

## Case Report

**Bedside twist drill aspiration of cerebral abscess less than 2.5 cm in size: A case series and discussion**Tyler Carson<sup>1,2</sup>, Dan Miulli<sup>1,2</sup><sup>1</sup>Department of Neurosurgery, Riverside University Health Systems Medical Center, Moreno Valley, <sup>2</sup>Department of Neurosurgery, Arrowhead Regional Medical Center, Colton, California, USAE-mail: \*Tyler Carson - [Tyler.a.carson@gmail.com](mailto:Tyler.a.carson@gmail.com); Dan Miulli - [MiulliD@armc.sbcounty.gov](mailto: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 regiment 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

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**Quick Response Code:****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.<sup>[13]</sup> People with poor socioeconomic status and those residing in underdeveloped countries are at an even higher risk.<sup>[14]</sup> 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

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abscess.<sup>[2,3,20]</sup> In fact, patients with predisposing condition such as HIV/immunosuppression, recent craniotomy, or traumatic brain injury constitute 86% of the cases.<sup>[2,3,20]</sup> The most common pathogen is *Streptococcus* and *Staphylococcus* species which compromised 34% and 18%, respectively, of 5,894 cases of cultured bacteria abscess.<sup>[2]</sup> 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.<sup>[3]</sup>

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.<sup>[2,8]</sup> 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 leukocytosis on presentation.<sup>[8]</sup> Often patient with underlying immunosuppression may not mount an appropriate response to such infection and altered mental status, personality changes or subtler 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.<sup>[10]</sup> 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%.<sup>[2]</sup>

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 abscess.<sup>[12]</sup> 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.<sup>[6]</sup> With improved surgical techniques, such as stereotactic guidance, some have suggested nonsurgical treatment in abscess only 1.5 cm in size or less.<sup>[15]</sup> 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.<sup>[17,11]</sup> 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.<sup>[7]</sup> 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.<sup>[5]</sup> 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 Ratnaik *et al.* showed a 6.6% mortality for patients who underwent aspiration compared to a 12.7% mortality for those undergoing excision of abscess.<sup>[16]</sup> 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.<sup>[17]</sup> Indeed many studies have compared the efficacy and safety of aspiration to open surgery<sup>[16,21,4,9,19]</sup> 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.<sup>[18]</sup> 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.

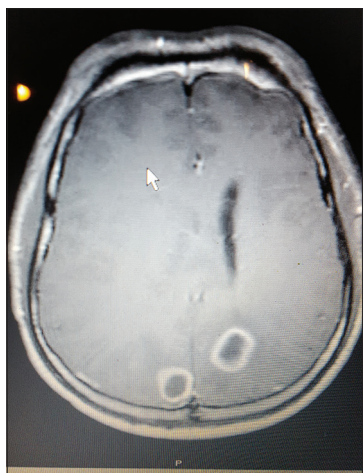


Figure 1: Patient 1 MRI brain T1WI + contrast upon admission

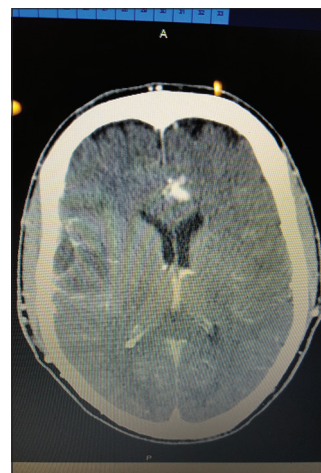
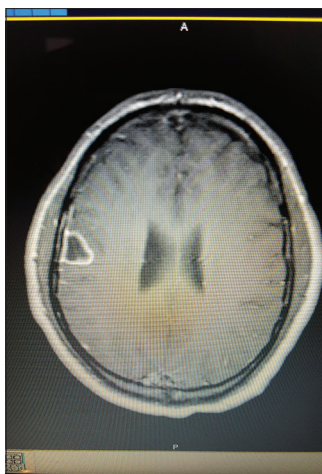


Figure 2: Patient 2 CT brain with contrast upon admission

Table 1: Results from patients undergoing bedside aspiration of cerebral 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



**Figure 3: Patient 3 MRI brain T1WI + contrast upon admission**

Patient 1 did not have a positive result from biopsy of suspected abscess and underwent open craniotomy for evacuation and tissue biopsy. Of note, this patient had multiple intracranial lesions and known cavitory lung lesion. 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.

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