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SURGICAL NEUROLOGY INTERNATIONAL

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SNI: Infection, a supplement to *Surgical Neurology International*

Case Report

Spontaneous intraventricular rupture of pyogenic brain abscess: A short series of three cases and review of literature

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Received: 07 September 16 Accepted: 29 September 16 Published: 05 December 16

Abstract

Background: Spontaneous intraventricular rupture of brain abscess (IVROBA) is a dreaded complication of pyogenic brain abscess (PBA) and is associated with very high mortality. We discuss the clinical, radiological, and therapeutic aspects associated with this potentially fatal complication of PBAs.

Case Descriptions: Three cases of spontaneous IVROBA presenting to our institute over a period of 6 months were reviewed with respect to their clinical and radiological presentation, their therapeutic plan, and neurological outcome. Individualized approach to our patients with IVROBA with abscess drainage/excision, intrathecal and intravenous antibiotic therapy, cerebrospinal fluid (CSF) diversion (if under high pressure), and close monitoring of clinical status, CSF reports, and computed tomography (CT) scan findings enabled us to achieve good neurological outcome in two patients presenting in conscious state; however, one patient presenting in poor neurological status succumbed to IVROBA due to fulminant septic arteritis.

Conclusion: In the present neurosurgical era, IVROBA is rarely encountered; however when it occurs, patient outcome is adversely affected. Early detection and prompt aggressive management, as seen in our short series, can give the patient a fighting chance and significantly improve the neurological outcome.

Key Words: Intraventricular rupture, outcome, pyogenic brain abscess, review of literature, ventriculitis

Access this article online

Website: www.surgicalneurologyint.com

DOI: 10.4103/2152-7806.195231

Quick Response Code:

INTRODUCTION

Intraventricular rupture of brain abscess (IVROBA) is a potentially fatal complication of pyogenic brain abscess (PBA). Mortality rates after IVROBA have been reported to range between 39% and 80%.[7,9] Treatment strategy for such cases is arbitrary. Early recognition and aggressive management of IVROBA (with intravenous and intrathecal antibiotics and removal of infected material) before the patient deteriorates into comatose state has been shown to improve the outcome.[3,7] We report our experience with 3 cases of PBA over a period of 6 months between August 2015 and January 2016 presenting with spontaneous IVROBA.

How to cite this article: Savardekar AR, Krishna R, Arivazhagan A. Spontaneous intraventricular rupture of pyogenic brain abscess: A short series of three cases and review of literature. Surg Neurol Int 2016;7:S947-51.
http://surgicalneurologyint.com/Spontaneous-intraventricular-rupture-of-pyogenic-brain-abscess:-A-short-series-of-three-cases-and-review-of-literature/

Individualized approach to patients with IVROBA with abscess drainage/excision, intrathecal and intravenous antibiotic therapy, cerebrospinal fluid (CSF) diversion (if under high pressure) and close monitoring of clinical status, CSF reports and computed tomography (CT) scan findings, helped us achieve good neurological outcome in two patients presenting in conscious state; whereas one patient presenting in poor neurological status (comatose) succumbed to IVROBA due to fulminant septic arteritis.

CASE REPORTS

Case 1

A 40-year-old gentleman presented with a history of intermittent high-grade fever and headache of 15 days' duration. On clinical examination, he was conscious, alert, and neurologically intact, and investigations revealed that he was immune-competent. Total leucocyte count (TLC) was 14500/mm^3. CT of the brain showed a ring-enhancing lesion in the right frontal region suggestive of brain abscess, which was communicating medially with the frontal horn of the right lateral ventricle. The "tell-tale" signs of IVROBA were ependymal enhancement seen in the right frontal horn [Figure 1a; dotted line with closed arrow head] and the presence of debris (pus) seen in the dependent right occipital horn, demonstrated by the pus-fluid level [Figure 1b; arrow with closed head].

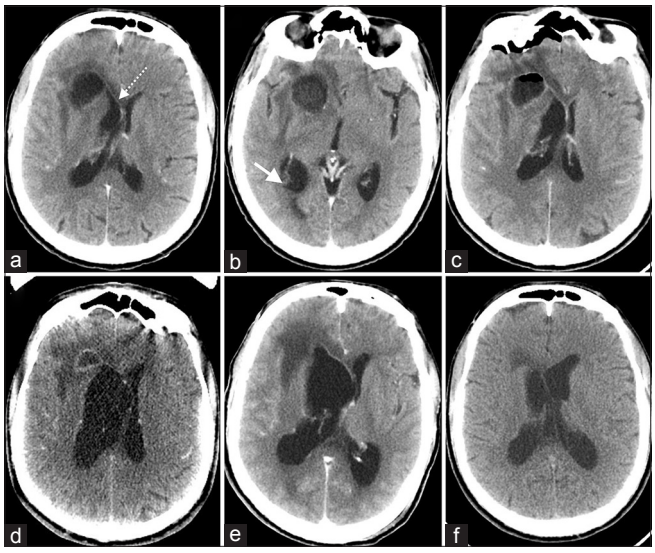

Figure 1: Case 1 – (a) and (b) Preoperative contrast-enhanced computed tomography (CECT) scan of the brain showing a right frontal abscess in close proximity to the frontal horn of the right lateral ventricle. The dotted line with closed arrow depicts the ependymal enhancement.The full line with closed arrow shows the "pus-fluid" level demonstrating debris in the dependent occipital horn. (c) Post-tapping CT showing air within the abscess cavity. (d and e) CECT scan during treatment showing the well-developed abscess wall communicating with the loculated right lateral ventricle. (f) Follow-up CECT shows resolution of the abscess and the ventriculitis

He was started on empirical intravenous antibiotics in appropriate meningitic doses after taking blood sample for culture. He underwent right frontal burr hole and tapping of the abscess; 30 ml of pus mixed CSF was aspirated. Gram stain showed gram positive cocci in clusters, however, pus culture yielded no growth. Treatment was continued with intravenous antibiotics (ceftriaxone, amikacin, and metronidazole); however, the gradually deteriorated in sensorium. Right frontal external ventricular drain (EVD) was placed and intraventricular colistin (dosage = 1 million units in 1:10 dilution) was administered twice daily for 7 days till the patient improved clinically and CSF parameters normalized. CSF cultures were sent daily but no organism was isolated. Simultaneously, intravenous colistin (dosage = 10 million units) twice a day was administered. After removal of the EVD, patient was continued on intravenous colistin for another 3 weeks till CT brain showed resolution of ependymal enhancement. Patient was discharged in fully functional status. Follow up imaging done at 3-months post discharge showed complete resolution of abscess and absence of ependymal enhancement [Figure 1f]. At 5-months post discharge, he has returned to his work and is leading a normal life without any sequelae.

Case 2

A 21-year-old gentleman, a known case of right chronic suppurative otitis media (CSOM), presented with history of headache, vomiting, and intermittent high-grade fever of 2-month duration. On presentation, he was conscious, alert with no focal neurological deficits and was immune-competent; TLC was 15100/mm^3. CT brain showed a right posterior temporal abscess situated close to the temporal horn of the right lateral ventricle. The presence of ependymal enhancement of the right temporal horn [Figure 2a; dotted arrow with closed arrow head] and evidence of debris within the temporal horn ("fluid-pus level" indicated by the closed arrow head in Figure 2a) suggested IVROBA.

The patient was started on empirical intravenous antibiotics (ceftriaxone, amikacin, and metronidazole) in meningitic doses after collecting blood sample for culture sensitivity. He underwent right temporoparietal craniotomy and excision of the abscess. Intraoperatively, the abscess wall was seen to be communicating with the right temporal horn anteromedially; thorough "saline wash" was given in the cavity and inside the ventricle.

Right frontal EVD was placed. CSF was turbid with total cell count of 5000 cells/hpf (95% polymorphocytes); glucose was 2 mg/dl and protein was 575 mg/dl. Pus cultures from the brain abscess as well as pus from the ear (ear swab) yielded *Streptococcus* spp. as the offending organism. CSF culture yielded *Enterococcus avium*. EVD was kept for 2 weeks and the patient received intraventricular as well as intravenous antibiotics

as per the culture sensitivity report (vancomycin and ciprofloxacin). Once the patient was afebrile, neurologically stable, and three consecutive CSF cultures were negative, the EVD was removed and intravenous vancomycin and ciprofloxacin (in meningitic doses) was continued for another 6 weeks at a local hospital.

Three weeks after stopping antibiotics, the patient presented to the casualty in altered sensorium. Fundus showed papilledema. CT scan of brain showed intraventricular septations with dilatation of contralateral lateral ventricle and third ventricle with cerebral edema. Bone flap at the operative site was raised suggestive of raised intracranial pressure (ICP) [Figure 2d]. Left frontal EVD was placed, following which the patient's sensorium improved. EVD was kept for 5 days. During this period, CSF samples were analyzed thrice and all samples were reported as sterile. CSF parameters were normal except for mildly elevated protein values. Patient underwent left Frazier's point "medium pressure" ventriculoperitoneal shunt. At discharge, he was conscious and alert with no focal neurological deficits. At 6 month follow-up, patient is doing well.

Case 3

A middle-aged male patient was brought to our casualty by the police after being found lying unconscious on the road; no further details were available. On clinical examination, his Glasgow coma score (GCS) was $E_1M_4V_1$, vital signs were stable, and pupils were equal and reacting to light. There was profuse pus discharge from the right ear; TLC was 28900/mm^3. He was evaluated with CT head which showed a left posterior temporal abscess, with rupture into the temporal horn of the left lateral ventricle [Figure 3a and b].

He underwent emergency twist drill craniostomy and tapping of the abscess, followed by left temporoparietal craniotomy and excision of the abscess. Postoperatively, the patient continued to be in poor neurological status and was admitted in the intensive care unit for ventilatory support. He was treated with empirical intravenous and intrathecal antibiotics (ceftriaxone, amikacin, and metronidazole) in meningitic dosages; however, his sensorium gradually deteriorated over the next 3 days to GCS of $E_1M_1V_1$. The pus culture revealed *Streptoccus pyogenes* to be the offending organism, and appropriate antibiotic therapy was instituted. Histopathology revealed an organizing abscess in the left temporal lobe. CT brain (3 days after the surgery) showed multiple cerebral infarctions suggestive of septic arteritis [Figure 3d]. He succumbed to the illness on the fourth postoperative day.

DISCUSSION

IVROBA is a catastrophic complication of pyogenic brain abscess. The reported incidence of IVROBA ranges from 1% to 31%.[3] Capsule formation in a developing abscess has been reported to be more complete on the cortical side compared to that on the ventricular side.[1,7] Hence, it has been postulated that PBAs have a propensity to rupture medially into the ventricle, rather than laterally onto the cortical surface.[1] PBAs caused by hematogenous spread are often deep-seated, being detected at the white matter–gray matter junction and are known to have poor capsule formation, and thus are more likely to rupture

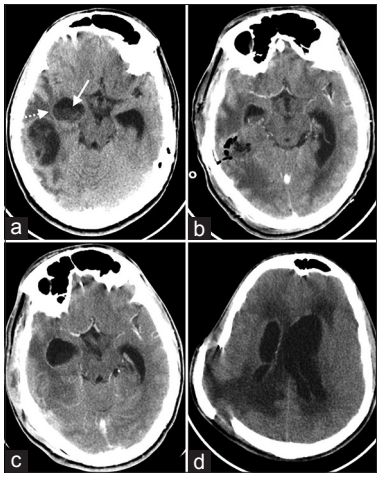

Figure 2: (a) Preoperative contrast-enhanced computed tomography (CECT) scan of Case 2 shows a superficially located brain abscess in the right temporal lobe; abscess shows well-formed lateral wall and ill-formed medial wall, with the temporal horn of the lateral ventricle showing ependymal enhancement (dotted line with closed arrow head) and presence of debris (full line with closed arrow). (b) Post-operative CECT scan shows excision of the abscess. (c) CECT during treatment showing loculated right temporal horn. (d) Follow-up CT scan at 3 weeks after stopping antibiotics showing loculated ventricles with hydrocephalus, elevated bone flap, and raised intracranial pressure

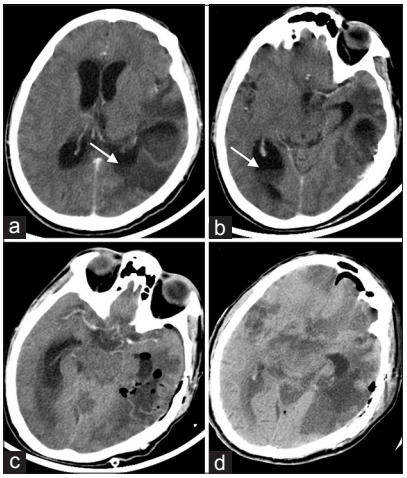

Figure 3: (a and b) Preoperative CECT scan of Case 3 shows a superficially located brain abscess in the left temporal lobe with clear-cut evidence of intraventricular rupture of brain abscess and debris in the dependent occipital horns (full line with closed arrow head). (c) Post-operative contrast-enhanced computed tomography (CECT) scan shows excision of the abscess and postlavage status of the ventricles. (d) CT scan done at 3 days after surgery reveals widespread patchy cerebral infarction secondary to septic arteritis

into the ventricles.[1,8] Two of the three PBAs in our short series were located superficially in the temporal lobe and occurred from contiguous spread of infection from the pre-existing CSOM, whereas one PBA was located deep within the frontal lobe and most likely developed from hematogenous spread.

In one of the very few studies dealing with the predictive factors associated with IVROBA, Takeshita *et al*. concluded that signs of meningeal irritation and localized enhancement of the ventricular wall adjacent to the abscess (observed on imaging studies) are events preceding the intraventricular rupture of a PBA.[7] Lee *et al*. concluded that the morphology of the abscess and the distance between abscesses and the ventricle walls, rather than the size of abscess, are predictive of intraventricular rupture.[3] Their study showed that the adjusted risk of intraventricular rupture during hospitalization for patients who have multiloculated brain abscess is 4.2 times greater than among those who do not; they also showed that a reduction of 1 mm in the distance between the ventricle and brain abscesses increases the rupture rate by 10%.[3]

Mortality rate of IVROBA was reported to be up to 80% in many earlier series, however, with the advent of better diagnostic imaging and aggressive antibiotic therapy, it has come down to below 40%.[6,7,9] Young patients, those presenting in good neurological status, and those with fewer complications after IVROBA are expected to have a better outcome.[3,7] IVROBA results in severe ventriculitis, which may progress to widespread pan-meningo-encephalitis if not treated early.[3,7] Case 3 (in our series) presented in a very late stage of the disease and expired following septic arteritis. Cases 1 and 2 presented relatively earlier and were managed aggressively with surgery and combined intraventricular and intravenous antibiotics, leading to survival with good neurological recovery.

In patients who tide over the acute crisis, intraventricular septations resulting in isolated ventricular dilatation is a late complication.[2,5] Isono *et al*. recommended intraventricular irrigation with antibiotics in the very early stages to prevent this complication.[2] Neuroendoscopy may be useful in draining the debris and breaking the septations caused by ventriculitis.[4] One of our patients (Case 2) had late neurological deterioration due intraventricular septations and possibly obstructive hydrocephalus due to scarring of the ependymal surfaces. EVD was placed to temporarily drain CSF so as to lower the ICP, as well as to send the CSF for examination in order to rule out residual infection. Once infection was ruled out, a ventriculoperitoneal shunt was performed.

Literature review, as well as our short case series, suggests that early identification of IVROBA is very important in determining the final outcome.[3,7,9] Hence, signs of IVROBA on initial CT scan of the brain are vital. On most occasions, direct communication between the abscess cavity and the ventricle may not be evident. Close proximity of the abscess to the ventricle along with ependymal enhancement seen in the ventricular wall adjoining the abscess (indicated by the dotted line and closed arrow head in Figures 1 and 2) and presence of pus/debris in the dependent part of the lateral ventricles (i.e., the occipital horns) (indicated by closed arrow head in Figures 1–3) are two tell-tale signs of IVROBA and should prompt the treating neurosurgeon to institute aggressive therapy.

Once diagnosis has been established, it is imperative to start simultaneous intrathecal and intravenous antibiotics, initially empirical, followed by appropriate ones recommended as per the culture sensitivity of the pus/CSF.[3,9] PBA can be excised or drained as deemed appropriate by the treating neurosurgeon taking into consideration the location of the abscess. At the time of excision of the abscess, if it is possible to insert a ventricular drain, the opportunity should not be missed. If not, frontal EVD should be placed and ventricular CSF drainage should be instituted (at the level of the tragus). This strategy can also be followed if intraventricular extension is discovered intraoperatively during abscess excision. The ventricular catheter should be used to administer intrathecal antibiotics in appropriate doses till the CSF parameters (cell counts, glucose, protein) are normalized and the CSF cultures turn sterile. The treatment needs to be highly individualized in accordance with the patient's clinical condition, the CSF reports, and the CT brain findings. After three consecutive CSF culture reports have been reported sterile and the patient's condition is stable, the EVD can be removed and patient continued on intravenous antibiotics till resolution of ependymal enhancement on the CECT scan of the brain.

The recurring point of contention noted in the sparse literature pertaining to IVROBA has been the lack of guidelines for managing these patients.[3,7,9] The message that we would like to impart through our cases is that there is indeed no fixed protocol or set guidelines or treatment duration that can be developed for managing patients of IVROBA. The strategy should be an approach individualized to each patient, which relies on the following tenets – drainage/excision of PBA, institution of intraventricular and intravenous antibiotics through EVD, provision for CSF drainage if ICP is above normal, and diligent monitoring of the patient's progress through clinical examination, CSF reports, and CT brain findings. We achieved good clinical outcome in Cases 1 and 2 by following these tenets.

Our short series of three cases does not itself lend any significant weight to the treatment guidelines for IVROBA; however, it does substantiate the present stance in the review of literature that the nihilistic

attitude towards IVROBA needs to be re-considered. Early diagnosis and aggressive treatment can result in full neurological recovery of patients presenting with IVROBA (as seen in Cases 1 and 2). Patients presenting in later stages with IVROBA and fulminant meningoencephalitis still continue to have grave prognosis (as seen in Case 3).

CONCLUSION

Presently, the ubiquitous imaging for neurological disorders and the advances in neurosurgical techniques and antibacterial therapy appear to have resulted in early diagnosis of PBAs and their successful management. As such, IVROBA may be rarely encountered. However, when it occurs, the patient's prognosis is adversely affected. In spite of current advances in diagnosis and treatment, IVROBA remains a dreaded complication of PBA. Early detection and prompt aggressive management in the form of abscess drainage/excision followed by intrathecal and intravenous antibiotic therapy (as per sensitivity) can give the patient a fighting chance and significantly improve the outcome.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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