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Clinico-Radiological Presentation and Outcome of Brain Abscess in Congenital Cyanotic Heart Disease

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ABSTRACT

Introduction

Patients with congenital cyanotic heart disease (CCHD) are at increased risk of developing brain abscesses. Having a brain abscess is itself a risk for the patient and concomitant cyanotic heart disease makes it a double jeopardy. The management of brain abscesses depends on the size, number, stage, and location of the abscess and can be medical and surgical.

Methods

This retrospective chart review was conducted at Tribhuvan University Teaching Hospital, Kathmandu, Nepal of patients treated between January 2018 and December 2022. Demographic and clinical profiles, imaging studies, treatment modalities, and outcomes were analyzed.

Results

Out of 17 patients, 11 were males and six were females. The mean age of the study population was 13.41±11.08 years. The most common associated cardiac problem was Tetralogy of Fallot seen in six (35.3%) patients and the most common abscess site was the parietal lobe (38%). The most common presenting symptom was vomiting, seen in 76%. Twelve patients underwent burrhole and aspiration and 17.6% of patients underwent surgical excision of the abscess wall whereas 11.7% of the patients were managed conservatively. Positive culture was seen in 33.3%. *S. aureus* was the most common organism grown. There was no mortality.

Conclusion

Majority of patients were male with Tetralogy of Fallot as the most common associated congenital cardiac condition. Most of the patients were managed with Burr hole and abscess aspiration with re-aspiration in three patients. Suspicion of brain abscess should be high in patients with congenital cyanotic heart disease.

Keywords

Brain abscess; burr hole; cyanotic heart disease; pus

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INTRODUCTION

A brain abscess is a collection of pus in an intracerebral location.[1] The origin of the abscess can be contiguous, hematological, post-operative, or sequelae of meningitis.[2] Patients with congenital cyanotic heart disease (CCHD) are at increased risk of developing brain abscesses. There is a right-to-left shunt of blood in these patients causing deoxygenated blood to mix with the peripheral circulation bypassing the lungs. This deoxygenated blood may be a substrate for any pathogenic bacteria for multiplication. In addition, there is compensatory polycythemia causing increased blood viscosity.[3] The peak incidence is seen in the age group of 4-7 years, although no age is exempt.[4]

The commonest clinical presentation is seizure, fever, headache, and vomiting. Focal neurological deficits may develop depending on the location of the abscess.[5] There are four stages of brain abscess based on radiology, gross appearance, and histopathology: early cerebritis (1-4 days), late cerebritis (4-10 days), early capsule (11-14 days) formation and late capsule formation (>14 days).[6,7] The predictors of poor prognosis are multiplicity, delayed presentation, associated cerebral edema, low Glasgow Coma Scale (GCS) at admission, immunocompromised state, intraventricular rupture of brain abscess, and inappropriate treatment.[8]

The management of brain abscesses is dictated by the size, stage of evolution, location, and clinical condition of the patient. The standard treatment is surgery as it reduces the mass effect in addition to identifying the organism.[9,10] We aimed to study the incidence, demographic, and clinical profiles and the factors predicting the outcome of cerebral abscess in patients with CCHD.

METHODS

This was a retrospective chart review conducted in the Department of Neurosurgery of Tribhuvan University Teaching Hospital following approval from the Institutional Review Committee of Institute of Medicine. We collected data from patient records in the hospital record section treated from January 2018 to December 2022.

The study included patients with brain abscesses with CCHD confirmed operatively and 2D echocardiography respectively. Patients with complete data and at least 3 months of follow-up postoperatively were included in the study. Demographic profiles, presenting symptoms, imaging findings, microbiological findings, treatment modalities, and outcomes were analyzed. The diagnosis of brain abscess was confirmed via contrast-enhanced computed tomography (CECT) of the brain. Other routine investigations needed for management were performed. The patients were routinely admitted to a high dependency unit (HDU) or Intensive Care Unit (ICU) depending on the condition of the patient. They were started on antiepileptics and antibiotics based on prevalent hospital organisms.

Surgery was offered to all the patients where surgery was deemed necessary. Repeat imaging was done one week and six weeks after surgery. The antibiotic was continued for six weeks followed by oral antibiotics for two more weeks. The resolution of the abscess was verified by the CECT brain. Data were analyzed using IBM SPSS Statistics version 26.

RESULTS

A total of 17 patients with 21 brain abscesses were included in the study. There were 11 (64.7%) male and six (35.3%) female patients. The mean age of the population was 13.41±11.08 years with a range

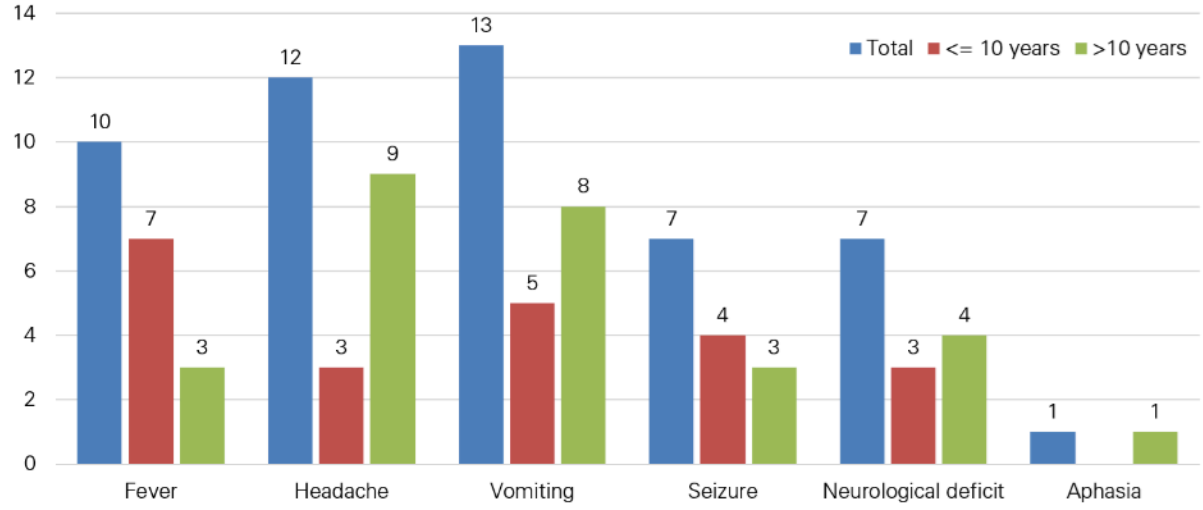

Figure 1. Presenting complaints of the population

of 2-43 years. The majority of the patients were in the age group of more than 10 years with 10 (59%) patients and the remaining 7 (41%) patients were less than 10 years of age.

The most common presenting complaint was vomiting which was present in 13 (76%) patients. Fever was the most common symptom in patients of age group 10 years or below (Figure 1). The other presenting symptoms were headache, seizure, neurological deficit, and aphasia.

Parietal lobe (38%) was the most common location of the abscess followed by the frontal lobe (33.3%), temporal lobe (9.5%), occipital lobe (4.7%), and other areas (14.2%). Multiple brain abscess was seen in four (23.5%) patients (Figure 2).

The majority of the patients were managed by burrhole and abscess aspiration in 12 (70.5%) patients followed by craniotomy and abscess excision in three (17.6%) patients. Two (11.7%) patients were managed conservatively. Three (17.6%) patients who were managed by Burrhole and abscess aspiration needed re-aspiration of abscess. The pus culture and sensitivity (C/S) done in 15 patients showed no growth in 10 (66.6%) patients, *S. aureus* in three (20%) patients, and E. coli in two (13.3%) patients (Table 1).

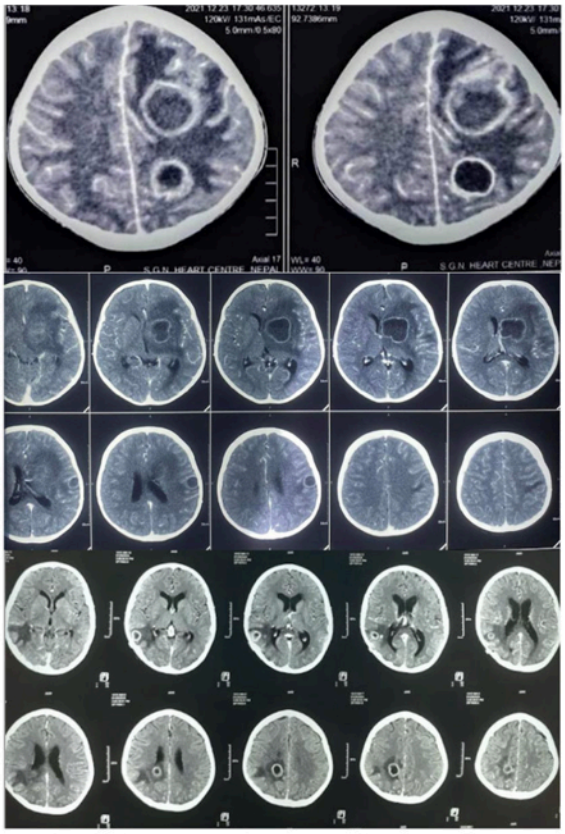

Figure 2. *Multiple abscesses in the population*

Table 1. *Demographic and clinical characteristics of the population*

Characteristics		Total	Age		p-value
			<=10 years	>10 years	
Gender	Male	11	5	6	
	Female	6	2	4	0.63
Age (years)	Mean	13.41±11.08	4.29±2.36	19.8±10.22	
	<=10 years	7	7 (100%)	0 (0%)	0.15
	>10 years	10	0 (0%)	10 (100%)	
Location of abscess	Frontal lobe	7	3	4	0.38
	Temporal lobe	2	1	1	
	Parietal lobe	8	2	6	
	Occipital lobe	1	1	0	
	Others	3	2	1	
Number of abscesses	Single	13	5	8	
	Multiple	4	2	2	0.68
Duration of hospital stay	<2 weeks	4	0	4	
	2-4 weeks	6	2	4	0.06
	>4 weeks	7	5	2	
Treatment	Conservative	2	0	2	
	Burrhole drainage	12	5	7	0.33
	Abscess excision via craniotomy	3	2	1	
Times of surgery	One	12	5	7	0.44
	Two	3	2	1	
Pus C/S	No growth	10	4	6	0.08
	S. aureus	3	1	2	
	E. coli	2	2	0	

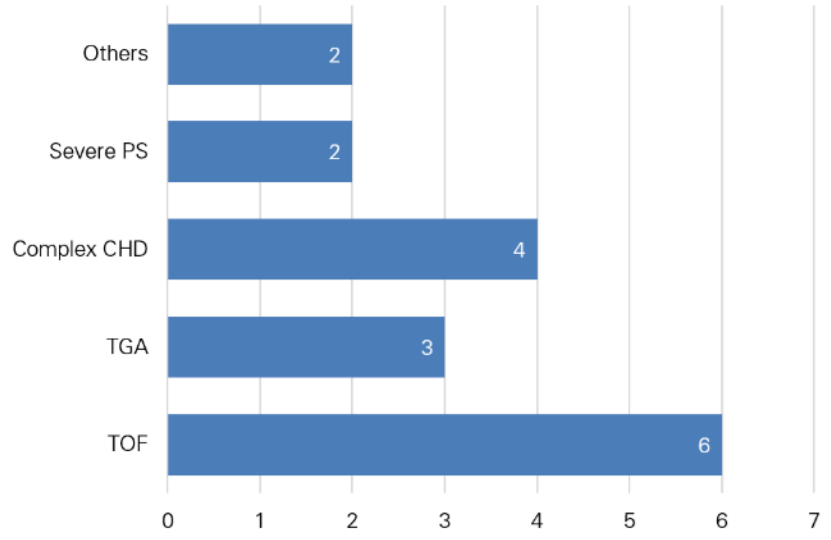

Figure 3. *Associated cardiac conditions in the population*
PS: Pulmonary stenosis; CHD: congenital heard disease; TGA: Transposition of great arteries; TOF: Tetralogy of Fallot

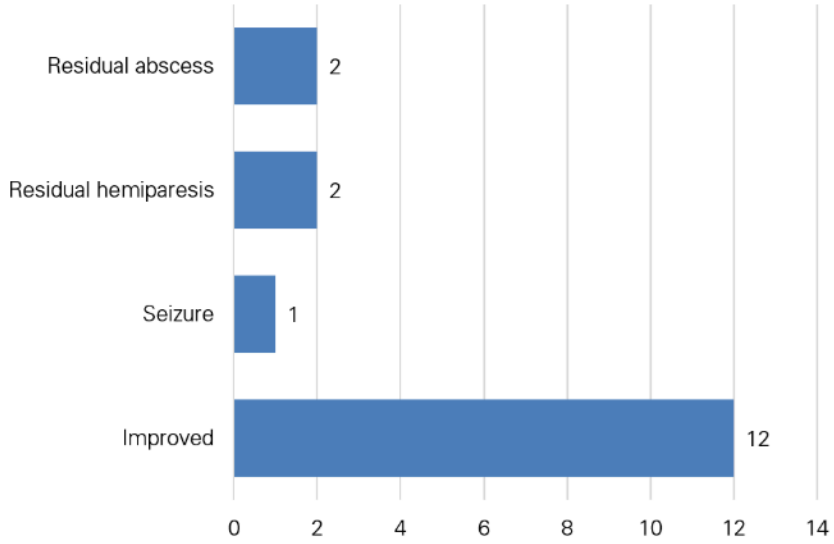

Figure 4. *Short-term outcome of the population (3 months minimum)*

The most common associated cardiac condition was Tetralogy of Fallot (TOF) seen in six (35.3%) patients followed by Transposition of Great Arteries (TGA), Complex Cyanotic Heart Disease, and Severe Pulmonary Stenosis (PS) (Figure 3).

All the patients were followed up for at least three months following surgery. The majority of the patients (70.5%) improved in terms of their presenting complaints at the time of discharge. The residual abscess was seen in 2 (11.7%) patients, residual hemiparesis was seen in 2 (11.7%) patients, and seizure in one (5.8%) patient (Figure 4).

DISCUSSION

Twenty-one brain abscesses in 17 patients with CCHD were observed over five years in our center. The male population was more affected than the female population, with the most common age group being less than 10 years of age, as corroborated by a study by Prasad et al [11] though Atiq et al[12] reported no sex predilection.

The most common presenting complaint was vomiting followed by headache. Vomiting was seen in 13 (76.4%) patients in our study. This is in contrast to a study by Abdulghani et al, where fever was the most common presenting symptom seen in 84.6% of patients followed by vomiting.[13] In our study, fever was seen in 10 (58.8%) patients. Risk factors often decide the location and the most likely pathogen. Abscesses in the frontal lobe often originate from a sinus infection or dental infection. Ear infections usually give rise to temporal and cerebellar abscesses. Abscesses arising from

hematogenous spread are usually found in the distribution of the middle cerebral artery and mainly give rise to parietal lobe abscesses.[14] In our study, parietal lobe abscess was the most common finding followed by frontal lobe abscess. This may be due to the hematogenous route of infection due to cyanotic heart disease. In a study by Chakraborty et al, the commonest site of the abscess was the frontal lobe (37.5%) followed by the parietal lobe (32.5%).[15] Cerebellum was the commonest site in a study by Borgohain et al.[16]

Depending on the literature, CCHD is detected in up to 69.4% of all cases of brain abscesses, the most common anomaly being TOF.[17] In our series also, TOF was the most common anomaly.

Multiple abscesses were seen in four (23.5%) patients in our study. In the study by Chakraborty et al, 32.1% of patients had multiple abscesses.[15] The pathogenesis is not well established but may be due to the hematogenous spread of infection in cyanotic heart disease.

The management of brain abscesses is largely individualized, based on the size, stage, and location. Recently, there has been an introduction of stereotactic techniques for the safe drainage of deep-seated small abscesses.[18] In selected cases, treatment by antibiotic is also successful. In our study, we managed the majority of the cases (70.5% of patients) with boreholes and aspiration of pus. In three (17.6%) patients, excision of abscess via craniotomy was done. In our study, three patients (20%) needed re-aspiration consistent with previously published literature that quotes the rate between 19%-28%.[19]

The mean duration of hospital stay in our series was 24.6 days. This is less than that reported previously by our group in 2013 where the mean length of stay was 30.5 days.20 Culture positivity was found in five cases (33.3%) out of 15 operated cases in our series. A similarly low rate of detection of organisms is reported in multiple studies. This is probably due to the unavailability of an anaerobic culture facility and the use of antibiotics.[16,21]

The reported mortality for this condition in the modern era is 6-17%.[22] The intraventricular extension of abscess is the single most predictor of higher mortality (up to 48%).[23] There was no mortality in our series. This is probably explained by the fact that we institute protocolized treatment by the multispecialty team, however, selection bias due to small sample cannot be excluded. In the study by Prusty et al, 44 (73.3%) patients improved in their neurological status, three (5%) patients had fixed neurological deficits, and five (8.33%) patients deteriorated further.[24] In our study, the majority of the patients (70.5%) had improvement in their symptoms compared to the symptoms at the time of presentation, two (11.7%) patients had fixed neurological deficits, two (11.7%) developed residual abscess which required re-aspiration and one (5.88%) patient developed seizure.

CONCLUSION

Brain abscess secondary to CCHD is not an uncommon entity. Majority of patients were male while Tetralogy of Fallot was the most common associated congenital cardiac condition. Most of the patients were managed with Burr hole drainage. Suspicion of brain abscess should be high in patients with CCHD. With timely diagnosis and treatment, a favorable outcome is achieved in nearly all patients.

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CONFLICT OF INTEREST

The author(s) declare that they do not have any conflicts of interest with respect to the research, authorship, and/or publication of this article.

AUTHOR CONTRIBUTIONS

Study concept and design: GS, SB, DKS, ABP, SKS, MRS. Data Collection: GS, SB, DKS, ABP, SKS, MRS. Analysis and interpretation of data: GS, SB. Drafting of the manuscript: GS, SB. All authors read and approved the final manuscript.

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