$, $SO_2$, $SO_3$, PAN, $NO_2$, $N_2O$, Organic & Inorganic Toxins |
| Hooghly | 7.62 | ~60-70 kms | +++ | +++ | Engineering, Rubber, Foundry, Textile, Metal, Car, Glass | High CO, $CO_2$, $SO_2$, $SO_3$, PAN, $NO_2$, $N_2O$, Organic & Inorganic Toxins, Heavy Metals, Coal Particles |
| South 24 Parganas | 6.62 | 55 kms | ++ | ++ | Textile, Engineering, Agro, Leather, Pharmaceutical, Polymer | Moderate CO, $CO_2$, $SO_2$, $SO_3$, PAN, $NO_2$, $N_2O$, Organic & Inorganic Toxins, Heavy Metals, Coal Particles |
| Midnapur | 6.62 | 110-140 kms | +++ | +++ | Chemical, Ceramic, Petroleum & Polymer | Moderate CO, $CO_2$, $SO_2$, $SO_3$, PAN, $CC_{l4}$, $NO_2$, $N_2O$, Organic & Inorganic Toxins, Oil |
| Nadia | 4.66 | 55 kms | ++ | +++ | Chemical, Metal, Breweries | Moderate CO, $CO_2$, $SO_2$, $SO_3$, Organic & Inorganic Toxins |
| Bardwan | 4.66 | 130-170 kms | ++ | +++ | Steel Plant, Metal, Coal Mining | Moderate CO, $CO_2$, $SO_2$, $SO_3$, Inorganic Toxins, Coal Particles |
| Bankura | 2.86 | Over 200 kms | + | ++ | Few | Low |
| Birbhum | 1.5 | Over 200 kms | ++ | ++ | Few | Low |
| Malda | 1.35 | Over 250 kms | + | ++ | Not Mentionable | Low |
| Dinajpur | 1.2 | Over 250 kms | + | ++ | Not Mentionable | Low |
| Mursidabad | 1.05 | Over 200 kms | + | ++ | Not Mentionable | Low |
| Purulia | 0.9 | Over 250 kms | + | ++ | Not Mentionable | Low |
| Jalpaiguri | 0.3 | Over 250 kms | + | ++ | Not Mentionable | Low |

to any occupational hazards. Not even a single case was found with any significant family history of having brain tumor.

West Bengal, occupying less than 3% of total land area of India, contains about 9% of its population and is most population dense state of India. Most of the people reside in this oldest industrial region of the country developed by the side of Hoogly river (lower part of river Ganges) in and around Kolkata. As the adjacent districts are well connected by roads and rails with the city, the centralized treatment facilities in Kolkata, particularly for brain tumor, is utilized by the people of neighboring areas. Therefore the malignant brain tumor patient data from the hospitals under the jurisdiction of KMDA showed the drainage of patients from different districts reflecting the incidence of the disease in those specific areas. Incidence of intracranial malignancy was highest in Kolkata (33.08%) (considering people living for 1 year in Kolkata is the resident of the city) followed by North 24-Parganas (18.2%). Howrah, Hoogly, South 24-Parganas and Midnapur were the other major districts of high disease incidence (Table-2 and Fig-2). All these districts were within a distance of 100 Kms from Kolkata, except Midnapur (Haldia port and Industrial belt), but well connected with Kolkata. The pollution levels of these areas were also high due to the disposal of industrial waste products. Moreover, even more than 8% of patients came to different hospitals of Kolkata from adjacent states of West Bengal like Bihar, Jharkhand and Tripura and from the neighboring country Bangladesh (4.81%) for better treatment.

Different clinical symptoms like headache, diplopia and protrusion of eye ball, recurrent convulsions, behavioral disturbance, slurring of speech, unconsciousness, weakness of limbs, paralysis, facial palsy etc observed among the brain tumor patients hinted for the disease were confirmed by diagnostic methods. Diagnostic procedures were dominated by radiological spotting of tumor with CT scan and MRI followed by stereo-tactic biopsy for histological identification. Histological confirmation with or without CT scan and MRI was done for about 58.61% cases. For about 41.39% cases only CT scan (22.02%), MRI (6.25%) or both (13.12%) were done for tumor detection (Fig-3). In almost all these cases tumor type and grading were determined by postoperative biopsy.

Therapeutic interventions against intracranial malignancies were mainly dependent upon surgery and radiotherapy. Surgical expropriation of the tumor mass without any supportive therapy was found in a maximum of 29.83% cases, while therapy depending solely on radiation was 28.92%. In about 27.7% cases radiotherapy used as post therapeutic treatment. Chemotherapy mainly by bis-ENU, cis-ENU and vincristrine were mainly applied as supportive

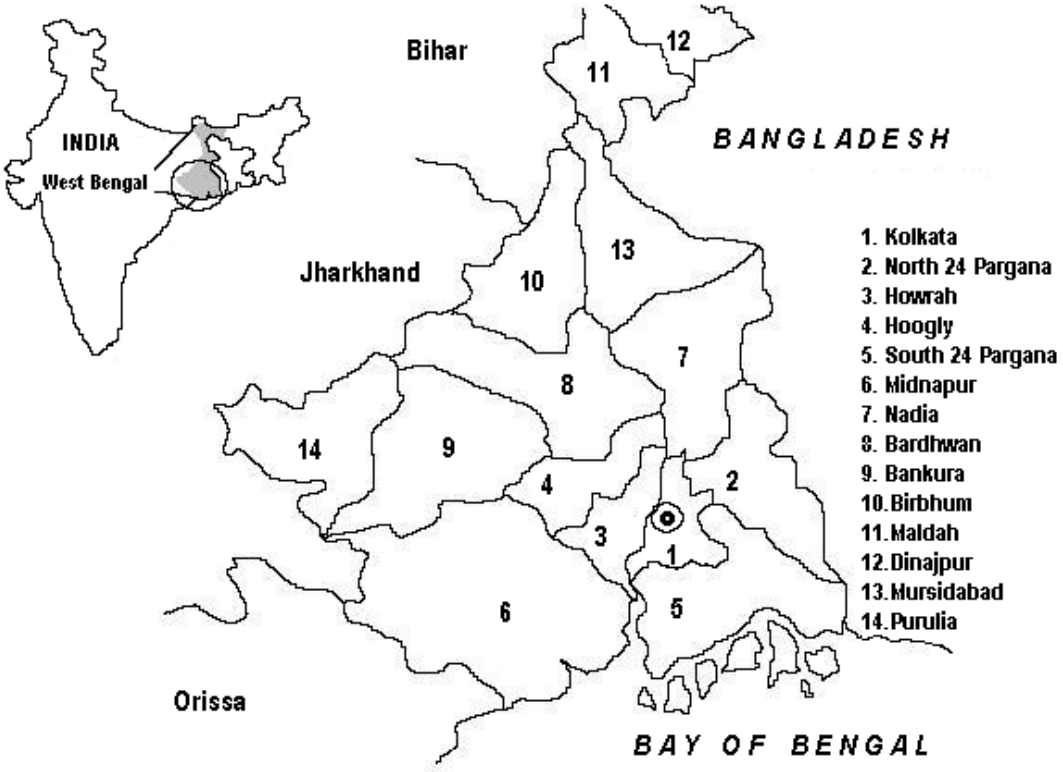


**Figure 2. Position of Southern Part of Westbengal in India, Which is One of the Most Densely Populated, Economically, Industrially and Agriculturally Important Areas in the Country. Districts of the Region are also Designated**

therapeutic protocol with surgery and radiotherapy. Almost no use of immunotherapy was found and 1.22% of patients were left untreated (Fig-4).

## Discussion

Brain tumor epidemiology in India has negligible evidences except few protracted references of incidence of brain tumor types (Roy et al, 2002). Even the registration of cancer cases in eastern India was not developed in a systemic manner until 1997 when the PBRC of Kolkata was organized by Chittaranjan National Cancer Institute (CNCI) by the support of International Agency of Research on Cancer (IARC), Lyon, France. Their attempt was a holistic approach considering all the cancer cases in a broad platform and showed only the frequency of brain cancer incidences among the total cancer types (Sen et al, 2002). However the increasing trend of incidence of brain cancer throughout the world, poor prognosis, failure of therapeutic strategies and high mortality rate has drawn the attention of concerned people to the disease (The Brain Tumor Society, 2002; Prados et al, 1998; Sant et al, 1998; Riggs, 2000; Johannesen et al, 2003). Being a group of investigators dealing with the immunotherapeutic protocols to combat against intracranial malignancy (Sarkar et al, 2002; Mukherjee et al, 2003; Begum et al, 2003), we found the lacuna of information on the patient data in this field. To define the priorities of controlling brain tumor, delineation of the demographic nature of incidence of the disease and status of existing diagnostic and therapeutic protocols are the necessity in this region.

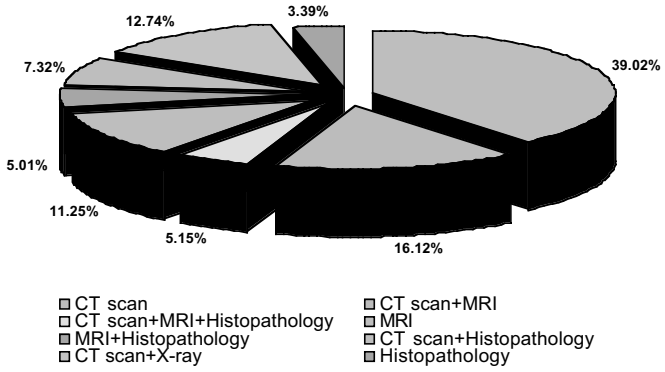


**Figure 3. Methods of Diagnosis of the Hospital Patients for Detecting Brain Tumors in Kolkata for the Years 2000-2003. Simultaneous Use of CT Scans, MRI or Stereotactic Biopsy are Most Common**

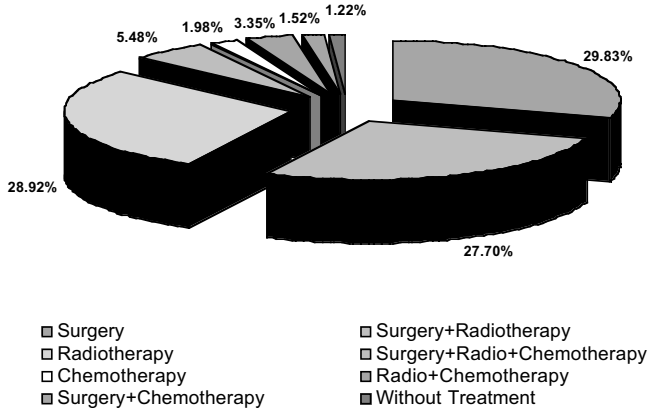


**Figure 4. Different Methods of Therapy Employed for Treating Intracranial Malignancies in Hospitals of Kolkata for the Year 2000-2003**

Kolkata is one of the most population dense cities of the world and the largest city in eastern India with profound economic, industrial and demographic importance. As the health care system in brain tumor is highly specialized and their availability is centralized in the city hospitals, most of the cases are referred from adjoining districts to the hospitals of Kolkata. The medical college hospitals, specialized cancer hospitals, private hospitals, nursing homes and clinics throughout Kolkata were the potential data sources where at least one of the facilities among radiotherapy, chemotherapy and surgery were available. Therefore the patient population reflected the trend of incidence of intracranial malignancy in the population of southern Westbengal. As the study was based on the hospital population, the death cases (DCN) after discharge from hospitals were not considered. The rate of mortality in malignant brain tumor being very high (Prados et al, 1998) and patients being scattered through a vast area (thousands of square kilometers), it was difficult to procure the DCN data. Though attempts were made to gather information by sending reply-paid postcards, the response was very poor. So the study was done to decipher the incidence of malignant brain tumor types, their distribution in age and sex, religion, food habits, occupations, districts and to evaluate diagnostic and therapeutic measures used against the disease depending on the hospital population. A remarkable decrease of hospital population in older ages could not be attributed with the lower incidence rate, because an increasing amount of DCN data above that age period was omitted. This study thus analyzing the hospital population, hinted towards the health care strategies to be developed against intracranial malignancy.

We had 2.39% brain tumor patients among total cancer cases, which vary between 2-3% throughout the world (Parkin et al, 1997). However a much higher incidence of glioma (60.03%) was observed differing from an observation where 50% incidence of glioma was found among the selected hospitals of Delhi, India (Roy et al, 2002). As the consensus classification of brain tumor is a questionable fact, the WHO classification established by Kleihues et al, 1993 is followed here. Among different types of glial tumors, astrocytoma was most frequent occupying 58,89% glioma incidences. As glioblastoma multiforme (GBM) is now regarded as high grade of astrocytic tumors (Kleihues et al, 1993; Russell and Rubinstein, 1989), their incidences if considered as astrocytoma, will reach up to 71.52%. Again mixed glioma, reported 15.42% among the glial tumors, also

have abnormal astrocytic cells. Therefore very high incidence of astrocytoma among the glioma patients showed similarity with the world scenario (over 80% are astrocytic tumors among gliomas) (Cancer Bureau, 2002; Hayostek et al, 1993). Oligodendroglioma (7.92%) and ependymoma (5.14%) were the other two glioma subtypes. Nonglial tumors consists of many different varieties, of which meningeoma was most common (30.96%) followed by craniopharingeoma. Around 22.06% nonglial tumors were identified nonspecifically. Though the identification of different types of brain tumors were done by skilled neuropathologists in different hospitals and diagnostic centers, certain anomalies may also arise regarding their classification and gradation. When handling with hospital data, investigators had to rely on the documented observations as in the primary data sources and except little confusion, the classification and relative frequencies of incidences were exhibiting the actual scenario of brain cancer in the region (Table-1).

From total brain cancer incidences male to female ratio was 1.71, which increased to 2.7 in glioma but 1.57 for nonglial tumors. Noticeably higher incidences of male glioma patients varied widely from the global trend where the ratio was 1.6 with some deviation in local communities (The Brain Tumor Society, 2002; Davis and Preston-Martin, 1998). Even a significance test was done among five most patient populated hospitals where no significant difference between the proportion of male and female patients was observed (data not shown). Thus this observation implied that male patients were homogeneously predominant in the hospitals. Even all subtypes of glioma showed more than two fold incidences of men than women. However in nonglial tumors, several types like meningioma and neuroblastoma were dominated by women, few had no gender bias and others were dominated by men (Table-1). The sex specific inclination of glioma incidence towards male in the region needs to be studied with much attention. As glioma is one of the most vulnerable malignancy among all types of cancer with a very high mortality rate, the causative factors behind male susceptibility to the disease or resistance among women in the community should be deduced for better prognosis of the disease.

The age specific incidence pattern showed a more or less similar trend in both male and female as well as for total brain cancer patients. However two major deviation of the trend of incidence were observed between male and female population. Between the age group of 20-29 years, a comparatively low incidence of brain tumor was observed in females. It was then increased to a considerable degree among 40-49 years of ages than their male counterparts. Again, 50-59 years of age group also contain significant number of brain tumor patients. On the contrary the male patients showed much regularity in their incidence curve of the disease. However from the 60 years of age, a sharp decline of the hospital patients were observed for both sexes. The highest incidence of brain tumor around 45 years of age may be due to estrogen deficiency in menopause. Estrogen balance which has an important neuroprotective role (Dena et al, 2001; Paganini-Hill and Henderson, 1994) may play a crucial role in developing less number of brain tumor in younger age group and increasing the incidence number between 40 to 59 years among female. The general tendency of higher incidence of malignant brain tumor in the age within 30 to 60 for both sexes might be correlated with the higher exposure to different environmental carcinogens. These make certain susceptible individuals more prone to brain tumor due to transformation of protooncogene to oncogene and also due to increased rate of mutational changes from the middle age groups (Biumenthal and DeAngelis, 1994; Vijg, 2000).

Kolkata and its adjoining districts have developed as one of the most important growth center of India with traditional and modern industries. From the period of British colonial ruling the basin of Hoogly river (one among two tributaries of river Ganges) emerged as the most important industrial zone of India, where modern industries are now developing. Including Kolkata, Howrah, Hoogly, North and South 24 Parganas and recently Midnapur are the major districts, which have developed as industrially and economically important regions, i.e a large portion of southern West bengal (Figure-2). This area also yields a high amount and variety of crops and has two ports (Kolkata and Haldia). Kolkata is the administrative and economic headquarter of the area and is the largest and most important city in eastern India. Kolkata is well connected with the area by national and district highways and rail. As modern medical facilities are available in the government sponsored and private hospitals of the city, most of the patients either with referance or directly come to the hospitals of Kolkata for proper treatment. The distance and communication facilities are two influencing factors for the proportion of inflow of patients. Including districts of southern Westbengal, patients come from adjoining states like Bihar, Jharkhand, Tripura as well as from neighboring country Bangladesh. Therefore the study of hospital population of Kolkata at least reflects the actual state of art of incidence of a complex disease like intracranial malignancy. Present study revealed that Kolkata is the most severely affected district with 33.08% incidence followed by North 24 parganas (Table-2). As Kolkata is a population dense city with several industries, a huge amount of industrial and automobile pollutants made the environment inhospitable for healthy living. The industrial pollution is also very high in North 24 Parganas, Howrah and Hooghly. Most polluting industries in this region are leather, chemical, polymer, metal industries and also other industries have a considerable polluting effects. Table-2 showed the incidence of intracranial malignancy among different districts, their distances, communication status, major industries and pollutants. Most of the districts with heavy industrial burden are adjacent to Kolkata and communicated well with roads and rail. Districts distant over 200 Kms from Kolkata are not communicated smoothly at least by roads (Table-2). Apart from distance factor, industrially less developed districts registered very low

number of brain tumor patients. However moderately polluted districts had considerable number of patients, while high incidence of brain tumor were found in highly polluted industrial districts. This incidences data hinted towards the pollution factors, which might have some role for the disease. The vast array of industrial contaminants like organochlorines, aromatic benzo pyrene, nitrous oxides, nitrosoamines, heavy metals etc in this industrial region borne by air, water and soil may lead to ulceration and cancerous tumors (Yuspa, 2000; IARC, 1972-2001). The metabolic derivatives of nitrate, nitrite and other organic compounds are nitrosoamins, which can be produced from a wide variety of primary sources like industrial wastes in air, water, food preservatives, pesticides, tobacco smoke and chewing etc. According to the recent reports of National Environment Research Institute (NERI), State and Central Pollution Control Board the presence of nitrogen dioxide is also very high in Kolkata and North 24 Parganas. Nitrosoamines showed different types of malignancy, particularly glioma in various laboratory animals and are now growing concern as etiological agent for cancer in the human (Lijinsky and Epstein, 1970; Lantos, 1993). Different types of nitrogenous compounds, organic and inorganic toxins and heavy metal toxicity from chemical, leather, metal, polymer industries and pesticides from the vast agricultural land of this area may have a potential role in inducing brain tumor in this region. As industrial belts showed higher incidence, further investigation is required to materialize any idea about environmental toxicity and occurrence of intracranial malignancy. Predisposition of male patients with glioma is the other area to clarify whether any genetic background or the exposure of environmental toxicity, use of tobacco etc have any effect over this gender bias.

Proper and early diagnosis is important to treat diseases like intracranial malignancy. The increased awareness and improved availability of high quality MRI, CT scans and stereotactic biopsy have increased the rate and quality of detection. This improved diagnosis is suggested as one of the main factors behind the recent increase of brain tumor identification (Leglar J M and Gloeckler Ries, 1999). The diagnostic approaches to detect brain tumor in this region used three basic process i.e histopathology, CT scans and MRI. Stereotactic biopsy prior to surgical resection of brain tumor is a difficult task requiring expertise in it and sometimes has some practical improbabilities due to the anatomy and biology of intracranial malignancy. Therefore about 40% patients were directly operated depending upon the depth and position of tumor load identified by CT scans and MRI, and then the biopsy were done. Another important observation was that, as the cost of MRI was higher than CT scan, the patients having moderate and lower economic status went for CT scan except few cases where MRI was the necessity. On the contrary, patients from better economic strata were more frequent with MRI.

The therapeutic procedures for intracranial malignancy were mainly dependent on surgery and radiotherapy. Where in 29.83% cases brain tumors were resected by surgery case, in another 34.7% cases surgery was followed by radio- and chemotherapy. On the contrary, only radiotherapy was done on 28.92% patients and in another 36.5% of cases radiation was either post surgical or with chemotherapy. But only a very small fraction of patients (1.98%) of brain tumor was dependent solely on chemotherapy and comparatively small number of patients (<10%) received chemotherapeutic drugs in addition to other treatments. One basic constrain for low use of chemotherapeutic and not a single use of immunotherapeutic drugs in this region was the high expenditure for these applications. Government sponsored hospitals only used these drugs when they were of utmost necessity and patients of higher economic strata afforded to have these therapeutics in private hospitals. Again the drug resistance property of brain tumor due to the blood brain barrier (BBB) (Zunkeler et al, 1996), poor response of chemotherapeutic drugs in the disease (Fine et al, 1993), less availability of expertise, proper infrastructural facilities and advanced drug for modern therapies with their high price etc emerged as the basic hindrances to use other modern therapies. However, existing mode of treatment did not show promising results at all, particularly for glioma. Therefore modern therapeutic strategies are required to be employed for providing better survival of the malignant brain tumor patients in this area.

Therefore, to satisfy the purpose of providing information about malignant brain tumor, an intrusion had been made in the unscanned territories of epidemiological aspect of the disease within the hospital population of Kolkata. This cross-sectional survey described the status of the disease in respect to different parameters of population and reflecting its mode of incidence within the region of southern Westbengal. Though a number of questions were still left, the present study establishes itself as the first landmark of its kind. Data tables and graphics helped to crystallize the idea by providing a community diagnosis that can be utilized in developing community oriented primary care (COPC) against malignant brain tumor in this region.

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## References:

Abramson JH, Abramson ZH (1999). Survay Methods in community medicine. 5th Ed. London: Churchill Livingstone.

Begum Z, Sarkar S, Mukherjee J, et al (2003). Evaluation of anti-tumor property of specific and non-specific BRMs in experimental glioma by assessing the microglial cell function and phenotypic modulations. *Cancer Biol Ther*, **2**, 356-63.

Biumenthal DT, DeAngelis LM (1998). Ageing and primary central

nervous system neoplasms. *Neuro Clin N America*, **16**, 671-86.

Brain tumor facts and figures (2002). The Brain Tumor Society. 124 Watertown Street, Suite 3-H Watertown, MA 02472, USA.

Cancer Bureau (2002). LCDC, Health Canada. Statistics Canada and the Canadian Council of Cancer Registries.

Davis FG, Preston-Martin S (1998). Epidemiology: Incidence and survival. In: Bigner D D, McLendon R E, Bruner I M (eds). Russell and Rubinstein's Pathology of Tumors of the Nervous System. London: Arnold, 5-45.

Dena B Dubal, Hong Zhu, Jin YU, et al (2001). Estrogen receptor alpha, not beta is critical link in estradiol-mediated protection against brain injury. *Proc Natl Acad Sci*, **98**, 1952-7.

Feinstein AR (1981). Clinical Biostatistics: LVII: A glossary of neologisms in quantitative clinical sciences. *Clin Pharmacology and Therapeutics*, **30**, 564.

Fine HA, Dear KB, Loeffler JS, et al (1993). Meta-analysis of radiation therapy with and without adjuvant chemotherapy for malignant gliomas in adults, *Cancer*, **71**, 2585-97.

Hayostek CJ, Shaw EG, Scheithauer B, et al (1993). Astrocytomas of cerebellum. A comparative clinicopathologic study of pilocytic and diffuse astrocytomas. *Cancer*, **72**, 856-69.

International Agency for Research on Cancer (1972-2001). Monographs series on the evaluation of carcinogenic risks to humans. Lyon, France.

Johannesen TB, Langmark F, Lote K (2003). Cause of death and long term survival in patients with neuro-epithelial brain tumors: a population based study. *Eur J Cancer*, **39**, 2355-63.

Kark SL, Abramson JH (1981). Community focused health care. *Israel J Med Sc*, **17**, 65.

Kleihues P, Burger PC, Scheithauer BW (1993). The new WHO classification of brain tumors. *Brain Pathology*, **3**, 255-68.

Lantos PL (1993). Chemical induction of tumors in nervous system. In: G.T. Thomas (eds). NeuroOncology. New York, London: Curchill Livingstone, 85-107.

Leglar JM, Gloeckler Ries LA (1999). Brain and other central nervous system cancers: recent trends in incidence and mortality. *Nat Canc Inst*, **91**, 1382-90.

Lijinsky W, Epstein SS (1970). Nitrosoamines as environmental carcinogens. *Nature*, **225**, 21-3.

Mukherjee J, Dutta S, Sarkar S, et al (2003). Priclinical changes in immunoreactivity and cellular architecture during the progressive development of intracranial neoplasms and an immunotherapeutic schedule with a novel biological response modifier, the T11TS/SLFA-3. *Asian Pac J Cancer Prev*, **3**, 325-37.

Paganini-Hill A, Henderson VW (1994). Estrogen deficiency and risk of Alzheimer's disease in women. *Am J Epidemiol*, **140**, 256-61.

Parkin DM, Whelan SL, Ferlay J, Raymond L, Young J (eds) (1997). Cancer incidence in five continents. VII (143), Lyon: IARC.

Prados MD, Berger MS, Wilson CB (1998). Primary central nervous system tumors: advances in knowledge and treatment. *CA Cancer J Clin*, **48**, 331-60.

Riggs JE (2000). The biphasic pattern of age specific malignant brain tumor mortality rates. *Neurology*, **55**, 750-3.

Roy S, Sarkar C, Sharma MC (2002). Epidemiology and classification of malignant brain tumors. In: Singh AK (eds). Malignant Brain Tumor, Indian Clinical Neurosurgery Vol-II. New Delhi: CBS Publication, 11-34.

Russell DS, Rubinstein LJ (1989). Pathology of tumors of the nervous system. 5th Ed, London: Edward Arnold, 111-114.

Sant M, van der Sanden G, Capocaccia R and the EUROCARE working group (1998). Survival rates for primary malignant brain tumor in Europe. *Eur J Cancer*, **34**, 2241-7.

Sarkar S, Begum Z, Dutta S, et al (2002). Sheep form of leucocyte function antigen-3 (T11TS) exerts immunostimulatory and anti-tumor activity against experimental brain tumor. A new approach to biological response modifier therapy. *J Exp Clinl Cancer Res*, **21**, 95-106.

Sen U, Sankaranarayan S, Mandal S, et al (2002). Cancer patterns in eastern India: the first report of the Kolkata Cancer Registry. *Int J Cancer*, **100**, 86-91.

Vijg J (2000). Somatic mutations and aging: a re-evaluation. *Mut Res*, **447**, 117-35.

Yancik R, Havlik RJ, Wesley MN, et al (1996). Cancer and comorbidity in older patients: a description profile. *Ann Epidemiol*, **6**, 399-412.

Yuspa SH (2000). Overview of carcinogenesis: past, present and future. *Carcinogenesis*, **21**, 341-4.

Zunkeler B, Carson RE, Olson J, et al (1996). Quantification and Phermacokynetics of blood-brain-barrier disruption in humans, *J Neurosurge*, **85**, 1056-65.