Nonseptic and Septic Lateral Sinus Thrombosis: A Review

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Received: 25 October 2011 / Accepted: 24 November 2011 / Published online: 7 December 2011
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Abstract Thrombosis of the lateral sinus can be classified into nonseptic lateral sinus thrombosis and septic lateral sinus thrombosis. Nonseptic lateral sinus thrombosis differs from septic lateral sinus thrombosis in that it is not associated with ear or sinus infection. Etiologies of these conditions are different and hence the management of these conditions is different. Nonseptic lateral sinus thrombosis requires medical line of management and anticoagulant therapy, where as septic lateral sinus thrombosis needs surgical treatment along with antibiotics therapy. An otologist should be familiar with the septic lateral sinus thrombosis existence and nonseptic variant lateral sinus thrombosis for early recognition and initiation of appropriate treatment.

Keywords Nonseptic lateral sinus thrombosis · Septic lateral sinus thrombosis · Lateral sinus

Introduction

The lateral sinus is formed by the confluence of the superior petrosal sinus and the transverse sinus. The right

transverse sinus is usually continues as sagittal sinus, and the left transverse sinus is a continuation of the straight sinus. The lateral, or sigmoid, sinus exits the skull through the jugular foramen to become the internal jugular vein.

Thrombosis of the lateral sinus can occur alone or in association with cortical venous thrombosis. Thrombosis of the lateral sinus can give rise to thrombo embolism. Thrombosis of the lateral sinus can be classified into two following types:

1. nonseptic lateral sinus thrombosis and
2. septic lateral sinus thrombosis.

Etiologies of these conditions are different and hence the management of these conditions is different. Nonseptic lateral sinus thrombosis requires medical line of management and anticoagulant therapy, where as septic lateral sinus thrombosis needs surgical treatment along with antibiotics therapy. Reviews of literature on both these conditions are presented in this article.

Nonseptic Lateral Sinus Thrombosis

Nonseptic lateral sinus thrombosis differs from septic lateral sinus thrombosis in that it is not associated with ear or sinus infection. The nonseptic type of lateral sinus thrombosis, which is not associated with ear or sinus infections, is being diagnosed with increasing frequency because of the availability of CT and MRI scan [1–3]. As there is no ear or sinus infection, otolaryngological examination will be normal. Nonseptic lateral sinus thrombosis involves primary thrombus formation within the dural sinus [1]. It usually occurs in adolescents or adults. It is seen more often in women than men.

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Predisposing conditions in women are:

1. pregnancy;
2. puerperium, oral contraceptives [1]; and
3. smoking is also a contributing factor in both sex [2, 3].

Nonseptic lateral sinus thrombosis has been reported to occur in association with following conditions [1, 4–6]:

1. thrombocytosis;
2. sickle cell disease;
3. chronic debilitating diseases (for example, malignancies such as leukemia);
4. altered cerebral hemodynamic states such as:
 - (a) congestive heart failure;
 - (b) dehydration;
 - (c) malnutrition; and
 - (d) diabetic ketoacidosis.

The mechanism of dural sinus thrombosis in women using oral contraceptives is not known. The following explanations have been given for sinus thrombosis in oral contraceptive users [1, 5]:

1. abnormal thrombogenesis;
2. hypercoagulable state; and
3. vascular lesions induced by oral contraceptives.

In pregnant women and oral contraceptive users, several factors in the coagulation cascade have been found to be altered resulting in hypercoagulable state. This altered coagulation cascade finally results in excessive fibrin deposition on endothelial lining of the venous system [7]. Researchers have shown endothelial proliferation in dural sinus wall in the areas adjacent to thrombus. It is proposed that vascular sub endothelial stimulation favors excessive deposition of fibrin and results in thrombus formation [8].

Generally, the initial symptom of nonseptic lateral sinus thrombosis is headache, which may be either generalized or localized to the temporoparietal region. There is no identifiable, uniform, recognizable pattern of headache in dural sinus thrombosis. It may be intermittent initially to become a constant headache later. It is usually unilateral or localized to any region of the head and usually throbbing in nature [9, 10]. The exact mechanism for headache in sinus thrombosis is not known. Multiple mechanisms including a combination of raised intracranial pressure, subarachnoid hemorrhage, stretching of nerves in sinus walls and inflammation of sinus walls are most likely responsible for variable patterns of headache among these patients. In some patients sigmoid sinus thrombosis is associated with occipital pain. This is probably related to inflammation and stretching of sigmoid sinus walls due to thrombus [9]. Subsequently, symptoms of increased intracranial pressure may develop, including seizures, blurred vision, and cranial nerve palsy. The characteristic fever of septic lateral sinus

thrombosis is absent in nonseptic lateral sinus thrombosis [1, 3]. As there is no ear or sinus infection, otolaryngological examination will be normal.

Computed tomography (CT) may demonstrate abnormally high density of the lumen of the sinus, which does not enhance after intravenous contrast administration. Enhancement of the dura surrounding the sinus may be prominent, causing the “empty triangle,” or “delta sign,” which may suggest the diagnosis. This sign is not seen in all cases of lateral sinus thrombosis [2, 11, 12].

MRI (Fig. 1) is superior to CT scanning in detecting lateral sinus thrombosis [11, 12]. Mastoid changes are frequently detected on MRI in case of nonseptic lateral sinus thrombosis. This mastoid abnormality consists of an increased T2-weighted MRI signal in the mastoid air space due to mucosal thickening within the air cells (Fig. 2). These changes are not due to mastoiditis but it is due to venous congestion as a consequence of thrombosis [3].

The aim of treatment of nonseptic lateral sinus thrombosis is

1. to prevent propagation of the thrombus;
2. to avoid the thromboembolism phenomenon; and
3. to control elevated intracranial pressure, when present [1].

Most authors recommend anticoagulant therapy for the management of nonseptic lateral sinus thrombosis [1–3, 13, 14]. This condition should be identified immediately and patient should be started on anticoagulant therapy to prevent thromboembolism and its complication. Duration of treatment depends on extent of thrombosis and patients condition. This condition responds well to anticoagulant therapy and no surgical intervention is required. Prognosis is good and any predisposing factors should be identified and managed accordingly.

Fig. 1 MRI showing (arrow) thrombus in the right lateral sinus

Fig. 2 MRI showing (arrow) mucosal thickening in the mastoid air cells

Septic Lateral Sinus Thrombosis

Septic lateral sinus thrombosis is usually seen as a complication of middle ear infection [15]. The proximity of the middle ear and mastoid air cells to the dural venous sinuses predisposes them to thrombosis and thrombophlebitis secondary to infection and inflammation in the middle ear and mastoid [16].

It usually develops as an extension of perisinus infection eroding the bone by coalescence, by granulation tissue, or by cholesteatoma. It may also be caused by osteo thrombophlebitis of emissary mastoid veins [12, 17, 18]. Thrombosis of the lateral sinus usually starts with mastoid bone erosion caused by cholesteatoma, granulation tissue or coalescence, causing the formation of a perisinus abscess. Pressure necrosis of the dural-outer wall of the sinus cause adherence of fibrin, blood cells and platelets, resulting in the formation a mural thrombus. The mural thrombus becomes infected and propagates to form an obliterating thrombus, occluding the lumen of the sinus. Fresh thrombus is formed and this may cause propagation proximally to the internal jugular vein, distally to other dural sinuses. Formation of a thrombus in the lateral sinus may be looked upon as a protective mechanism, attempting to localize infection [15, 17, 19].

Septic lateral sinus thrombosis accounts for 2–20% of intracranial complications [20, 21]. Numerous reports have documented a clear male predominance [15, 22–24].

Severe headache, otalgia, “picket-fence” fever, and papilloedema are regarded as specific symptoms and signs for septic lateral sinus thrombosis [22, 24–27]. The most frequent presenting symptoms are headache, otalgia, fever and vomiting and pain in the neck [2, 23, 28]. Occlusion of the lumen of the sinus, interruption of cortical venous circulation results in headache, papilloedema and increased intracranial pressure. Tenderness and edema over mastoid (Griesinger’s sign) are pathagmomic of septic lateral sinus thrombosis and reflex thrombosis of mastoid

emissary vein [29]. Internal jugular vein thrombosis can manifest as tender mass in the neck along or across sternocleidomastoid muscle [30]. Pressure of clot in the jugular bulb can paralyze 9th, 10th, 11th cranial nerves (jugular foramen syndrome) [29]. As there is ear infection, otolaryngological examination shows features of middle ear infection. Usually lateral sinus thrombosis is seen as a complication of attico antral ear disease, but it can also occur as a complication of tubotympanic ear disease. In the present days, patient do not present with classical picture of lateral sinus thrombosis. This is due to preadmission antibiotics therapy which may mask the typical signs and symptoms of septic lateral sinus thrombosis and radiological investigations are required for the accurate diagnosis [28].

CT and MRI are the investigations of choice in making diagnosis. MRI is more specific than CT in detecting the thrombus [12, 31]. This should be performed in conjunction with CT to evaluate associated otologic and cerebral pathology [11]. The classic CT (with contrast) finding is the absence of enhancement (Fig. 3) of the thrombosed sigmoid sinus (delta sign) [22, 32]. This finding is more sensitively demonstrated by MRI with gadolinium; the thrombus has low signal intensity on T2-weighted images with an absence of flow on MRI venography (Fig. 4) [18].

In septic lateral sinus thrombosis, ear swab cultures characteristically yields mixed flora including bacteroides, staphylococcus, enterobacteriaceae, proteus, pseudomonas and others species [23, 27, 28, 33, 34]. Since antibiotics are commonly used during the prodromal ear infection, blood culture is often negative [24, 27, 28].

The management of septic lateral sinus thrombosis includes antibiotic therapy and prompt mastoid surgery. Mastoidectomy with incision of the lateral sinus, removal of the clot and local packing are considered standard care [15]. However, some reports have shown that the prognosis was not improved by exploring the sinus or by removing

Fig. 3 CT with contrast showing (arrow) absence of enhancement in the thrombosed left lateral sinus and enhancement of the dura surrounding the sinus

Fig. 4 MRI venography showing (arrow) absence of flow in the right lateral sinus

the thrombus. Removal of surrounding granulation tissue and inflammation around the sinus is sufficient for effective treatment [2, 16, 22].

Two controversial issues in the management of have been discussed in the literature

1. ligation of internal jugular vein and
2. the use of anticoagulants.

The ligation of internal jugular vein is still a controversial issue in the management of septic lateral sinus thrombosis. Before the advent of antibiotics, ligation of the internal jugular vein was performed almost routinely in order to avoid dissemination of thrombophlebitic process and septic emboli.

Cody [35] summarized the argument for internal jugular vein ligation as follows:

- This procedure isolates the source of infection from the general circulation.
- This procedure protects against the possibility of the mural thrombus embolizing.
- This procedure does not alter the favorable course of the disease or add undue burden to the patient.

Lyman [36] summarized the argument against internal jugular vein ligation as follows:

- Numerous cases of symptom less lateral sinus thrombosis were found during mastoid surgery.
- Septic complication often followed internal jugular vein ligation because the ligation above the entrance of the facial vein does not block off collateral circulation.
- In the presence of collateral circulation, ligation may cause retrograde thrombosis and interruption of the venous return from the head, resulting in intracranial infection.

- Operative interventions on the internal jugular vein exposed the patient to damage to the vagus, accessory, and hypoglossal nerves.

Today internal jugular vein ligation is indicated in the following situations:

- When the clots extends beyond the mastoid area.
- When septicemia and pulmonary complications persist despite initial treatment with surgery and antibiotics.
- When infection or thrombosis of the internal jugular vein is found.

Recent authors are of the opinion that with modern antibiotic therapy internal jugular vein ligation is not required [21, 28, 31]. Internal jugular vein ligation should be reserved for those cases in which septicemia and embolisation which do not respond to initial surgery and antibiotic treatment [37, 38].

Most authors agree that there is no place for anticoagulants in the management of septic lateral sinus thrombosis [27–29]. The use of anticoagulants is not a part of standard care of patients with septic lateral sinus thrombosis and was more common prior to the advent of antibiotics. Anticoagulants have been advocated to prevent extension of the thrombus to the distal sinuses. However, they are rarely used now because most infections can be controlled with antibiotics and surgery, and this tends to prevent the thrombus from propagating. Anticoagulants arrest the spread of thrombosis but may increase the risk of venous infarctions and are therefore no longer used [17, 37, 38]. Their use has been reserved by some authors for cases in which the thrombus spreads proximally to the internal jugular vein or retrogradely to the more distal intracranial sinuses [15, 32, 39, 40].

Earlier studies by Seid and Sellars [41], Teichgraber et al. [27] and Kaplan et al. [15] there was a significant mortality in cases of septic lateral sinus thrombosis. In later studies by Syms et al. [23], Bardley et al. [32], Ooi et al. [2], Seven et al. [22], Manolidis and Kutz [33], Viswanatha [28] and Nathan et al. [20] there was no mortality (Table 1). This due to availability of CT and MRI scans which helps in early detection of cases and availability of good antibiotics.

Conclusion

Both nonseptic and septic variety of lateral sinus thrombosis can result in thrombosis of dural venous sinuses, thrombosis of internal jugular vein and embolism. Though few clinical features are similar, etiology and management of these conditions are different. Nonseptic lateral sinus thrombosis requires medical line of management and

Table 1 Summary of details from previous studies on septic lateral sinus thrombosis

Author(s)' name(s)	Year	Study period (years)	No. of cases	Mortality (%)
Seid and Sellars [41]	1973	4	13	23
Teichgraeber et al. [27]	1982	10	6	16
Samuel and Fernandes [26]	1987	6	45	0
Amirmajdi [24]	1988	7	16	0
Kaplan et al. [15]	1999	16	13	7.6
Syms et al. [23]	1999	5	6	0
Bardley et al. [32]	2002	6	9	0
Ooi et al. [2]	2003	4	4	0
Seven et al. [22]	2004	11	11	0
Manolidis and Kutz [33]	2005	6	12	0
Viswanatha [28]	2006	7	12	0
Nathan et al. [20]	2009	11	7	0

anticoagulant therapy, where as septic lateral sinus thrombosis needs surgical treatment along with antibiotics therapy. Preadmission antibiotics therapy may mask the typical signs and symptoms of septic lateral sinus thrombosis and radiological investigations are required for the accurate diagnosis. The clinician should be familiar with both non-septic and septic lateral sinus thrombosis for initiation of appropriate therapy and to prevent its complication.

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