Proportions and characteristics of patients with brain abscess at Sanglah General Hospital in Denpasar, Bali, Indonesia in 2019-2020

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ABSTRACT

Introduction. A brain abscess is a collection of pus, immune cells, and other materials that are generally caused by bacterial or fungal infection in the brain parenchyma. This disease has a high level of morbidity and mortality, nonetheless, until now there has been no in-depth research on this disease, especially in Bali.

Objective. This study aimed to determine the proportion and characteristics of patients with brain abscess at the Sanglah General Hospital, Denpasar, Bali, Indonesia in 2019-2020.

Material and methods. This study is an observational study with a cross-sectional method. A total of 41 patients with brain abscesses recorded in hospital medical records in 2019-2020 were included in this study. Univariate analysis was performed to obtain the characteristics of patients with brain abscesses.

Results. Most of the patients were male (63.4%), aged 20-39 years. The main complaint most often found in patients was decreased consciousness (56.1%), with neurological symptoms in the form of hemiparesis (32.3%). Most of the abscesses were found on the right frontal, right parietal, and left parietal with a percentage of 14.06% each. The CT scan results showed a rim contrast enhancement (63.4%), cerebral edema (75.6%), and normal sulcus gyri (51.2%). Up to 50% of patients with a history of surgical procedures underwent a craniotomy. Other disease histories most often found in patients were sinusitis (29.5%), diabetes mellitus (15.3%), and toxoplasmosis (12.5%).

Conclusion. There are varying results of the clinical characteristics of patients with brain abscesses, and indicate the natural course of this disease.

Keywords: brain abscess, patient's characteristics, CT scan

INTRODUCTION

Central nervous system (CNS) infection is one of the main sources of morbidity today. The presence of new, broader spectrum antibiotics as well as improved clinical imaging technology and intensive care facilities has changed the history of previous CNS infection management. It is known that the brain does not have its own immune system but the blood-brain barrier is predominantly immune to infection. However, it is not uncommon for these infections to cause serious illness in the body. Brain abscess is one of the serious diseases that affect the CNS (1). A brain abscess is a collection of pus, immune cells, and other materials commonly caused by bacterial or fungal infection in the brain parenchyma. When a part of the brain becomes infected through blood or directly, it becomes swollen and inflamed. Infected brain cells, white blood cells, live and dead bacteria, or fungi collect in this area of the brain. The surrounding tissue will form a mass (abscess) (2-5). Often the source of infection is not found, but the most common source is infection of the lungs and rare cases occur from heart infection. Several factors...
can increase the risk of developing a brain abscess, including a weak immune system (HIV/AIDS patients), a history of chronic diseases such as cancer, taking immunosuppressants (corticosteroids or chemotherapy), and congenital heart disease (2).

Undiagnosed or untreated brain abscess has very high morbidity and mortality. Brain abscess morbidity reaches 46% with a mortality rate of 13.58%. Complications caused by brain abscess include septicemia, neurological deficits, meningitis, ventriculitis, intracranial vascular thrombosis, brain herniation, seizures, and increased intracranial pressure (2,6,7). Brain abscess has a higher prevalence in developing countries than in developed countries. This is due to differences in socio-economic conditions that occur in these countries (8). Indonesia has reported several cases of brain abscess, but there is no definite national data (9). Each region has its own characteristics of patients so that it requires different management.

The need for science encourages research on certain health issues. To determine the characteristics of a patient with a brain abscess, data is needed to describe this.

MATERIAL AND METHODS

This research is a descriptive observational study with a cross sectional approach to determine the proportion and characteristics of patients with brain abscesses at Sanglah General Hospital in 2019-2020. This research was conducted at Sanglah General Hospital Denpasar by taking secondary data from the Medical Record Installation. The population in this study were all patients with brain abscesses who were registered at the Sanglah General Hospital Medical Record Installation, Denpasar, Bali. The sampling technique used in this study was total sampling technique. Subjects taken from the population were those who met the inclusion criteria, namely medical record data that show that the patients had been diagnosed with brain abscess by doctors at Sanglah General Hospital Denpasar in 2019-2020, and were in accordance with the research variables, and did not meet the exclusion criteria in the form of incomplete medical record data of patients with brain abscess disease at Sanglah General Hospital Denpasar in 2019-2020.

This research has received permission from the Research Ethics Commission of Udayana Medical Faculty/Sanglah Hospital Denpasar number 2110/UN14.2.2.VII.14/LT/2020.

RESULTS

Table 1 shows the demographic characteristics of patients. Most of the patients were male (n = 26, 63.4%).

| TABLE 1. Demographic characteristics of patients |
|-----------------------------------------------|
| Sociodemographic Characteristic | N   | %   |
|--------------------------------|-----|-----|
| Gender                        |     |     |
| Male                          | 26  | 63.4|
| Female                        | 15  | 36.6|
| Total                         | 41  | 100.0|
| Age                           |     |     |
| 20-39 Years                   | 16  | 39.0|
| 40-59 Years                   | 16  | 39.0|
| > 60 Years                    | 9   | 22.0|
| Total                         | 41  | 100.0|

The main complaints of the patient are shown in Table 2. Most of the patients had the main complaints in the form of decreased consciousness (n = 23, 56.1%), weakness of half of the body (n = 8, 19.5%) and headache (n = 6, 14.6%).

| TABLE 2. Main complaints of patients |
|-------------------------------------|
| Main complaints | N   | %   |
|----------------|-----|-----|
| Decrease in awareness | 23  | 56.1|
| Headache         | 6   | 14.6|
| Hemiparesis      | 8   | 19.5|
| Seizures         | 1   | 2.4 |
| Vomiting         | 1   | 2.4 |
| Slurred speech   | 2   | 4.9 |
| Total            | 41  | 100.0|

Data regarding the results of vital signs examination on patients can be seen in Table 3. Most of the patients have blood pressure, respiratory rate, and pulse rate, and body temperature within normal limits. Patients also have a fairly mild pain intensity.

| TABLE 3. Vital signs of patients |
|----------------------------------|
| Vital signs | Mean   | Median   |
|------------|--------|----------|
| Systolic blood pressure | 124.39 mmHg | 120.0 mmHg |
| Diastolic blood pressure | 77.68 mmHg | 80.00 mmHg |
| Respiratory rate | 21.53x/minute | 20.00x/minute |
| Pulse        | 84.14x/minute | 84.00x/minute |
| Body temperature | 36.79 C | 36.50 C |
| GCS          | 12.31  | 14.00   |
| Pain scale   | 1.34   | 1.00    |

Neurological symptoms found in patients are shown in Table 4. Most of the patients had neuro-
logical symptoms in the form of hemiparesis (n = 33, 32.3%), 7 nerve paresis (n = 25, 24.5%), and Babinski’s sign (n = 15, 23.0%).

**TABLE 4. Neurological symptoms**

| Neurological symptoms | N  | %  |
|-----------------------|----|----|
| Neurological symptoms |    |    |
| Hemiparesis           | 33 | 2.3|
| Diparesis             | 3  | 2.9|
| Stiff neck            | 4  | 3.9|
| Cephalgia             | 11 | 10.7|
| Nerve paresis 3       | 1  | 0.9|
| Nerve paresis 6       | 1  | 0.9|
| Nerve paresis 7       | 25 | 24.5|
| Nerve paresis 12      | 8  | 7.8|
| Babinski              | 15 | 23.0|
| Seizure               | 1  | 0.9|

Table 5 shows the location of the abscess found in the patient. In general, most abscesses were in the right hemisphere (n = 38, 59.4%). Specifically, the abscess locations were found mostly on the right frontal (n = 9, 14.06%), right parietal (n = 9, 14.06%), and left parietal (n = 9, 14.06%).

**TABLE 5. Location of patient’s brain abscess**

| Abscess location         | N  | %  |
|--------------------------|----|----|
| Abscess location         |    |    |
| Right temporal           | 6  | 9.40|
| Left temporal            | 3  | 4.70|
| Right frontal            | 9  | 14.06|
| Left frontal             | 6  | 9.40|
| Right occipital          | 2  | 3.13|
| Left occipital           | 2  | 3.13|
| Right parietal           | 9  | 14.06|
| Left parietal            | 9  | 14.06|
| Right cerebellum         | 2  | 3.13|
| Right ventricle          | 1  | 1.56|
| Left ventricle           | 1  | 1.56|
| Left thalamus            | 1  | 1.56|
| Right tempo parietal     | 4  | 6.20|
| Right tempo occipital    | 1  | 1.56|
| Left tempo occipital     | 1  | 1.56|
| Right frontoccipital     | 1  | 1.56|
| Right frontotemporal     | 1  | 1.56|
| Left frontotemporal      | 1  | 1.56|
| Left frontoparietal      | 2  | 3.13|
| Right temporoparietal    | 1  | 1.56|
| Right front temporoparietal | 1 | 1.56|

Results of patients’ CT scan of can be seen in Table 6. Most of the patient’s CT scan results showed a rim of contrast enhancement (n = 26, 63.4%), cerebral edema (n = 31, 75.6%), and normal sulcus gyri (n = 21, 51.2%). Meanwhile, only a small proportion of patients showed leptomeningeal enhancement (n = 7, 17.1%) and a calcification (n = 2, 4.8%).

History of surgical procedures in patients is shown in Table 7. There were 8 patients with a history of surgical procedures, and 4 of them with a history of craniotomy.

**TABLE 6. Other CT scan examination results on patients**

| Ct scan examination      | N  | %  |
|--------------------------|----|----|
| Rim contrast enhancement |     |    |
| Exist                    | 26 | 63.4|
| None                     | 15 | 36.6|
| Total                    | 41 | 100.0|
| Leptomeningeal enhancement |     |    |
| Exist                    | 7  | 17.1|
| None                     | 34 | 82.9|
| Total                    | 41 | 100.0|
| Edema cerebri           |     |    |
| Exist                    | 31 | 75.6|
| None                     | 10 | 24.4|
| Total                    | 41 | 100.0|
| Scalp                    |     |    |
| Normal                   | 40 | 97.5|
| Not normal               | 1  | 2.5|
| Total                    | 41 | 100.0|
| Sulcus gyri             |     |    |
| Normal                   | 21 | 51.2|
| Move closer              | 16 | 39.0|
| Narrowed                 | 4  | 9.8|
| Total                    | 41 | 100.0|
| Midline deviation        |     |    |
| Exist                    | 14 | 34.1|
| None                     | 27 | 65.9|
| Total                    | 41 | 100.0|
| Calcification            |     |    |
| Exist                    | 2  | 4.8|
| None                     | 39 | 95.2|
| Total                    | 41 | 100.0|
| Pons                     |     |    |
| Normal                   | 40 | 97.5|
| Not Normal               | 1  | 2.5|
| Total                    | 41 | 100.0|
| Cerebellum               |     |    |
| Normal                   | 40 | 97.5|
| Not normal               | 1  | 2.5|
| Total                    | 41 | 100.0|
| Calvaria                 |     |    |
| Normal                   | 41 | 100.0|
| Not normal               | 0  | 0.0|
| Total                    | 41 | 100.0|
| Basis cranii             |     |    |
| Normal                   | 41 | 100.0|
| Not normal               | 0  | 0.0|
| Total                    | 41 | 100.0|
| Herniation               |     |    |
| Exist                    | 6  | 17.1|
| None                     | 35 | 82.9|
| Total                    | 41 | 100.0|

Data related to the history of other patients is shown in Table 8. Sinusitis is the most common medical history in patients (n = 21, 29.5%), followed by diabetes mellitus (n = 11, 15.3%) and toxoplasmosis (n = 9, 12.5%).

**DISCUSSION**

Patients with brain abscess in this study were dominated by men. This is in line with the prevalence data which stated that brain abscess patients...
are more dominant in men than women with a ratio varying between 2:1 and 3:1. In addition, there is no significant relationship between geographic and seasonal differences with the prevalence of brain abscess. Brain abscess accounts for a disproportionate percentage of intracranial lesions in developing countries compared to developed countries (10,11).

The age characteristics in this study are also in line with the data which stated that the age range of brain abscess patients ranges from 24 to 57 years. The average age of onset is higher in developed than developing countries. This relationship is not yet clearly defined, but may be related to reduced immune conditions in the elderly as well as greater life expectancy and lower rates of traumatic brain injury in younger individuals in developed countries (12).

The main complaint most often experienced by patients in this study was a decrease in the level of consciousness by 23 people (56.1%), followed by half-body weakness (hemiplegia), headache, slurred speech, seizures, and vomiting. This clinical manifestation is in accordance with the research conducted by Patel and Clifford, but in that study the most common sign was headache.

The clinical manifestations of brain abscess vary and are not specific depending on the location, size, stage and number of lesions, bacterial malignancy, degree of brain edema, the patient’s response to infection, and the patient’s age. If the progression of the abscess continued, the complaints would be more clearly seen in the patient. There is a classic triad showing brain abscesses, namely fever, headache, and decreased level of fo-

cal consciousness, but recent reports suggest that this constellation only occurs in a small proportion of cases (5,12,13).

Based on the results of the study, Table 3 shows the data regarding the status of vital signs of Sanglah General Hospital patients, Denpasar for the period 2019-2020 with parameters in the form of mean and mean values. The values for blood pressure (systolic and diastolic), pulse rate, and body temperature are known to be within the normal range. An increase in the respiratory rate from the normal range (18-20x/min) can be caused by an infection-related condition (14). These results are also directly proportional to previous case studies which reported a similar condition in the form of an increase in respiratory rate of 28x/minute, especially in the condition of Streptococcus sp. (15). The decrease in the mean GCS is known to be in a state of apathy (12,13). A similar reduction was also found in previous studies where 42% of the total patients had GCS status < 14 (16). Recent retrospective studies also showed similar results, with 48.14% of the total patients having a GCS status < 14 and associated with a poor prognosis (17). The study by Landriel et al. reported a median GCS of 15 patients with the condition that 79.6% of patients were on GCS 14-15 and only two patients had GCS < 8 (18). The study by Zhang et al. reported that 13.33% of patients had GCS <13 during the admission process of a total of 60 patients (19). The study by Helweg-Larsen et al. reported that 77% of patients had a GCS of 12-15, 10% had a GCS of 8-11, and 9% had a GCS of < 8 of a total of 102 patients (6). There is also another study which reported that 11.53% of the total patients had GCS < 8 (20). Another study also reported altered consciousness and neurological deficits in 43% and 48% of total patients, respectively (21).

GCS values are also known to influence the clinical outcome of the intracranial surgery caused by bacterial infection (22). Decreased GCS and mental state are associated with a poor prognosis for bacterial brain abscess (12). Pain assessment has a mean of 1.34 with a susceptible value of 1-10. Pain characteristics are generally localized to the area around the lesion with a gradual or sudden onset. Pain sensation is also generally not decreased with pain-reducing drugs (5).

Based on the results of the study, table 4 shows that the highest neurological symptom experienced

| Other diseases | N  | %   |
|---------------|----|-----|
| Toxoplasmosis | 9  | 12.5|
| HIV           | 8  | 11.1|
| Diabetes mellitus | 11 | 15.3|
| Hydrocephalus | 3  | 4.2 |
| Meningitis   | 4  | 5.5 |
| Brain tumor  | 2  | 2.7 |
| Kidney failure | 2 | 2.7 |
| Hypertension | 3  | 4.2 |
| COVID-19     | 2  | 2.7 |
| SLE          | 1  | 1.4 |
| UTI          | 1  | 1.4 |
| Ear infection | 2  | 2.7 |
| Heart disease | 1  | 1.4 |
| TB           | 2  | 2.7 |
| Sinusitis    | 21 | 29.5|
| Total        | 72 | 100.0|

TABLE 8. History of other diseases in patients
by patients of brain abscess at Sanglah General Hospital Denpasar in 2019 was hemiparesis, which was 33 people (32.3%) while the lowest neurological symptom experienced by patients was seizures by 1 person (0.9%). There is a case report which stated that a man with a brain abscess found evidence of right sided dysarthria and hemiparesis (23). The results of this study are also in line with studies conducted by Chang et al., with the same results, namely that the most common clinical manifestation found is hemiparesis, followed by fever, altered consciousness, headache, septic shock, and the least common is seizure (24). However, the results of this study are not in line with the results obtained by Hsu et al., who stated that the least clinical manifestation found was hemiparesis. This is probably due to differences in the number of patients who were used as subjects, differences in demographics, and locations where the study was conducted (25).

The location of infection in a brain abscess can vary, but the most common intracranial sites are the frontal – parietal, frontal – temporal, cerebellum, occipital and partial lobes (26). The location of the brain abscess is closely related to the cause of the infection. Autogenic abscesses are more common in the temporal lobe and cerebellum, whereas abscesses due to sinus infections are predominantly frontal (12). Brain abscess is known to occur more frequently in the left hemisphere than in the right hemisphere for which the cause is not clearly defined (26,27).

Based on the results of the study, Table 6 shows the data on the results of CT scans in patients. CT scan can be used for early detection, locale, characteristics, determination of the number, size and stage of the abscess quickly so that it is very helpful in planning treatment and further action. The results of the CT scan of patients with brain abscesses in Sanglah General Hospital in 2019-2020 showed that more cases were not accompanied by a hernia (82.9% of people), this is in line with a previous analysis by Muzumdar et al., of 289 cases of pyogenic abscess in Seth. GS Medical College and King Edward VII Memorial Hospital, Mumbai, India during a period of 7 years (1999-2006) there were 3 out of 289 patients who died came in a coma with transtentorial herniation (28).

Imaging findings depend on the stage of the lesion. Brain abscess cases are common with rim-enhancing lesions with either CT or MRI. Rim-enhancing is typically thin (2-7 mm), convex in shape, and has fine outer and inner margins. In this study, more were found of rim contrast enhancement (63.4% of patients). Research by Britt et al. reported that the CT findings in early-stage cerebrum were unevenly elevated and subsequently progressed to rim-enhancing in advanced cerebrum which subsequently formed brain abscesses (36).

In this study, leptomeningeal enhancement was only found in 7 patients (17.1%). Leptomeningeal enhancement is usually followed by meningitis and meningoencephalitis caused by viruses, bacteria, or fungi. Leptomeningeal enhancement is an increase in pia-arachnoid which will then fill the subarachnoid space of the sulcus and water tank and will then describe “gyriform” or “serpentine”. Sulcus gyri in patients in this study were dominated by normal conditions (51.2% of people) (28). The study of Bokhari and Mesfin reported (65%) a change in mental state of lethargy to coma is an indication of the occurrence of cerebral edema and a poor prognosis. CT examination of an advanced abscess shows a progressive decrease in edema and mass due to steroid administration (2).

Based on the results of the study, Table 7 shows the data regarding the history of the management of surgical procedures in patients. Surgical procedures generally aim to reduce pressure (decompression) in the area of the lesion, reduce intracranial pressure, and eradicate the presence of both primary and secondary infection (29). The craniotomy procedure had the highest prevalence found in four patients or by 50% with other procedures, namely VP shunt, abscess trepanation, pus aspiration, and resection each having a prevalence of 12.5%. In previous studies, a craniotomy was generally required for a traumatic brain abscess to remove foreign bodies or residual bone. Craniotomy with excision is generally performed when the abscess does not respond to pus aspiration (29). The study by Tan et al. used a total of 51 cases of brain abscess patients with therapeutic characteristics in the form of craniectomy accompanied by excision (54.9% of patients) and aspiration (45.1% of patients), and results in the form of improved neurological function and better radiological clearance and significant decreased rates of re-surgery (p < 0.05) in the craniotomy group compared to...
aspiration without any significant differences in mortality and morbidity between the two treatment
groups (30). Another retrospective study reported that at least 53% of patients with primary brain ab-
session underwent a craniotomy procedure (5). A re-
cent study by Makwana et al. reported that 72% of 
patients underwent craniotomy and 28% of pa-
tients underwent aspiration (31). Pus aspiration is 
a safe and relatively easy procedure that generally 
results in a rapid drop in intracranial pressure while 
identifying the causal organism. Research by 
Gadgil et al. reported that 27% of patients receiv-
ing open aspiration by excision had the highest 
prevalence of 67% of patients (16). Research by 
Zhang et al., at the General Hospital of Tianjin 
Medical University, during the period 1952-2014, 
reported that 253 patients received aspiration, 211 
excisions, and 92 received both out of a total of 
620 patients (32). Previous studies also reported 
that as many as 60% of patients used the aspiration 
method (stereotactically guided aspiration) and 
30% received craniotomy from a total of 60 pa-
tients (19). Another study also showed results sim-
ilar to stereotactically guided aspiration were ac-
cepted in 74.6% of patients, while 25.4% of 
patients received craniotomy (19). Study by Hel-
weg-Larsen et al. at the Rigshospitalet University 
Hospital reported that 67% of patients received 
aspiration, 20% received a craniotomy, and 13% 
did not receive surgery (antibiotics only) from a 
total of 102 patients (6).

Based on the results of the study, Table 8 shows 
that the history of medical treatment and other dis-
ease history experienced by brain abscess patients 
at Sanglah General Hospital Denpasar in 2019-
2020 was sinusitis, which was 21 people (29.5%)
followed by diabetes mellitus in 11 people (15.3%)
with a history of medical action and other diseases,
the lowest was systemic lupus erythematosus 
(SLE), urinary tract infections (UTI), and heart 
disease in 1 person (1.4%) each. This is in accord-
ance with previous references which stated that 
important risk factors for brain abscess are diabe-
tes mellitus, liver cirrhosis, malignancy, malnutri-
tion, and immunosuppression. The results of this 
study are also in line with Ong et al., who 
reported that the most frequently found history of 
other diseases in brain abscess patients is lung dis-
ease, diabetes mellitus, hypertension, and hepatitis 
(35).

CONCLUSIONS

The proportion of patients with brain abscesses 
in Sanglah General Hospital in 2019-2020 was 41 
people. Characteristics of patients with brain ab-
ses at Sanglah General Hospital based on socio-
demographic data are dominantly male, com-
monly occurred in the age range < 60 years, the 
main complaint experienced was a decrease in the 
level of consciousness, vital signs were mostly in 
the normal range, neurological symp-
toms that often appeared were hemiparesis, fol-
lowed by nerve paresis 7, and nerve paresis 12, the 
parietal area both right and left and right frontal 
area are were most common locations for abcess-
es, from the results of CT scans Patients often 
showed rim enhancement and edema cerebri, cra-
niectomy is the most commonly performed surgi-
cal procedure for people with brain abcesses. Pa-
ients also have a history of other diseases including 
sinusitis, diabetes mellitus, toxoplasma and HIV.

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