Case Report

Bedside twist drill aspiration of cerebral abscess less than 2.5 cm in size: A case series and discussion

Tyler Carson¹², Dan Miulli¹²

¹Department of Neurosurgery, Riverside University Health Systems Medical Center, Moreno Valley, ²Department of Neurosurgery, Arrowhead Regional Medical Center, Colton, California, USA

E-mail: *Tyler Carson ‑ Tyler.a.carson@gmail.com; Dan Miulli ‑ MiulliD@armc.sbcounty.gov
*Corresponding author

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Abstract

Background: Intracranial abscess remains a potentially deadly condition despite development of newer antibiotics and improved surgical methods. Many studies have evaluated the surgical indications for abscess drainage, and it has been generally accepted that intracranial abscesses greater than 2.5 cm may best be treated with surgical intervention followed by antibiotic therapy. More recently, studies have shown good results with stereotactic aspiration of abscesses to 1 cm in size. Furthermore, a recent case series in 2014 of 103 cases of bedside twist drill aspiration of cerebral abscess >2.5 cm showed a good recovery in 83.4% of cases.

Case Description: This case series examines the benefits of bedside twist drill aspiration of peripherally located brain abscess less than 2.5 cm in size. In our series, all patients were placed on broad-spectrum antibiotics and had negative blood and cerebrospinal fluid cultures. Our bedside biopsy resulted in de-escalation of antibiotics in 2 of the 3 patients and decreased hospital length of stay.

Conclusion: In patients with peripherally located brain abscesses less than 2.5 cm in size, bedside twist drill drainage may be a safe and reasonable approach. Positive identification of infective pathogen allows for a decreased hospital length of stay and de-escalation of antibiotics regimen resulting in significant reduction of hospital costs and resources in 2 of the 3 patients treated. This is of benefit to the patient as well as the health system.

Key Words: Abscess, aspiration, bedside, brain, evacuation, surgical

BACKGROUND

Intracranial abscess remains a potentially deadly condition despite development of newer antibiotics and improved surgical methods. Cerebral abscess affects 1 in 10,000 hospital admissions or 1,500 to 2,500 people per year in the US. People with poor socioeconomic status and those residing in underdeveloped countries are at an even higher risk. In the case of human immunodeficiency virus (HIV) or other immunosuppressed individuals, the incidence increases to 10 times the average or 1 in 1,000 hospital admissions, and therefore, undiagnosed HIV infection should always be worked up in patients presenting with cerebral abscess.
abscess. In fact, patients with predisposing condition such as HIV/immunosuppression, recent craniotomy, or traumatic brain injury constitute 86% of the cases. The most common pathogen is Streptococcus and Staphylococcus species which compromised 34% and 18%, respectively, of 5,894 cases of cultured bacteria abscess. Other opportunistic infections such as Toxoplasmosis gondii and Mycobacterium tuberculosis as well as fungi and parasites are also of concern, especially given the frequency of HIV and immunosuppressed individuals afflicted by the condition. Presenting symptoms have classically been described as a triad of fever, headache, and nausea, however, this classic triad is present in on 20% of the patients. In fact Helweg-Larson et al. showed that of 102 patients with pyogenic brain abscess 39% had no fever, 26% had normal C-reactive protein (CRP), and 49% had no leucocytosis on presentation. Often patient with underlying immunosuppression may not mount an appropriate response to such infection and altered mental status, personality changes or subtle neurologic findings may be the only clue to diagnosis. Magnetic resonance imaging (MRI) can be helpful in determination of cerebral abscess versus necrotic tumor. Both tend to be ring enhancing lesions, however, abscesses show restricted water diffusion as indicated by hyperintensity on diffusion weighted imaging (DWI) and hypointensity on apparent diffusion coefficient (ADC) sequences. With improved medical and surgical treatment patient outcome has improved; mortality has decreased from 40% to 10% over the past 5 decades, whereas the rate of patients with full recovery increased from 33% to 70%.

Treatment for cerebral abscess relies on both surgical and nonsurgical approaches. The classic study by Rosenblum et al. showed that patients may be successfully treated nonsurgically with small abscesses. Three centimeter was the suggested cutoff size for which medical management alone was not recommend. Best outcomes for medical treatment alone are small size, early cerebritis stage, early administration of antibiotic, and early clinical improvement. With improved surgical techniques, such as stereotactic guidance, some have suggested nonsurgical treatment in abscess only 1.5 cm in size or less. However, each individual patient’s situation should be taken into consideration. For example, deep-seeded abscess in the cerebritis stage greater than 3 cm in size may be poor surgical candidates. Furthermore, patients with superficial abscess in the capsular stage less than 3 cm in size may with no known source may benefit from surgical drainage for diagnostic purposes. A trend towards minimally invasive drainage and medical management with serial MRI brain is emerging. Regardless of whether medical treatment alone or a combination of surgical resection followed by medical therapy, the success of treatment hinges on isolation of the causative organism. Medical management success, whether in combination with surgical drainage or not, relies on antimicrobial therapy that not only diffuses into the cerebrospinal fluid (CSF) but also has bactericidal activity on the causative organism. Because of this, identification of the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) from culture of either the abscess itself or the suspected source is a necessity.

The two main surgical options for brain abscess are excision versus aspiration. A retrospective comparison between the two approaches between 1990 and 2008 performed by Ratnaie et al. showed a 6.6% mortality for patients who underwent aspiration compared to a 12.7% mortality for those undergoing excision of abscess. A recent review by Zhai et al. suggested resection of superficially located encapsulated brain abscesses versus aspiration showed a high rate of neurologic improvement at 1 month, but no significant difference at 3 months from surgery in either neurologic outcome or mortality. Indeed many studies have compared the efficacy and safety of aspiration to open surgery and each may have its usefulness depending on the specific condition and presentation of the patient.

This articles examines the role for aspiration of cerebral abscess via twist drill craniotomy, specifically for patients with abscess less than 2.5 cm in size and in whom no source had been identified. A recent case series by Singh et al. details their experience with 103 cases of pyogenic brain abscess >2.5 cm in size that were treated with aspiration via twist drill craniotomy. They report a 4.8% mortality, with 92.1% having only mild or moderate disability. Our series of 3 patients to this point in time show similar efficacy and results.

**CASE DESCRIPTION**

All patients received computed tomography (CT) of the head upon admission with a significant finding of lesion(s) concerning for intracranial abscess based on patient history. Using CT reconstructions and imaging software, the entry point for each biopsy site was calculated using fixed boney anatomy. Entry point was selected to be orthogonal to skull surface and traversing as little cortex as possible. Specifically, the entry point was calculated by measuring the distance above the external auditory meatus (EAM), the distance posterior from the Nasion corresponding to 90-degree angle to the entry site and the distance from the midline to the entry point. This site was then clipped of hair and marked with a 1 cm × 1 cm square metal marker and in one case an MR-Spot® marker. Follow-up imaging after marker placement confirmed entry point, adjustments to entry point were made as necessary.
Another option would be bedside stereotactic navigation, however, it was not used in these 3 cases. In our institution, we used AxiEM™ electromagnetic navigation for bedside localization of hematomas and lesions. The benefits include possible improved accuracy and real-time adjustment of trajectory with image feedback. The downside is its availability. There is also expense associated with the equipment use and possibly additional imaging studies needed.

After entry point was confirmed we proceeded with surgical aspiration of the abscess at bedside using a twist drill method. Patients received versed preoperatively and local anesthetic of 5–10 cc of 1% lidocaine with epinephrine. A 2-cm linear incision was made and the hand twist drill was utilized to access the intracranial space. Dura was palpated and opened with an 11 blade, and a brain needle (Dandy ventricular needle) was advanced orthogonal to the skull to a depth corresponding the abscess depth noted on CT/MRI imaging. Fluid from abscess was aspirated and sent for pathology and microbiology studies. The incision was then closed with suture or staple and patient was sent for a postoperative CT to confirm that there were no hemorrhage and correct site was accessed.

All patients presented with headache. 2/3 presented with fever. One presented with seizure. The results of each individual patient are detailed in Table 1. Images of each abscess associated with these patients on admission can be seen in Figures 1-3.

Of the 3 patients who received bedside twist drill aspiration of cerebral abscess, a positive identification of the infective agent was made in 2 cases. This was despite each having had blood cultures drawn prior to antibiotic therapy and both having had lumbar punctures performed with negative cultures. In addition, each had already been placed on vancomycin, flagyl, and ceftriaxone prior to biopsy and identification of infective agent.

Based on the final MIC/MBC results from cultures, both patients 2 and 3 were able to have their antibiotics de-escalated to a single agent (vancomycin in both cases) per infectious disease recommendations rather than broad-spectrum coverage of vancomycin flagyl and fortaz. Both patients were discharged with a PICC line and home antibiotic therapy. This resulted in decreased cost to the patient and health system in terms of fewer medications, fewer trips for home health to administer IV medications, and less inpatient hospital days. Home antibiotic regimen would not have been possible with more than 2 infusions per day which would have required the patient to be placed in a skilled nursing facility rather than discharging home. Upon follow-up, both patients had good outcomes without any residual neurologic deficit or return of abscess.

| Age/Sex | Presentation | Abscess size | Blood cx | CSF from LP | Aspirate culture | Changes to medical treatment | Glasgow Outcome Score |
|---------|--------------|--------------|----------|-------------|----------------|-----------------------------|----------------------|
| 31 M    | Headache, confusion | 3 cm         | Negative | Negative | No Growth | Open crani, negative pathology and microbiology | 4 |
| 55 M    | Headache, fever, focal motor seizure, hemiparesis | 1.5 cm       | Negative | Negative | MRSA       | Changed to single antibiotic | 5 |
| 40 M    | Headache, fever, facial numbness | 2.5 cm       | Negative | Negative | Staph epi + Propionibacterium Ances | Changed to single antibiotic | 5 |
In addition, we realized a decreased hospital stay and determining whether this approach is safe and effective. Though no adverse outcomes were seen in this limited tremenously helpful for maintaining hospital resources. The results from a lung biopsy as well as open biopsy of brain were negative for malignant tissue or infection. Patient was discharged to inpatient rehab and referred to outside hospital for rheumatology and infectious disease work-up.

CONCLUSION

We show in this small series of patients that peripherally located brain abscesses less than 2.5 cm in size and peripherally located may be safely treated with bedside twist drill aspiration. We did not have a lower size limit to treat though abscesses less than 0.5 cm in size may be difficult to access and/or obtain material from. Positive identification of infective pathogen allowed for a decreased hospital length of stay and de-escalation of antibiotics regiment in 2 of our 3 patients resulting in significant reduction of hospital costs and resources. The ability to perform this procedure at the bedside rather than utilizing valuable operating room time and expense as well as subjecting the patient to the risks of general anesthesia may also be of benefit to the patient as well as the health system.

We intend to use this method of bedside twist drill aspiration in certain situations at our institution. The ability to safely obtain a diagnosis in patients who may otherwise be treated solely with broad-spectrum antibiotic therapy for many weeks may be of benefit. Furthermore, at an extremely busy county medical center where resources are limited, the ability to perform this at bedside can be tremendously helpful for maintaining hospital resources.

Though no adverse outcomes were seen in this limited series of 3 patients, more data is needed before determining whether this approach is safe and effective. In addition, we realized a decreased hospital stay and antibiotic regiment in 2 patients, but again more patient outcomes are needed to determine whether this results in any significant benefit to the patient or health system.

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Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Alvis Miranda H, Castellar-Leones SM, Elzain MA, Moscote-Salazar LR. Brain abscess: Current management. J Neurosci Rural Pract 2013;4(Suppl 1):S67-S81.
2. Brouwer MC, Coutinho JM, van de Beek D. Clinical characteristics and outcome of brain abscess: Systematic review and meta-analysis. Neurology 2014;82:806-13.
3. Brouwer MC, Tunkel AR, McKhann GM 2nd, van de Beek D. Brain Abscess. N Engl J Med 2014;371:447-56.
4. Duma CM, Kondziolka D, Lunsford LD. Image-guided stereotactic management of non-AIDS-related cerebral infection. Neurosurg Clin N Am 1992;3:291-302.
5. Garvey G. Current concepts of bacterial infections of the central nervous system. Bacterial meningitis and bacterial brain abscess. J Neurosurg 1983;59:735-44.
6. Greenberg MS. Cerebral Abscess: In: Handbook of Neurosurgery. 7th edition. New York: Thieme Publishers; 2010. pp 350-6.
7. Hakan T. Management of bacterial brain abscess. Neurosurg Focus 2008;24:E4.
8. Helweg-Larsen J, Astradsson A, Richhall H, Erdal J, Laursen A, Brennum J. Pyogenic brain abscess, a 13 year survey. BMC Infect Dis 2012;12:332.
9. Kariev MK, Kadyrbekov RT, Akhmediev MM, Akmedov SC, Khuzhaniazyov SB. Comparative analysis of surgical methods in the treatment of brain abscesses. Zh Vopr Neirokhir Im N N Burdenko 2001;2:17-20; discussion 20–21
10. Leuthardt EC, Wippold FJ. Brain abscess: Current management. J Neurosci Rural Pract 2013;4(Suppl 1):S67-S81.
11. Lu CH, Chang WN, Lui CC. Strategies for the management of bacterial brain abscess. J Clin Neurosci 2006;13:979-85.
12. Rosenblum ML, Hoff JT, Norman D, Edwards MS, Berg BO. Nonoperative treatment of brain abscesses in selected high-risk patients. J Neurosurg 1980;52:217-25.
13. Mathisen GE, Johnson JP. Brain abscess. Clin Infect Dis 1997;25:763-79.
14. Nathoo N, Naib SS, Narotam PK, van Dellen JR. Brain abscess: Management and outcome analysis of a computed tomography era experience with 973 patients. World Neurosurg 2011;75:716-26.
15. Obana WG, Rosenblum ML. Nonoperative treatment of nosocomial infections. Neurosurg Clin N Am 1992;3:359-73.
16. Ratnam TE, Das S, Gregson BA, Mendelow AD. A review of brain abscess surgical treatment – 78 years: Aspiration versus excision. World Neurosurg 2011;76:431-6.
17. Sharma BS, Gupta SK, Khosla VK. Current concepts in the management of pyogenic brain abscess. Neurol India 2000;48:105.
18. Singh I, Rohilla S, Kumawat M. Twist drill aspiration of pyogenic brain abscesses: Our experience in 103 cases. J Neurol Surg 2014;74:189-94.
19. Stevens DC, Asfora WT. 8-year-old patient with multiple large cerebral abscesses successfully treated with stereotactic aspiration: Case report and literature review. S D Med 2013;66:420-3.
20. UK Collaborative HIV Cohort (CHIC) Study Steering Committee. Garvey L, Winston A, Walsh J, Post F, Porter K, et al. HIV-associated central nervous system diseases in the recent combination antiretroviral therapy era. Eur J Neuro 2011;18:527-34.
21. Zhai Y, Wei X, Chen R, Guo Z, Raj Singh R, Zhang Y. Surgical outcome of encapsulated brain abscess in superficial non-eloquent area: A systematic review. Br J Neurosurg 2016;30:29-34.