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Clinical Manifestations and Neuroimaging Features of Intracranial Infection among Study at a Tertiary Care Hospital in Bangladesh

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Abstract

Background: Intracranial infection is one of the life-threatening infections that can affect the meninges or the brain. It is a major cause of emergency and death in children and adults. Preconception regarding the clinical manifestation of intracranial infection may be helpful for physicians in managing such emergency cases. **Objective:** This study was aimed to assess the clinical manifestation and neuro-radiological features among patients presented with intracranial infections. **Methodology:** This was a cross-sectional observational study that was conducted in the Department of Radiology and Imaging (CT section) of BSMMU and Dhaka Medical College Hospital, Dhaka, Bangladesh from March 2006 to September 2006. In total 50 patients, by using the spiral CT system with various complaints suspecting intracranial infections and few number of pre-diagnose cases for evaluation of complications were enrolled in this study as the study subjects by random sampling technique. Data were processed, analyzed and disseminated by using MS Office. **Results:** Male patients contributed 66.0% of the total; most of the patients who underwent a CT of the brain were from 31 to 50 years old. As the most frequent complaint, fever, headache and vomiting were observed in 24.0%, 20.0% and 16.0% of the cases; in about half of the patients (46.0%) high-grade fever was found. As the CT finding, abnormal meningeal enhancement (11.5%), cerebral oedema (7.5%) and mild ventricular dilatation with subarachnoid space enlargement (8.5%) were found among a noticeable number of patients. **Conclusion:** The prevalence of intracranial infection among males is about double that in females. Fever, headache and vomiting are the most common complaints of intracranial infection patients. Abnormal meningeal enhancement, cerebral oedema and mild ventricular dilatation with subarachnoid space enlargement are very common CT findings in such cases.

Keywords: Clinical status; Intracranial Infection; CT-scan; Fever; Brain; COMA

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Introduction

The diverse array of infectious conditions can impact the brain. These include abscesses, meningitis, vasculitis, and encephalitis. In our routine medical practice, numerous patients have been seeking medical attention for various intracranial infections. A recent study highlighted that the prevalence of intracranial infections ranks among the most frequent neurological issues in Bangladesh[1]. The occurrence patterns of these diseases vary based on factors such as gender, age, geographical location, and clinical circumstances, particularly regarding the patient's immunosuppression status. Intracranial infections pose a grave risk as they

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can target the meninges or the brain. Microorganisms underlie central nervous system infections, exhibiting clinical forms like encephalitis, meningitis, and pyogenic infections such as brain abscesses and empyema[2].

According to a 2009 study, meningitis stands as the most prevalent intracranial infection among infants and children. Bacterial meningitis is notably frequent within the first months of life and remains elevated until around age two, subsequently declining significantly[3]. Rapid diagnosis and specific treatment are imperative for encephalitis, a medical emergency. Acute encephalitis incidence varies worldwide, generally ranging from 3.5 to 7.4 cases per 100,000 individuals annually[4]. In Indonesia, the encephalitis mortality rate ranks 14th in Asia, at 1.2 cases per 100,000 populations. This figure was approximately 38.3% in 1990, averaging a yearly increase of 1.7% cases. The highest mortality rates were observed in pediatric cases aged 1 to 4 years, specifically 4 cases per 100,000 in boys and 2.6 cases per 100,000 in girls[5].

Research conducted on adult patients revealed that encephalitis-related deaths were linked to cerebral edema, thrombocytopenia, and epileptic states[6]. Additionally, a study involving pediatric cases with acute encephalopathy found that mortality was associated with factors like recurrent seizures, a Glasgow Coma Scale (GCS) score below 8, shock, severe anemia, and bradycardia[7]. At present, over 10 high-risk factors have been identified primarily for surgical site infections following craniotomy[8]. However, there has been no analysis regarding the risk factors for postoperative oral infections and their seasonal patterns. The concept of seasonal variation in arterial blood pressure was reported in the 1980s[9]. Furthermore, Herweh et al[10] established a connection between hypertensive intracerebral hemorrhage and increased air pressure through a global cohort study.

Regarding oral infections, a previous study highlighted brain abscesses as potential lethal complications arising from odontogenic infections by summarizing relevant cases[11]. Despite this, there has been no case-control study conducted to establish a conclusive relationship between intracranial infections and oral infections. The objective of this current study was to assess the clinical manifestation of intracranial infection.

Methodology

Study Settings and Population: This cross-sectional study was conducted at the Department of Radiology and Imaging (CT section) of BSMMU and Dhaka Medical College Hospital in Dhaka, Bangladesh, spanning from March 2006 to September 2006. The study included a patients suspected of having intracranial infections or those with pre-diagnosed cases for complications evaluation, all of whom underwent assessment using a spiral CT system. Exclusion criteria encompassed patients who had not undergone craniotomy, exhibited severe organ functional impairment, had malignant tumors, suffered from metabolic or blood systemic disorders, had spinal deformities, discontinued treatment, were obese to the extent that lumbar puncture couldn't be performed, experienced failed lumbar puncture, were treated with nonsurgical interventions like intravenous antibiotics, or displayed subarachnoid space adhesion leading to cerebrospinal fluid circulation issues.

Study Procedure: The participants were selected using a random sampling technique. Demographic and clinical data of the participants were comprehensively recorded. The CT-scan were performed to all the patients. The neuroimaging features of the patients were recorded. The evaluation of the neuroimaging findings was re-evaluated by another radiologist in blinded way to diagnose accurately without any bias.

Statistical Analysis: Statistical analysis was performed by Windows based software named as Statistical Package for Social Science (SPSS), versions 22.0 (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). Continuous data were expressed as mean, standard deviation, minimum and maximum. Categorical data were summarized in terms of frequency counts and percentages. Every efforts were made to obtain missing data.

Ethical Clearance: The ethical committee of the mentioned hospital approved the study, and informed consent was obtained from all participants before data collection. The study followed the principles outlined in the Helsinki Declaration[12] and adhered to relevant regulations, including the General Data Protection Regulation (GDPR)[13].

Results

This study included a total of 50 patients suspected of having intracranial infections or those with pre-diagnosed cases for complications evaluation, all of whom underwent assessment using a spiral CT system. Among the total participants, 66% were male whereas the rest 34% were female. So, the male-female ratio of the participants was 2:1 (Figure I).

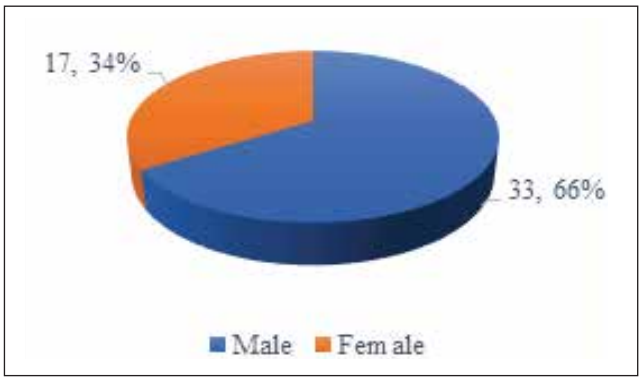

Figure I: Distribution of Participants as Per Gender (N=50)

In analyzing the ages of the total participants, we observed that the youngest one of the patients was 1-year-old and the oldest one was 69 years old. Most of the patients who underwent CT of the brain were from the 31 to 50 years age group (Figure II).

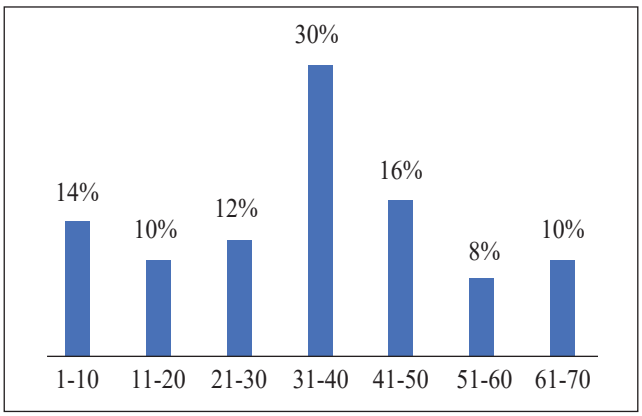

Figure II: Distribution of participants as per age (years) (N=19)

In this study, the most frequent complaints of fever were found in 24%, headache in 20% and vomiting in 16% of the total cases. In analyzing the basis of fever among total febrile participants, about half of the febrile patients had high-grade fever (Table 1).

Table 1: Analysis of patients based on presenting complaints (N=50)

Complaints	Frequency	Percent
Fever	12	24.0
Headache	10	20.0
Vomiting	8	16.0
Drowsiness	2	4.0
Convulsion	5	10.0
Circulatory collapse	1	2.0
Neurological deficits	4	8.0
Restlessness	4	8.0
Neck rigidity	6	12.0
COMA	1	2.0
Malaise	3	6.0
Hemiparesis	1	2.0
Rash	2	4.0

Upon analyzing the nature of the diseases, it was evident that encephalitis (6%), tubercular meningitis (6.5%), and pyogenic meningitis (7%) emerged as the most prevalent intracranial infections across all age groups (Table 2).

Table 2: CT analysis of the nature of intracranial infection

CT Findings	Frequency	Percent
Encephalitis	12	6
Tubercular meningitis	13	6.5
Pyogenic meningitis	14	7
Tuberculoma	3	1.5
Brain abscess	4	2
Subdural empyema	2	1
TORCH infection	2	1

In analyzing the CT finding among the participant we observed that abnormal meningeal enhancement (11.5%), cerebral oedema (7.5%) and mild ventricular dilatation with subarachnoid space enlargement (8.5%), were comparatively more frequent among the participants. Ring enhancement (3.5%), parenchymal calcification (1%) and brain atrophy with hydrocephalus (0.5%) were also detected in some cases (Table 3).

Table 3: Pattern of CT findings (N=50)

CT Findings	Frequency	Percent
Cerebral oedema	15	7.5
Abnormal meningeal enhancement	23	11.5
Mild ventricular dilatation and subarachnoid space enlargement	17	8.5
Dural calcification	2	1.0
Exudate in basal cistern	13	6.5
Parenchymal calcification	2	1.0
Ring enhancement	7	3.5
Brain atrophy and hydrocephalus	1	0.5
Normal	7	3.5

Discussion

Despite contemporary methods of effective control, intracranial infections continue to be a prevalent clinical issue in our country. In this research, the majority of the patients (66.0%) were male, while the remaining patients (34.0%) were female. The age range varied from one year, representing the youngest, to 69 years, representing the oldest participant.

Notably, the highest proportion of patients (46.0%) who underwent brain CT scans fell within the 31 to 50-year age group. This age distribution suggests a predominance of middle-aged patients. Furthermore, when considering the gender distribution of intracranial infections, it is evident that females are less frequently affected compared to males. This finding aligns with previous studies conducted by Fang et al[14] and Kourbeti et al[15].

In this study, the most frequent complaints of fever were found in 24.0%, headache in 20.0% and vomiting in 16.0% of the total cases. In analyzing the basis of fever among total febrile participants we observed that about half of the febrile patients had high-grade fever. Others have found a fever occurrence rate of 10.0% in mild-to-moderate TBI and up to 58.0% in sTBI[16]. In another study, up to 52.0% of cases had an episode of fever during their PICU stay, but only one-half of febrile patients were diagnosed with infections[17]. Upon scrutinizing the nature of the diseases, it became evident that encephalitis (6.0%), tubercular meningitis (6.5%), and pyogenic meningitis (7.0%) emerged as the most prevalent intracranial infections across all age groups.

During the analysis of CT findings among the participants, notable observations included a higher occurrence of abnormal meningeal enhancement (11.5%), cerebral edema (7.5%), and mild ventricular dilatation with subarachnoid space enlargement (8.5%). Additionally, ring enhancement (3.5%), parenchymal calcification (1.0%), and brain atrophy with hydrocephalus (0.5%) were also detected in certain cases. All the findings of this current study may be helpful in further similar studies.

There is some limitation of the study. This was a single-centered study with small-sized samples. Moreover, the study was conducted over a very short period. So, the findings of this study may not reflect the exact scenario of the whole country.

Conclusion

Intracranial infections are infections within the cranial cavity. The prevalence of these infections is about twice as high in males compared to females. This suggests potential gender-related susceptibility due to factors like genetics, hormones, or behavior. Patients with these infections commonly experience symptoms such as fever, headache, and vomiting, which result from the body's immune response and the infection's impact on brain function. Diagnosis often involves tools like computed tomography (CT) scans. CT- scan in such cases reveal key findings like abnormal meningeal enhancement (indicating brain and spinal cord membrane inflammation), cerebral edema (brain tissue swelling due to fluid accumulation), mild ventricular dilation (slight enlargement of fluid-filled brain cavities), and subarachnoid space enlargement (widening between brain and arachnoid membrane). These CT findings aid medical professionals in assessing infection severity. Timely diagnosis and treatment are vital to manage these infections and prevent serious complications or life-threatening situations.

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None

Conflict of Interest
The authors have no conflicts of interest to disclose.

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Authors' contributions
Khan AU, Sajedeen S conceived and designed the study, analyzed the data, interpreted the results, and wrote up the draft manuscript. Khan AU contributed to the analysis of the data, interpretation of the results and critically reviewing the manuscript. Akhter N, Moureen A, Sattar AFMA, Hasan MS involved in the manuscript review and editing. Khan AU, Sajedeen S as collector of Data and Data Analyst. All authors read and approved the final manuscript.

Data Availability
Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate
Ethical approval for the study was obtained from the Institutional Review Board. As this was a prospective study the written informed consent was obtained from all study participants. All methods were performed in accordance with the relevant guidelines and regulations.

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References

1. Huq N, Haque ME, Jahan N, Yusuf MA, Baqui MN, Rozhana S, Shirin S, Islam MN. Histopathological Pattern of Central Nervous System Infection: Experience of 61 cases at Referral Neuroscience Hospital in Bangladesh. Journal of histopathology and cytology. 2019;3(2):143-50
2. Beckham JD, Tyler KL. Neuro-intensive care of patients with acute CNS infections. Neurotherapeutics. 2012 Jan 1;9(1):124-38.
3. Sahu RN, Kumar R, Mahapatra AK. Central nervous system infection in the pediatric population. Journal of Pediatric Neurosciences. 2009;4(1):20-4
4. Johnson RT. Acute Encephalitis. Clinical Infectious Diseases. 1996;23(2):219-24
5. Quan TM, Thao TT, Duy NM, Nhat TM, Clapham H. Estimates of the global burden of Japanese encephalitis and the impact of vaccination from 2000-2015. Elife. 2020;9:e51027.
6. Thakur KT, Motta M, Asemota AO, Kirsch HL, Benavides DR, Schneider EB, et al. Predictors of outcome in acute encephalitis. Neurology. 2013;81(9):793-800
7. Bokade CM, Gulhane RR, Bagul AS, Thakre SB. Acute febrile encephalopathy in children and predictors of mortality. Journal of Clinical and Diagnostic Research: JCDR. 2014;8(8):PC09-11
8. Kourbeti IS, Jacobs AV, Koslow M, Karabetsos D, Holzman RS. Risk factors associated with post-craniotomy meningitis. Neurosurgery. 2007;60(2):317-26.
9. Brennan PJ, Greenberg G, Miall WE, Thompson SG. Seasonal variation in arterial blood pressure. Br Med J (Clin Res Ed). 1982;285(6346):919-23
10. Herweh C, Nordlohne S, Sykora M, Uhlmann L, Bendszus M, Steiner T. Climatic and seasonal circumstances of hypertensive intracerebral hemorrhage in a worldwide cohort. Stroke. 2017;48(12):3384-6.
11. Moazzam AA, Rajagopal SM, Sedghizadeh PP, Zada G, Habibian M. Intracranial bacterial infections of oral origin. Journal of Clinical Neuroscience. 2015;22(5):800-6
12. World Medical Association. World Medical Association Declaration of Helsinki. Ethical principles for medical research involving human subjects. Bulletin of the World Health Organization, 2001;79(4):373 - 374
13. Voigt P, Von dem Bussche A. Enforcement and fines under the GDPR. The EU General Data Protection Regulation (GDPR). Springer, Cham, 2017. 201-217
14. Fang C, Zhu T, Zhang P, Xia L, Sun C. Risk factors of neurosurgical site infection after craniotomy: A systematic review and meta-analysis. American Journal of Infection Control. 2017;45(11):e123-34
15. Kourbeti IS, Jacobs AV, Koslow M, Karabetsos D, Holzman RS. Risk factors associated with postcraniotomy meningitis. Neurosurgery. 2007;60(2):317-26.
16. Natale JE, Joseph JG, Helfaer MA, Shaffner DH. Early hyperthermia after traumatic brain injury in children: risk factors, influence on length of stay, and effect on short-term neurologic status. Critical care medicine. 2000;28(7):2608-15.
17. Suz P, Vavilala MS, Souter M, Muangman S, Lam AM. Clinical features of fever associated with poor outcome in severe pediatric traumatic brain injury. Journal of neurosurgical anesthesiology. 2006;18(1):5-10.