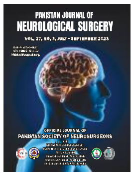

PAKISTAN JOURNAL OF NEUROLOGICAL SURGERY (QUARTERLY) – OFFICIAL JOURNAL OF PAKISTAN SOCIETY OF NEUROSURGEONS

Original Article

Re-Operation Rates after Burr-Hole Aspiration of Brain Abscess

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ABSTRACT

Objectives: To determine the re-operation rates after burr-hole aspiration of brain abscess.

Materials & Methods: The cross-sectional study was conducted from August 2022 to January 2023 at Jinnah Postgraduate Medical Centre (JPMC). A single burr-hole aspiration was used to treat a total of 64 cerebral abscess patients. Demographics, clinical presentation, predisposing variables, abscess location on imaging, and clinical outcomes were examined in medical records.

Results: The study included 64 patients with 60.9% males and 39.1% females. Patients most commonly presented with headache (90.6%) and fever (81.2%) with the majority of patients (92.1%) aged less than 30 years. The commonest source of infection was congenital heart disease (29.6%) in both aspiration and re-aspirations (46.6%). The parietal region was the most common location in both aspiration (32.8%) and re-aspiration (40%) of abscesses with the majority (40%) of re-aspirations done in the 3rd postoperative month.

Conclusion: Single burr-hole aspiration is a safe and effective method for the management of brain abscesses. It is a less invasive procedure and is associated with minimal complications. The learning curve is short and safely be performed by neurosurgeons in training.

Keywords: Brain abscess, Burr-hole aspiration, Re-aspiration, Infection, Meningitis.

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Date of Submission: 05-04-2023
Date of Revision: 06-07-2023
Date of Acceptance: 01-09-2023
Date of Online Publishing: 30-09-2023
Date of Print: 30-09-2023

DOI: 10.36552/pjns.v27i3.890

INTRODUCTION

A brain abscess (BA) is an infection that manifests as a collection of pus surrounded by a well-demarcated capsule after a localized, intraparenchymal, or meningeal infection.[1] Brain abscess has been associated with otitis media, mastoiditis, frontal or ethmoid sinusitis, dental infections, bacterial endocarditis, and congenital heart abnormalities.[1]

More than 95% of brain abscesses in immunocompetent individuals are caused by bacteria.[2] The brain is particularly susceptible to bacterial infections once the blood-brain barrier has been broken, and polymicrobial infections by anaerobes and other bacteria may play a role in pathogenesis.[2]In 40–50% of cases, bacteria penetrate the brain through the contiguous spread, and in 30–40% of cases, they do so through hematogenous dissemination (for example, in the case of infective endocarditis).[2]In one-third of the cases, hematogenous spread was suspected, most commonly with endocarditis (13%), lung infection (8%), or tooth infection (5 percent).[2] Others were related to post-surgical intervention (9%) or cerebral trauma (14%), while in 19% of instances, the source could not be determined.[2]

To diagnose a BA, typically a CT scan brain with contrast is required.[3] A hypodense lesion with a contrast-enhancing ring is the most common finding on CT or MRI.[3] Pyogenic abscesses may be identified very well using MRI images.[4] On T1-weighted (T1W) images, a core area of liquefaction shows high signals, whereas the surrounding edematous brain tissue shows low signals.[4] The necrosis produces higher signals on T2-weighted imaging, similar to the grey matter.[5] Abscess maturity is indicated by the rim of the abscess, which is made up of collagen, inflammation by free radicals, and micro hemorrhages in the abscess wall.[5]

On T1W contrast images there is a ring enhancement which is usually thin, smooth, and is usually thinner at the medial boundary.[5] The diagnosis of brain abscesses has been revolutionized by advances in MR technology.[6] For example, diffusion-weighted imaging (DWI), which typically demonstrates restricted diffusion (bright signal), helps to distinguish abscesses from necrotic neoplasms, which are typically not restricted.[6] A non-invasive imaging method called proton MR spectroscopy (1H-MRS) may be able to discriminate between brain abscesses and necrotic/cystic tumors.[6]

Antibiotics, glucocorticoids (dexamethasone), and surgical drainage are commonly used to treat brain abscesses.[8] Brain abscesses can be treated with needle aspiration or surgical excision.[1]Brain abscesses initially treated with needle aspiration should be re-aspirated if they fail to regress in size or recur.[1] Because of the increased risk of neurologic consequences, excision via craniotomy is not used as frequently as needle aspiration.[2]

This study aims to determine the re-operation rates after burr-hole aspiration of brain abscess to increase our knowledge and a better understanding of the management of brain abscess using less invasive burr-hole aspiration technique.

MATERIALS AND METHODS

Study Design & Setting

This prospective cross-sectional descriptive study was conducted at the Department of Neurosurgery, Jinnah Postgraduate Medical Centre Karachi from August 2022 to January 2023. A total of 64 intracranial abscess patients were treated with single burr-hole aspiration during this period. The location of the abscess on imaging, predisposing factors, demographic information, clinical presentation, and clinical outcomes were all analyzed in medical data.

Inclusion Criteria

Patients of all ages who underwent burr-hole aspiration of brain abscess were included.

Exclusion Criteria

Patients with deep-seated or intra-ventricular extension or recurrent abscess, who are non-compliant with the postoperative antibiotic regimen, whose data were incomplete or lost during follow-up, who were managed through craniotomy rather than the burr-hole aspiration, and who are not fit for any surgical intervention are excluded from this study.

Pre and Postoperative Evaluation

Preoperatively CT Brain plain and contrast were obtained for all patients. Postoperative CT brain plain is obtained on 1st postoperative day, 1 week after surgery, 1 month after surgery, at 3 months, and at 6 months to assess the residual volume of the abscess and significant residual abscess that are greater than 50% of the original volume were re-aspirated (Figure 1 and 2). An empirical antibiotic course, until culture reports were available, has been started in all patients, and the regimen is continued for a total of 12 weeks (6 weeks IV+ 6 weeks oral).

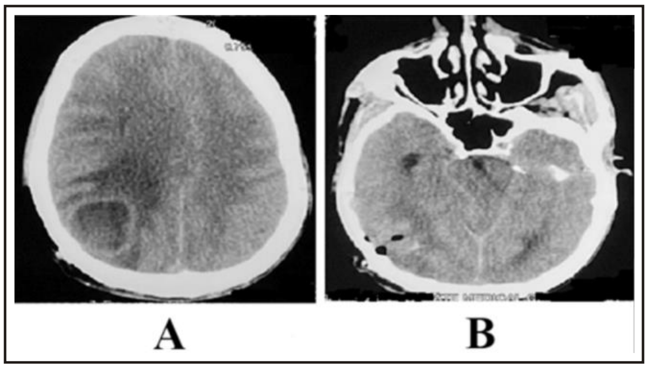

Figure 1: Pre **(A)** and Post **(B)** Operative Scans Of Parietal Abscess Tap.

(Informed verbal and written consent was taken from patients before including these scans).

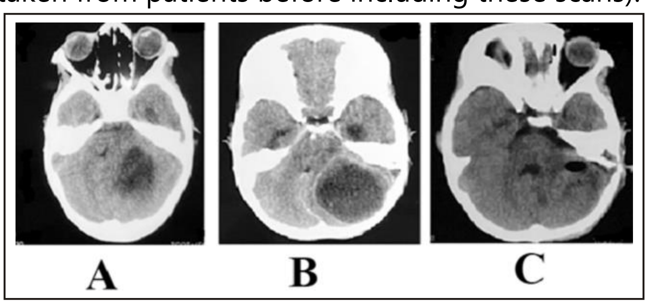

Figure 2: Pre **(A and B)** and Postoperative **(C)** Scans of Posterior Fossa Abscess Tap.

(Informed verbal and written consent was taken from patients before including these scans).

Statistical Analysis

The data were analyzed statistically using SPSS version 23, and descriptive statistics were used to present the results. For quantitative data, a mean and standard deviation were calculated; for qualitative variables, frequencies, and percentages were computed.

RESULTS

Demographics in First Aspiration

Out of total 64 patients, the majority of patients (92.1%) (n=59) belonged to the younger age group and were less than 30 years while only 7.8% (n=5) were more than 30 years. About 60.9% (n=39) were predominantly males while 39.1% (n=25) were females. The mean age of the patients was 17.5 years. The minimum age reported was 2 years and the maximum age was 52 years.

Presentation, Source, and Location of Abscess in First Aspiration

Patients most commonly presented with headache (90.6%) and fever (81.2%) while other symptoms include vomiting (n=33, 51.5%), seizures (n=21, 32.8%), altered level of consciousness (ALOC) (n=15, 23.4%) and focal neurological deficit (n=12, 18.7%).

The common source of infection identified was congenital heart disease (29.6%), ear infection (18.7%), meningitis (9.3%), and head trauma (4.6%) while no underlying cause was identified in the majority (37.5%) of cases (Chart 1).

The abscesses were predominantly located in the parietal region (n=21, 32.8%), followed by frontal (n=19, 29.6%), posterior fossa (n=12, 18.7%), temporal (n = 9, 14%) and occipital region (n=3, 4.6%) (Table 1).

Demographics in Re-Aspiration

Out of 64 patients, 15 (23.4%) patients undergo re-aspiration of the abscess. Among 15 patients who underwent re-aspiration 9 (60%) were males and 6 (40%) were females.

Table 1: Frequency of Source and Location of Abscess.

Source of Infection	No of Patients	Percentage
Congenital heart diseases	19	29.6%
Ear infection	12	18.7%
Meningitis	6	9.3%
Head trauma	3	4.6%
No underlying cause	24	37.5%
Location of Abscess		
Parietal	21	32.8%
Frontal	19	29.6%
Temporal	9	14%
Occipital	3	4.6%
Posterior fossa	12	18.7%

Presentation, Source, and Location of Abscess |in Re-Aspiration

The presentation at re-aspiration was less severe and the most common presentation was only headache (n=14, 93.3%) followed by fever (n=8, 53.3%), vomiting (n=5, 33.3%), seizures (n=4, 26.6%), ALOC (n=3, 20%) while no patient presented with any new neurological deficit (Figure 3).

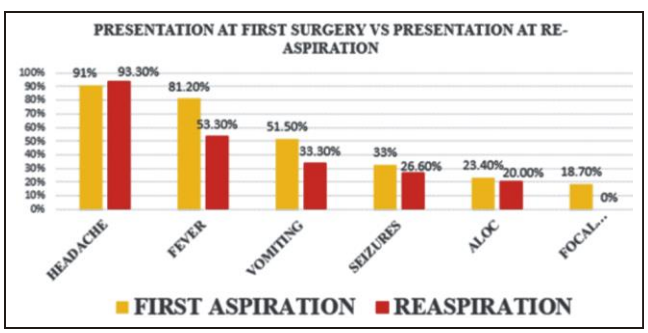

Figure 3: Presentation of Abscess at First Surgery Vs. Re-Aspiration

When compared, re-aspiration rates were more common among patients with congenital heart diseases (n=7, 46.6%) followed by ear infection (n=5, 33.3%), patients with no underlying cause (n=2, 13.3%), meningitis (n=1, 6.6%) while there was no re-aspiration of abscess done in cases of head trauma. The re-aspiration rates were more common in the parietal region (n=6, 40%) followed by the posterior fossa (n=4, 26.6%), frontal (n=3, 20%), temporal (n=2, 13.3%) and none in the occipital region.

Duration between Aspiration and Re-Aspiration

Most of the patients had a maximum period of 2–3 months (n=6, 40%) postoperatively between the first surgery and re-aspiration with the majority re-aspiration being done in 3rd month (n=4, 26.6%). Five (33.3%) patients presented at 4–5 months postoperatively, 2 (13.3%) patients presented in the 1st month postoperatively while only 1 (6.6%) patient presented at 6 months postoperatively (Figure 4).

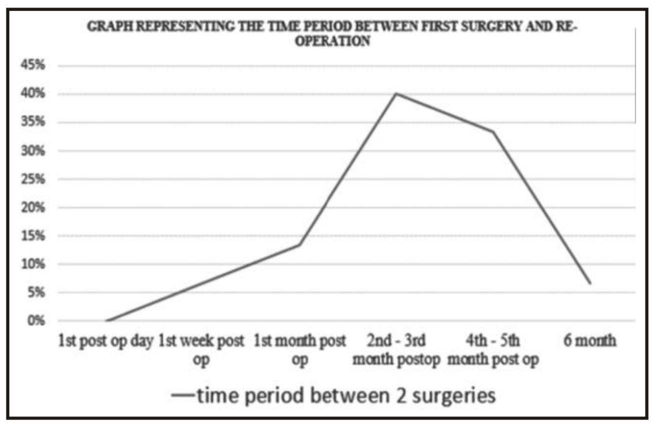

Figure 4: Duration between First Aspiration Vs. Re-Aspiration.

Complete Recovery of Preoperative Neurological Status

Complete recovery of preoperative neurological status was noted in 56 (87.5%) of patients while 12 (80%) out of 15 patients had complete recovery in cases of re-aspiration of abscess (Figure 5). Only 1 (6.6%) patient expired after re-aspiration due to poor neurological status preoperatively and associated severe congenital heart disease.

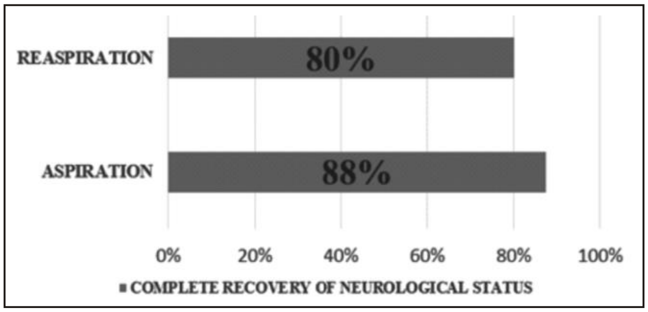

Figure 5: Complete Recovery of Neurological Status after Aspiration and Re-Aspiration.

DISCUSSION

Our study showed that about 15 (23.4%) patients undergo re-aspiration even after adequate initial aspiration radiologically. In a study conducted by Yasser et al, only one patient (7.6%) needed a second aspiration session due to an abscess recurrence two weeks after the initial treatment.[9] In another study conducted by Ahmad S et al, significant residual abscesses in 17 (17%) of the patients required re-aspiration.[10] This slightly increased rate of re-aspiration in our study might be a result of the patient's late presentation and poor preoperative health, which prevents the antibiotic from entering the abscess sac while the abscess is in the late capsule stage.

In a study conducted on the pediatric population in 2021 by Kanu et al, the most prevalent symptoms noted were headache (80%), fever (78%), and hemiparesis (78%).[11] Our study showed a similar trend of common presentation with headache (90.6% vs 93.3% at first presentation and 2nd presentation for re-aspiration respectively) being the most common symptom followed by fever (81.2% aspiration vs 53.3% re-aspiration), vomiting (51.5% aspiration vs 33.3% re-aspiration), seizures (32.8% aspiration vs 26.6% re-aspiration), ALOC (23.4% aspiration vs 20% re-aspiration) and focal neurological deficit (18.7% aspiration vs 0% re-aspiration). The clinical presentation of these abscesses is dependent on the size and location of the abscesses.

In our study, the most common location of abscess on the first aspiration identified was the parietal region (n=21, 32.8%), followed by frontal (n=19, 29.6%), posterior fossa (n=12, 18.7%), temporal (n=9, 14%) and occipital region (n=3, 4.6%). The re-aspiration rates were more common in the parietal region (n=6, 40%) followed by the posterior fossa (n=4, 26.6%), frontal (n=3, 20%), temporal (n=2, 13.3%) and none in the occipital region. This can be due to the relatively large size of the abscess in the parietal region and difficulty in aspiration of abscesses in the posterior fossa region due to surrounding vital structures and in the vicinity of the brainstem. In a study conducted by Chetty et al, the parietal region (parietal lobe (45/140, 32%) was found to be the most predominant anatomic location.[12] In another study conducted by Ahmad et al, the parietal region was the most frequently affected in 44 patients (44%) followed by the frontal in 33(33%), temporal in 13 (13%), and occipital regions in 10 (10%).[10] This may be attributed to the hematogenous source being the most common route of infection and the internal carotid artery's role in providing 80% of the blood supply to the brain.

In our study,87.5% and 80% of patients with aspiration and re-aspiration of abscess had complete recovery of preoperative neurological status which is comparable to the study conducted by Chowdhury et al, which showed complete recovery of preoperative neurological status in 80.86% of patients.[13] This explains the effectiveness of burr-hole aspiration as well as the lower rate of postoperative complications.

The mortality rate in our study was found to be 6.6% due to late presentation and associated severe congenital heart disease. In a study conducted by Duarte et al, the mortality rate noted was found to be 10%.[14] In another study conducted by Aras Y showed a mortality rate of

4.9% in patients who underwent aspiration as compared to 9.8% for patients who underwent craniotomy and excision of the abscess.[15] This demonstrates the safety of single burr-hole evacuation in emergency settings.

CONCLUSION

Single burr-hole aspiration is a safe and effective method for the management of brain abscesses that can be done in emergencies with lower postoperative complications. It is associated with lesser operative and anesthesia duration, reduced intraoperative blood loss, and length of incision. The learning curve is short and can safely be performed by neurosurgeons in training. Newer image-guided burr-hole aspirations can be done for better surgical outcomes.

REFERENCES

1. Brook I. Microbiology and treatment of brain abscess. J Clin Neurosci. 2017;38:8-12. Cantiera M, Tattevin P, Sonneville R. Brain abscess in immunocompetent adult patients. Rev Neurol (Paris). 2019;175(7-8):469-474.
2. Umeda S, Fujikawa A, Tsuchiya K. [Brain Abscess]. No Shinkei Geka. 2021;49(2):368-374. Japanese.
3. Sonneville R, Ruimy R, Benzonana N, Riffaud L, Carsin A, Tadié JM, Piau C, Revest M, Tattevin P; ESCMID Study Group for Infectious Diseases of the Brain (ESGIB). An update on bacterial brain abscess in immunocompetent patients. Clin Microbiol Infect. 2017;23(9):614-620.
4. Weinberg GA. Brain Abscess. Pediatr Rev. 2018;39(5):270-272.
5. Bo L, Zhang Z, Jiang Z, Yang C, Huang P, Chen T, Wang Y, Yu G, Tan X, Cheng Q, Li D, Liu Z. Differentiation of Brain Abscess From Cystic Glioma Using Conventional MRI Based on Deep Transfer Learning Features and Hand-Crafted Radiomics Features. Front Med (Lausanne). 2021;8:748144.
6. Corsini Campioli C, Castillo Almeida NE, O'Horo JC, Wilson WR, Cano E, DeSimone DC, Baddour LM, Sohail MR. Diagnosis, management, and outcomes of brain abscess due to gram-negative versus gram-positive bacteria. Int J Infect Dis. 2022;115:189-194.
7. Suthar R, Sankhyan N. Bacterial Infections of the Central Nervous System. Indian J Pediatr. 2019 Jan;86(1):60-69. Doi: 10.1007/s12098-017-2477-z. Epub 2018 Jan 3.
8. Abdul Ghani YS, Elzain MA, Ahmed ADS, Abdelhalim SA. Brain abscess burr hole aspiration in children with congenital heart disease in low facility centers: case series. Sudan J Paediatr. 2021;21(1):61-66.
9. Ahmad S, Rehman L, Afzal A, Rizvi R. Outcome of burr-hole aspiration of brain abscess. Pak J Med Sci. 2017;33(5):1161-1165.
10. Kanu OO, Ojo O, Esezobor C, Bankole O, Olatosi J, Ogunleye E, Asoegwu C, Eghosa M, Adebayo B, Oladele R, Nwawolo C. Pediatric brain abscess - etiology, management challenges and outcome in Lagos Nigeria. Surg Neurol Int. 2021 Dec 8;12:592.
11. Chetty M, Rakhi B, Rachana K, Sujatha S, Srinivasan GM. An Eight Year Clinico-Microbiological Retrospective Study on Brain Abscesses in India. Microbiol Insights. 2022;15:11786361221106111.
12. Chowdhury FH, Haque MR, Sarkar MH, Chowdhury SN, Hossain Z, Ranjan S. Brain abscess: Surgical experiences of 162 cases Neuroimmunol Neuroinflamm. 2015;2(3):153.
13. Duarte MJ, Kozin ED, Barshak MB, Reinshagen K, Knoll RM, Abdullah KG, Welling DB, Jung DH. Otogenic brain abscesses: A systematic review. Laryngoscope Investig Otolaryngol. 2018;3(3):198-208.
14. Aras Y, Sabanci PA, Izgi N, Boyali O, Ozturk O, Aydoseli A, Ali A, Sencer A, Hepgul K, Unal F, Barlas O. Surgery for Pyogenic Brain Abscess over 30 Years: Evaluation of the Roles of Aspiration and Craniotomy. Turk Neurosurg. 2016;26(1):39-47.

Additional Information

Disclosures: Authors report no conflict of interest.
Ethical Review Board Approval: The research was a retrospective study.
Human Subjects: Consent was obtained by all patients/participants in this study.
Conflicts of Interest:
In compliance with the ICMJE uniform disclosure form, all authors declare the following:
Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.
Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

AUTHOR CONTRIBUTIONS

Sr. No.	Author's Full Name	Intellectual Contribution to Paper in Terms of
1.	Sehrish Altaf	Study Design, Methodology, and Paper Writing.
2.	Farrukh Javeed	Data Calculation and Data Analysis.
3.	Iram Bokhari	Interpretation of Results.
4.	Anas Ahmed	Statistical Analysis.
5.	Raheel Gohar	Literature Review.
6.	Mohammad Daniyal Mumtaz	Literature Review and Quality Insurer.