Vascular and Parameningeal Infections of the Head and Neck

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Overview

• General principles
• Specific review
  – septic venous thrombosis
  – arterial aneurysms and erosions
  – subdural empyema and epidural abscesses
• Conclusions and questions
General

- Rare in populations with ready access to modern medical care
- Complications of meningitis or odontogenic, paranasal sinus, or otogenic infections, or major trauma
General

- Clinical presentations varied
  - primary infection site
  - adjacent anatomical structures
- More than one may co-exist
- Diagnosis clinical and radiologic
- Microbiology reflective of primary source
<table>
<thead>
<tr>
<th>Type of infection</th>
<th>Aerobic and facultative organisms</th>
<th>Anaerobic organism</th>
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<tbody>
<tr>
<td>Otitis media, acute</td>
<td><em>S. pneumoniae</em>&lt;sup&gt;a&lt;/sup&gt;</td>
<td><em>Peptostreptococcus</em> spp</td>
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<td><em>H. influenzae</em>&lt;sup&gt;a&lt;/sup&gt;</td>
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<td><em>M. catarrhalis</em>&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>Otitis media and mastoiditis, chronic</td>
<td><em>S. aureus</em>&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Pigmented <em>Prevotella</em> and</td>
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<td>peripherparyngeal abscess</td>
<td><em>E. coli</em>&lt;sup&gt;a&lt;/sup&gt;</td>
<td><em>Porphyromonas</em> spp</td>
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<td>Suppurative thyroiditis</td>
<td><em>K. pneumoniae</em>&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>Sinusitis, acute</td>
<td><em>S. pyogenes</em></td>
<td>Pigmented <em>Prevotella</em> and</td>
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<td>Cervical lymphadenitis</td>
<td><em>S. pneumoniae</em></td>
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<td>Postoperative infection disrupting oral mucosa</td>
<td><em>H. influenzae</em>&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Pigmented <em>Prevotella</em> and</td>
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<td>Odontogenic and deep neck infections</td>
<td><em>S. aureus</em>&lt;sup&gt;a&lt;/sup&gt;</td>
<td><em>Porphyromonas</em> spp</td>
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<td>Necrotizing ulcerative gingivitis, or Vincent's angina</td>
<td><em>Mycobacterium</em> spp</td>
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<td></td>
<td><em>Staphylococcus</em> spp&lt;sup&gt;a&lt;/sup&gt;</td>
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<td><em>Enterobacteriaceae</em>&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Bacteroides spp&lt;sup&gt;a&lt;/sup&gt;</td>
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<sup>a</sup> Organisms that have the potential of producing β-lactamase.
General

• Combined medical-surgical approach
• Anti-biotherapy
  – drug
  – dose
  – delivery
• Other (ie anticoagulants)
Septic intracranial thrombosis

- Infection-associated thrombosis of cerebral veins or dural venous sinuses
- Nearly always adjacent infection
Septic intracranial thrombosis

Superior sagittal sinus (large arrows)
Straight sinus (short arrows)
Transverse sinuses (open short arrows)
Confluence of sinuses (open large arrow)

From Scott JN and Farb RI
*Neuroimaging Clin N Am*
2003
Septic intracranial thrombosis

- Clinically group as sagittal, lateral (including the transverse, sigmoid, and petrosal sinuses), and cavernous sinuses
- Receive blood primarily from cerebral veins
- Also sphenoparietal sinuses through communicating veins in the bone, other veins in the head such as the ophthalmic veins, and through emissary veins that connect with extra-cranial veins in the head and neck
- *Valveless*
Septic intracranial thrombosis

- Septic sagittal sinus thrombosis
  - frontal sinusitis or meningitis
  - poor prognosis

- Septic lateral sinus thrombosis
  - otitis media and complications
  - ½ chronic infections and erosion through infected bone
  - frequently (25% cases) associated with brain and epidural abscesses, subdural empyema, and meningitis
  - Increased intracranial pressure (sigmoid sinus obstruction)
  - Often occult to primary infection
Septic intracranial thrombosis
Cavernous sinus septic thrombosis

- Sphenoid and ethmoid > frontal sinusitis
- Infections of face, orbits, middle ears, and oral cavity especially the maxillary teeth
- The clinical findings largely arise as a result of
  - Venous obstruction (headache, proptosis, chemosis, and periorbital swelling)
  - Cranial neuropathy (ophthalmoplegia, ptosis, and pupillary abnormalities; visual loss is relatively uncommon at least early in course)
Cavernous sinus septic intracranial thrombosis

- **Bilateral spread within 24-48 hours** through anterior and posterior inter-cavernous sinuses
- Direct spread to other dural sinuses and the internal jugular vein, and meningitis, subdural empyema, brain abscess, internal carotid artery, compromise and pituitary necrosis may arise from extension into adjacent tissue
Septic intracranial thrombosis

- MRI investigation of choice but contrast enhanced CT also performs very well
- Little empirical evidence exists for the specific management
  - urgent surgical debridement/drainage
  - early intravenous antibiotics with CNS penetration
    - ceftriaxone 2 G IV q12h and metronidazole 500 mg IV q8h; vancomycin or linezolid
    - *Pseudomonas aeruginosa, Aspergillus* species and mucormycosis in special circumstances
Septic intracranial thrombosis

- treatment of complications such as seizures, pituitary-associated endocrinopathy, and increased intra-cranial pressure
- routine steroids not indicated (?benefit in the setting of cranial neuropathies)
- anticoagulants and thrombolytics controversial; anti-coagulate if no contraindication (de Bruijn SF Stroke 1999; Einhaupl KM Lancet 1991)
Septic internal jugular vein thrombosis

• Lemierre syndrome
  – septic thrombophlebitis of the internal jugular vein
  – oropharyngeal infection
  – bacteremia
  – metastatic foci

• *Fusobacterium necrophorum*
Septic internal jugular vein thrombosis

- ≈ 1 in a million incidence
  - young adults
  - pharyngitis (87%)
  - lungs, joints as metastatic foci
  - case-fatality rate 6%
Septic internal jugular vein thrombosis

- Presentation with toxicity, fever, neck pain, and sternocleidomastoid tenderness and swelling
- Doppler ultrasonography sensitive but views limited above the level of the mandible
- Contrast enhanced CT is sensitive for the presence of intravenous clot and added detail
- MRI probably the highest sensitivity and specificity
Septic internal jugular vein thrombosis

- Treatment principles as for intracranial disease
  - Surgical drainage
  - Empiric high dose anti-microbial coverage for *Fusobacterium necrophorum*, other oral anaerobes, and alpha- and beta-hemolytic streptococci; increasing case reports of MRSA
  - Metronidazole in combination with penicillin or a cephalosporin +/- vancomycin
  - Case-by-case anticoagulation (vein surgical ligation rarely required)
Arterial aneurysms and erosions

  - Mycotic aneurysms strictly speaking fungal etiology
  - Most (80%) secondary to embolization from endocarditis
  - syphilis, meningitis, cavernous sinus thrombosis, sinusitis, and skull osteomyelitis
- Erosions into the internal carotid artery are usually extra-cranial and arise from infection of the lateral pharyngeal space, Ludwig’s angina, deep cervical lymph nodes infection, and Lemierre syndrome
- May complicate endarterectomy (esp Dacron patches)
Arterial aneurysms and erosions

- The clinical presentation primarily anatomical
  - compression of adjacent vessels and nerves
  - rupture, thrombosis, distal embolus, or stenosis of the affected vessel manifested according to neurovascular territory
- Erosions may present as fever in association with minor hemorrhages from nose, mouth or ear
Arterial aneurysms and erosions

- The microbial etiology of these infections reflects primary source
  - *Staphylococcus aureus*
- Blood cultures typically (persistently) positive
- Gold standard diagnostic test angiography
- MRI and contrast enhanced CT both have high utility and have the advantage of defining non-vascular sources of infection and complications
Arterial aneurysms and erosions

- Lack of systematic study of different management approaches
- Intravenous anti-microbial therapy
- Surgical evaluation is required
  - artery
  - associated source control
- Medical approach possible for small infected arterial aneurysms in non-critical sites
- Rapidly enlarging or critical site requires surgical intervention (clipping, ligation, or resection with arterial reconstruction)
- Endovascular approaches emerging (biofilm infection)
Subdural empyema and epidural abscess

- Subdural empyemas and epidural abscesses - pus collections between the dura mater and arachnoid and the dura mater and the skull, respectively
- Complications of sinusitis, otogenic infections, meningitis, trauma, or surgery
- May be diagnosed concurrently
- Frequently associated with dural sinus thrombosis
Subdural empyema and epidural abscess

- Rates vary dramatically worldwide
  - 1-3 cases per year of subdural empyema and/or epidural abscess North America, Australia, Europe
  - 5 middle east
  - 50 cases per year in South Africa (Nathoo N et al Neurosurgery 1999)

- Complicate ≤1% of severe acute otogenic infections and paranasal sinusitis, higher in chronic under- or untreated disease

- Complicate ≤1% of cases of bacterial meningitis in adults but up to 10% in infants
Subdural empyema

- Subdural empyemas acute and severe onset and risk rapid progression (no anatomical limitation of the subdural space)
- Nathoo et al South Africa 699 cases during 15-year period
  - paranasal sinusitis 67% [Pott’s puffy tumor (subperiosteal abscess, osteomyelitis, frontal sinusitis) in 1/3]
  - meningitis 10%
  - otogenic 9%
  - trauma 8%
  - dental infections 1%
  - fever, neck stiffness, headache and focal seizures
  - case fatality 12%
Epidural abscess

- often insidious onset
  - tight adherence of the dura to bone limits extension
- Nathoo and colleagues (*Neurosurgery* 1999) 82 cases of cranial epidural abscesses South Africa
  - males and children and young adults
  - paranasal sinusitis 65% (Pott’s puffy tumors 50%)
  - mastoiditis 20%
  - trauma 6%
  - dental infections 1%
  - fever, neck stiffness, and periorbital edema
  - case fatality rate 1%
Subdural empyema and epidural abscess

- Nathoo et al also reported on 13 and 9 cases of infratentorial subdural empyema and epidural abscess in South Africa (Neurosurgery 1997)
- chronic otogenic origin of infection
- most had hydrocephalus
- Five (23%) all subdural empyema, died
Subdural empyema

- contrast CT vs. MRI (small and infratentorial collections, etiologies)
Epidural abscess
Subdural empyema and epidural abscess

- urgent neurosurgical and otorhinolaryngology surgical assessment
  - subdural empyema surgical emergency
  - delayed and/or inadequate drainage associated with adverse outcome
  - highly selected sinusitis-associated epidural abscesses in children potentially with sinus drainage alone

- intravenous antimicrobial therapy
  - CNS penetration
  - \textit{Streptococcus milleri} group
Conclusions

• Rare but important infections
• Clinical and radiological diagnosis
• Combined medical-surgical management
  Think of the anatomy
  Drain the pus
  Appropriate antibiotics