Infectious Diseases causing Seizures and/or Epilepsy

Erich Schmutzhard
Department of Neurology – Division of Neurocritical Care
University Hospital Innsbruck, Austria
In short: in many parts of Africa: Infections are main cause of symptomatic/ secondary seizures
Neurological infections

Infectious causes that can lead to generalised seizures in equatorial Africa are mainly of parasitic origin. Among these conditions are malaria, cysticercosis, onchocerciasis, and toxocariasis.

Neurocysticercosis is the most common neurological infection and a major cause of epilepsy in many countries in Africa, Asia, and Latin America. Neurocysticercosis is the main cause of partial epilepsy in adults in areas where Taenia solium is endemic. Cysticercosis is not common in Jewish and Muslim countries (there is little contact between people and pigs, and pork is not eaten) because of the low risk of infection.


Epidemiology, causes, and treatment of epilepsy in sub-Saharan Africa

Awa Ba-Diop, MSc.
INSERM UMR1094, Tropical Neuroepidemiology, and Institute of Neuroepidemiology and Tropical Neurology, School of Medicine, University of Limoges, Limoges, France

neurocysticercosis, cerebral malaria, toxocariasis, acute bacterial meningitis, viral encephalitis, cerebral abscess, sub-, epidural empyema, CNS tuberculosis (esp. tuberculomata) febrile convulsions in early childhood

African countries found a significant association between cysticercosis and epilepsy (overall OR 3.4, 95% CI 2.7–4.3).
NEUROCYSTICERCOSIS AND OTHER HELMINTHIC DISEASES
ACUTE BACTERIAL MENINGITIS
BRAIN ABSCESS
ACUTE VIRAL ENCEPHALITIS
CHRONIC MENINGITIS INCL GRANULOMA (TB)
CEREBRAL MALARIA AND OTHER Protozoal DISEASES

FREQUENT CAUSES OF
- SYMPTOMATIC EPILEPTIC SEIZURES IN THE ACUTE PHASE
- SYMPTOMATIC POSTENCEPHALITIC EPILEPSIES
Epilepsy and neurocysticercosis in rural Tanzania—An imaging study

Andrea Sylvia Winkler, Joachim Blocher, Herbert Auer, Thaddaeus Gotwald, William Matuja, and Erich Schmutzhard

Department of Neurology, Ludwig-Maximilians-University, Munich, Germany; Haydom Lutheran Hospital, Manyara Region, Tanzania; Department of Neurology, Medical University of Innsbruck, Innsbruck, Austria; Department of Medical Parasitology, Clinical Institute of Hygiene and Medical Microbiology, Medical University Vienna, Vienna, Austria; Department of Radiology, Medical University of Innsbruck, Innsbruck, Austria; and Department of Neurology, Muhimbili National Hospital, Dar es Salaam, Tanzania

Africa, who were therefore at risk of developing epilepsy, was between 1.9 and 6.16 million. In many resource-poor areas, with no access to neuroimaging, serological detection of cysticercal antibodies or cysticercal antigen is the method of choice to assess the prevalence of human cysticercosis or neurocysticercosis. The prevalence of cysticercosis varies throughout sub-Saharan Africa. A meta-analysis in 2010 on eight African countries found a significant association between cysticercosis and epilepsy (overall OR, 95% CI 2.7–4.3).
Efficacy of combined antiparasitic therapy with praziquantel and albendazole for neurocysticercosis: a double-blind, randomised controlled trial


Instituto Nacional de Ciencias Neurológicas, Lima, Peru (Prof H H Garcia PhD, I Gonzales MD, H Saavedra MD); Department of Microbiology (Prof H H Garcia, J A Bustos MD), Center for Global Health Tumbes (Prof H H Garcia), School of Public Health (A G Lescano PhD), and Bioinformatics Unit, Laboratory of Research and Development, School of Sciences and Philosophy (Prof M Zimic PhD), Universidad Peruana Cayetano Heredia, Lima, Peru; Department of Parasitology and Public Health Training Program, US Naval Medical Research Unit No 6 (NAMRU6), Callao, Peru (A G Lescano); Magnetic Resonance Imaging Center, Resocentro, Lima, Peru (D Escalante MD); Hospital Nacional Edgardo Rebagliati, Essalud, Lima, Peru (M Gavidia MD); Hospital Nacional Guillermo Almenara, Essalud, Lima, Peru (L Rodriguez MD); Hospital Nacional Cayetano Heredia, Ministerio de Salud, Lima, Peru (E Najar MD, H Umeres MD); and Hospital Nacional Alberto Sabogal, Essalud, Callao, Peru (E Javier Pretell MD)
Table 2
Cysticidal efficacy by treatment group and number of cysts

<table>
<thead>
<tr>
<th>One to two cysts</th>
<th>Albendazole plus praziquantel (n=39)</th>
<th>Standard albendazole (n=41)</th>
<th>Increased albendazole (n=38)</th>
<th>Overall p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viable cysts at baseline</td>
<td>27</td>
<td>22</td>
<td>23</td>
<td>0.284</td>
</tr>
<tr>
<td>Mean per patient (SD)</td>
<td>1.4 (0.6)</td>
<td>1.1 (0.3)</td>
<td>1.3 (0.6)</td>
<td>0.281</td>
</tr>
<tr>
<td>Cyst range</td>
<td>1–3*</td>
<td>1–2</td>
<td>1–3*</td>
<td>..</td>
</tr>
<tr>
<td>Number of patients</td>
<td>20</td>
<td>20</td>
<td>18</td>
<td>..</td>
</tr>
<tr>
<td>Viable cysts at day 180</td>
<td>10</td>
<td>6</td>
<td>3</td>
<td>0.237</td>
</tr>
<tr>
<td>Mean per patient (SD)</td>
<td>0.5 (07)</td>
<td>0.3 (0.5)</td>
<td>0.2 (04)</td>
<td>0.162</td>
</tr>
<tr>
<td>Cysts resolved</td>
<td>17/27 (63%)</td>
<td>16/22 (73%)</td>
<td>20/23 (87%)</td>
<td>0.141</td>
</tr>
<tr>
<td>Patients cured</td>
<td>12/20 (60%)</td>
<td>14/20 (70%)</td>
<td>15/18 (83%)</td>
<td>0.287</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Three or more cysts</th>
<th>Albendazole plus praziquantel (n=39)</th>
<th>Standard albendazole (n=41)</th>
<th>Increased albendazole (n=38)</th>
<th>Overall p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viable cysts at baseline</td>
<td>171</td>
<td>142</td>
<td>142</td>
<td>0.179</td>
</tr>
<tr>
<td>Mean per patient (SD)</td>
<td>9.0 (4.8)</td>
<td>6.8 (4.2)</td>
<td>7.1 (44)</td>
<td>0.245</td>
</tr>
<tr>
<td>Cyst range</td>
<td>3–19</td>
<td>3–18</td>
<td>3–18</td>
<td>..</td>
</tr>
<tr>
<td>Number of patients</td>
<td>19</td>
<td>21</td>
<td>20</td>
<td>..</td>
</tr>
<tr>
<td>Viable cysts at day 180</td>
<td>11</td>
<td>112</td>
<td>74</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Mean per patient (SD)</td>
<td>0.6 (1.0)</td>
<td>5.3 (4.2)</td>
<td>3.7 (3.1)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Cysts resolved</td>
<td>160/171 (94%)</td>
<td>30/142 (21%)</td>
<td>68/142 (48%)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Patients cured</td>
<td>13/19 (68%)</td>
<td>1/21 (5%)</td>
<td>5/20 (25%)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Data are n/N (%), unless otherwise indicated.
Seizure frequency and risk by cure status

<table>
<thead>
<tr>
<th></th>
<th>Seizure events per day (n)</th>
<th>Seizure rates per year</th>
<th>Seizure rate ratios (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Persistent infection</td>
<td>Resolved infection</td>
<td>Persistent infection</td>
</tr>
<tr>
<td><strong>Overall period</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All seizures</td>
<td>225</td>
<td>72</td>
<td>4.39</td>
</tr>
<tr>
<td>Partial</td>
<td>217</td>
<td>66</td>
<td>4.24</td>
</tr>
<tr>
<td>Generalised</td>
<td>9</td>
<td>6</td>
<td>0.18</td>
</tr>
</tbody>
</table>

| **Days 181–540†‡**   |                            |                        |                             |                  |                      |                   |                 |
| All seizures         | 113                        | 40                     | 3.51                        | 0.61             | 1.00                 | 0.17 (0.12–0.25)  | <0.0001          |
| Partial              | 109                        | 36                     | 3.38                        | 0.55             | 1.00                 | 0.16 (0.11–0.24)  | <0.0001          |
| Generalised          | 4                          | 4                      | 0.12                        | 0.06             | 1.00                 | 0.49 (0.12–1.95)  | 0.311            |

* 18 714 patients per days in non-cured periods and 31 273 patients per days in cured periods.

† 6960 patients per days in non-cured periods and 7200 patients per days in cured periods.

‡ 11 762 patients per days in non-cured periods and 24 073 patients per days in cured periods.
Guidelines

Diagnosis and Treatment of Neurocysticercosis: 2017 Clinical Practice Guidelines by the Infectious Diseases Society of America (IDSA) and the American Society of Tropical Medicine and Hygiene (ASTMH)

A. Clinton White, Jr., 1 Christina M. Coyle, 2 Vedantam Rajshekhar, 3 Gagandeep Singh, 4 W. Allen Hauser, 5 Aaron Mohanty, 6 Hector H. Garcia, 7, 8 and Theodore E. Nash 9

1 University of Texas Medical Branch, Galveston, Texas; 2 Albert Einstein College of Medicine, Bronx, New York; 3 Christian Medical College, Vellore, India; 4 Dayanand Medical College, Ludhiana, India; 5 Columbia University, New York, New York; 6 University of Texas Medical Branch, Galveston, Texas; 7 Instituto Nacional de Ciencias Neurologicas, Lima, Peru; 8 Universidad Peruana Cayetano Heredia, Lima, Peru; 9 National Institutes of Health, Bethesda, Maryland
We recommend albendazole (15 mg/kg/day) combined with praziquantel (50 mg/kg/day) for 10–14 days rather than albendazole monotherapy for patients with more than two viable parenchymal cysticerci (strong, moderate).
Nodding syndrome in Uganda is a tauopathy

Michael S. Pollanen¹,² · Sylvester Onzivua³ · Janice Robertson⁴ · Paul M. McKeever⁴ · Francis Olawa⁵ · David L. Kitara⁶ · Amanda Fong²

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Abstract
Nodding syndrome is an epidemic neurologic disorder of unknown cause that affects children in the subsistence-farming communities of East Africa. We report the neuropathologic findings in five fatal cases (13–18 years of age at death) of nodding syndrome from the Acholi people in northern Uganda. Neuropathologic examination revealed tau-immunoreactive neuronal neurofibrillary tangles, pre-tangles, neuropil threads, and dot-like lesions involving the cerebral cortex, subcortical nuclei and brainstem. There was preferential involvement of the frontal and temporal lobes in a patchy distribution, mostly involving the crests of gyri and the superficial cortical lamina. The mesencephalopontine tegmental nuclei, substantia nigra, and locus coeruleus revealed globose neurofibrillary tangles and threads. We conclude that nodding syndrome is a tauopathy and may represent a newly recognized neurodegenerative disease.
NEUROCYSTICERCOSIS AND OTHER HELMINTHIC DISEASES
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FREQUENT CAUSES OF
- SYMPTOMATIC EPILEPTIC SEIZURES IN THE ACUTE PHASE
- SYMPTOMATIC POSTENCEPHALITIC EPILEPSIES
Viral Meningoencephalitis

Chen et al. Neuroimmunol Neurolflammation 2017;4:124-31
DOI: 10.20517/2347-8659.2017.17

Neuroimmunology and Neuroinflammation
www.nnjournal.net

Original Article

Analysis of clinical data of viral encephalitis patients complicated with epilepsy during the acute phase

in viral encephalitis:
incidence of epileptic seizures: 33.6%
mainly generalized seizures: 66.4%

encephalitic patients with sz:
- more involvement of cortical regions in imaging
- higher level of glucose in CSF
- prognosis slightly poorer
Acute viral Meningoencephalitis

- after prodromal „signs and symptoms“, incl fever
  - headache
  - behavioural disturbance
  - disorientation
  - confusion
  - hallucinations
  - somnolence/sopor/coma

- Focal or generalized epileptic seizures
  - focal neurology
  - Meningism (frequently only mild)
Acute viral Meningoencephalitis

- after prodromal „signs and symptoms“, incl. fever
  - headache
  - behavioural disturbance
  - disorientation
  - confusion
  - hallucinations
  - somnolence/sopor/coma

- qualitative
  - impairment of consciousness

- quantitative

- Focal or generalized epileptic seizures
  - focal neurology
  - Meningism (frequently only mild)
Clinically indicative for Herpes simplex-Virus-1 Encephalitis (HSVE):

➔ Acyclovir i.v. and Neurocritical Care Unit
Herpes simplex I Meningoencephalitis

Signs and Symptoms

1. Flu like prodromal stage

2. Focal encephalitic stage:
   aphasia, mono- or hemiparesis,
   (pseudo-)psychotic symptoms
   seizures, focal, generalised
   impairment of consciousness
Most frequent Indications for **NICU admission:**

- impairment of consciousness
- epileptic seizures, **status epilepticus**
- ventilation, airways
- impairment of swallowing
Viral Meningoencephalitis

Neuro-/intensive care management:

• **Brain edema** (dexamethasone?, decompressive-craniectomy?)
• **Anticonvulsive Therapy in status epilepticus**
• Analgesics and sedative drugs
  
  **CAVE:** Neuroleptic drugs!
• optimal **temperature management**
• Therapeutic Hypotherma?
• **Multimodal Neuromonitoring**
Review

Raised intracranial pressure in acute viral encephalitis

Gyanendra Kumar\textsuperscript{a,*}, Jayantee Kalita\textsuperscript{b}, Usha Kant Misra\textsuperscript{b}

\textsuperscript{a} Department of Neurology, University of Missouri-Healthcare Columbia, Columbia, MO, USA
\textsuperscript{b} Department of Neurology, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, UP, India
Neuroglucopenia and Metabolic Distress in Two Patients with Viral Meningoencephalitis: A Microdialysis Study

Mario Kofler¹ · Alois Schiefecker¹ · Ronny Beer¹ · Florian Sohm² · Gregor Broessner¹ · Paul Rhomberg³ · Peter Lackner¹ · Bettina Pfausler¹ · Claudius Thome² · Erich Schmutzhard¹ · Raimund Helbok¹
Short Communication

Cerebral glucose hypometabolism in Tick-Borne Encephalitis, a pilot study in 10 Patients

Anelia Dietmann\textsuperscript{a,1,*}, Daniel Putzer\textsuperscript{b,c,1}, Ronny Beer\textsuperscript{a}, Raimund Helbok\textsuperscript{a}, Bettina Pfausler\textsuperscript{a}, Abdul Jalil Nordin\textsuperscript{d}, Irene Virgolini\textsuperscript{b}, Astrid E. Grams\textsuperscript{e}, Erich Schmutzhard\textsuperscript{a}

TBE: the older the more likely encephalitic course
NEUROCYSTICERCOSIS AND OTHER HELMINTIC DISEASES
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FREQUENT CAUSES OF
- SYMPTOMATIC EPILEPTIC SEIZURES IN THE ACUTE PHASE
- SYMPTOMATIC POSTENCEPHALITIC EPILEPSIES
Epidemiology of brain abscess

incidence 0.4 – 1.3 /100,000 persons/year nowadays

decreasing incidence over decades
   by improvement of the general health and medical access of the population (-> data South Africa, USA)
   in childhood by early diagnosis and treatment of otitis, sinusitis
      (Brasilia: 26% vs 11%)

higher incidence in risk groups (-> immunosuppression)

male-to-female sex ratio of 2:1 to 3:1

median age of 30-40 years (meta-analysis of ~ 10 000 cases)

Goodkin, Saez-Llorenz, Brouwer, Sonnevile
highly susceptible to bacterial infections once the blood-brain barrier has been crossed- preexisting lesion necessary (necrosis, ischemia, hypoxia)

**Early cerebritis** (day 1 – 3)
- perivascular inflammatory response
- surrounding the necrotic center, no ring on CT

**Late cerebritis** (day 4 – 9)
- central necrosis

**Early capsule formation** (day 10 – 13)
- accumulation of fibroblasts and neovascularization

**Late capsule formation** (beyond day 14)
- host defenses act to wall off the abscess well-formed capsule
Contiguous spread (per continuitatem)

responsible for 40-50% of brain abscess focus

- middle ear, mastoid cells, paranasal sinuses
- cranial trauma (→ bone fragments, wound contamination)
- post neurosurgery
- (in close relationship to the primary infection)

typically located in frontal and temporal lobe
Etiology

Hematogenous dissemination

responsible for 30-40%

endocarditis (13-23%, “multiorgan involvement”)
pulmonary infections
dental abscesses (↑Laulajainen-Hongisto A et al, Infect Dis 2016)
osteomyelitis, intraabdominal infections, skin infections etc
tend to develop in the area supplied by the middle cerebral artery
Headache is the leading symptom (82% [64-97%])
focal clinical signs can be very subtle
classic triad of fever, headache, and focal neurologic deficits in <20%

Seizures: 25%

Brouwer et al, Neurology 2014
Clinical signs and symptoms

Headache is the leading symptom (82% [64-97%])
focal clinical signs can be very subtle
classic triad of fever, headache, and focal neurologic deficits in <20%

<table>
<thead>
<tr>
<th>Symptoms and signs</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>4,526</td>
<td>69%</td>
</tr>
<tr>
<td>Nausea/vomiting</td>
<td>1,993</td>
<td>47%</td>
</tr>
<tr>
<td>Fever</td>
<td>3,718</td>
<td>53%</td>
</tr>
<tr>
<td>Altered consciousness</td>
<td>3,207</td>
<td>43%</td>
</tr>
<tr>
<td>Neurologic deficits</td>
<td>2,996</td>
<td>48%</td>
</tr>
<tr>
<td>Seizures</td>
<td>1,647</td>
<td>25%</td>
</tr>
<tr>
<td>Nuchal rigidity</td>
<td>1,465</td>
<td>32%</td>
</tr>
<tr>
<td>Papilloedema</td>
<td>845</td>
<td>35%</td>
</tr>
</tbody>
</table>

Brouwer et al, Neurology 2014
CSF examination

**NO** routine CSF examination in brain abscess!
only in very selected cases with risk – benefit weighing
risk of cerebral herniation
risk of abscess rupture leading to ventricular empyema or pyocephalus
→ worsening of outcome!

normal CSF analysis does not exclude brain abscess
Diagnostic approach

CSF examination
no routine examination in brain abscess!
only in very selected cases with risk – benefit weighing
risk of cerebral herniation
risk of abscess rupture leading to ventricular empyema or pyocephalus
  worsening of outcome!
normal CSF analysis does not exclude brain abscess

Blood examination
aerobic and anaerobic blood cultures prior to antimicrobial therapy (~30% pos)
Leucocyte count, and serum C reactive protein increased in ~60%
may be abnormal in most differential diagnosis
Treatment

- Surgery (also for diagnosis)
- Appropriate antibiotic therapy
- Eradication of the primary source
Neurosurgery

stereotactic aspiration $\geq 1\text{cm} \varnothing$ by neuro-navigation

continuous drainage of abscess has to be considered

$\geq 2,5\text{cm} \varnothing$

periventricular location with high risk of intraventricular rupture

➢ reduction of abscess size, decrease of ICP
➢ microbiological examination
appropriate empiric antibiotic therapy depends on
- activity against the suspected or proven infecting flora (-> focus?)
- capacity to penetrate the brain tissue and intracranial pus
- good long-term safety profile (Cave: encephalopathy, seizures, ataxia)
- administrable both intravenously and orally

as soon as possible

starting after stereotactic aspiration depends on time of availability, patient’s comorbidity, size and location of abscess
<table>
<thead>
<tr>
<th>Underlying condition</th>
<th>Typical Pathogens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otitis, mastoiditis, sinusitis</td>
<td>polymicrobial&lt;br&gt;mainly <em>streptococci</em>, <em>Enterobacteriaceae</em>&lt;br&gt;<em>Streptococcus pneumoniae</em>&lt;br&gt;anaerobes (<em>Prevotella</em> sp., <em>Bacteroides</em> sp.), <em>S. aureus</em></td>
</tr>
<tr>
<td>Cranial trauma</td>
<td>polymicrobial&lt;br&gt;mainly <em>S. aureus</em>, <em>Streptococcus pyogenes</em> anaerobes&lt;br&gt;(<em>Clostridium</em> sp., <em>Actinomyces</em> sp.)</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>polymicrobial&lt;br&gt;mainly <em>S. aureus</em>, <em>coagulase-negative staphylococci</em>&lt;br&gt;<em>Enterobacteriaceae</em></td>
</tr>
<tr>
<td>Infective endocarditis</td>
<td><em>Staphylococcus aureus</em>&lt;br&gt;oral <em>streptococci</em>, <em>HACEK bacteria</em></td>
</tr>
<tr>
<td>Dental infection</td>
<td>polymicrobial,&lt;br&gt;mainly <em>Streptococcus milleri</em> group&lt;br&gt;anaerobes (<em>Actinomyces</em> sp., <em>Prevotella</em> sp., <em>Bacteroides</em> sp., <em>Fusobacterium</em> sp)</td>
</tr>
<tr>
<td>Pulmonary circulation shunts (congenital heart disease)</td>
<td>Polymicrobial,&lt;br&gt;including <em>streptococci</em>&lt;br&gt;anaerobes (<em>Actinomyces</em> sp., <em>Prevotella</em> sp., <em>Bacteroides</em> sp., <em>Fusobacterium</em> sp.)</td>
</tr>
</tbody>
</table>
Clinical characteristics and outcome of brain abscess
Systematic review and meta-analysis

ABSTRACT
Objective: To define clinical characteristics, causative organisms, and outcome, and evaluate trends in epidemiology and outcome of brain abscesses over the past 60 years.

Methods: We performed a systematic review and meta-analysis of studies on brain abscesses published between 1970 and March 2013. Studies were included if they reported at least 10 patients with brain abscess, included less than 50% extra-axial CNS infections (empyema) without brain abscess, and did not solely report on brain abscesses caused by a single pathogen.

Results: We identified 123 studies including 8,669 patients reported between 1935 and 2012. There was a male predominance of 2.4 to 1, and the mean age of patients with brain abscesses was 34 years. The most common causative microorganisms were Streptococcus and Staphylococcus species, comprising 2,000 (34%) and 1,076 (18%) of 5,894 cultured bacteria. Geographical distribution of causative microorganisms over continents was similar and did not substantially change over the past 60 years. Predisposing conditions were present in 8,134 of 9,484 patients (86%) and mostly consisted of contiguous or metastatic focus of infection. The classic triad of fever, headache, and focal neurologic deficits was present in 13 of 668 (20%) of patients. Case fatality rate decreased from 40% to 10% over the past 5 decades, while the rate of patients with full recovery increased from 33% to 70%.

Conclusions: The prognosis of patients with brain abscesses has gradually improved over the past 60 years. Important changes over time were the modality of cranial imaging, neurosurgical technique, and antimicrobial regimen. Neurology 2014;82:806-813
Clinical characteristics and outcome of brain abscess
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Results: We identified 123 studies including 8,669 patients reported between 1935 and 2012. There was a male predominance of 2.4:1, and the mean age of patients with brain abscesses was 34 years. The most common causative microorganisms were Streptococcus and Staphylococcus species, comprising 2,000 (34%) and 1,076 (18%) of 5,914 cultured bacteria. Geographical distribution of causative microorganisms over continents was similar and did not substantially change over the past 60 years. Predisposing conditions were present in 8,134 of 9,484 patients (86%) and mostly consisted of contiguous or metastatic focus of infection. The classic triad of fever, headache, and focal neurologic deficits was present in 131 of 686 (20%) of patients. Case fatality rate decreased from 40% to 10% over the past 5 decades, while the rate of patients with full recovery increased from 33% to 70%.

Conclusions: The prognosis of patients with brain abscesses has gradually improved over the past 60 years. Important changes over time were the major causative bacteria, neurological deficits, and antimicrobial regimen. Neurology 2014;82:8.

Cave: MRSA
Empirical antimicrobial therapy in the immunocompetent

3rd or 4th cephalosporin*  
+ metronidazole  
+ oxacillin/ vancomycin/ linezolid/ rifampicin...

*alternatively meropenem
Empirical antimicrobial therapy in the immunocompromised

**Bone marrow and solid organ recipients**

Aspergillus spp., Candida spp., Nocardia, Toxoplasmosa gondii, atypical mycobacteria

- $3^{rd}$ cephalosporin + metronidazole
- $+\,$ trimethoprim–sulfamethoxazole or sulfadiazine (Nocardia spp)
- $+\,$ voriconazole (Aspergillus)

**AIDS patients**

Toxoplasmosa gondii, Cryptococcus neoformans, Listeria monocytogenes, Mycobacterium spp., Aspergillus, Candida spp

$+\,$ pyrimethamine plus sulfadiazine (if antitoxoplasma IgG pos.)

**Suspected M. tuberculosis**

isoniazid, rifampin, pyrazinamide, ethambutol
CONTROVERSIES

**Abscess irrigation**  -> yes/no

**Corticosteroids**
- only in patients with significant edema for max 5 days
- decreased antibiotic penetration into the abscess

**Continuing anaerobic therapy in case of negative microbiology**
- microbiological results might not identify all pathogens
- neurotoxicity of metronidazole

**Duration of therapy and when to switch from iv to po**
- at least 4-6 iv weeks duration according to therapy response
- 1-2 weeks iv and then po (Neurosurgery Working Party of the British Society for Antimicrobial Chemotherapy 2000)
Treatment

- Surgery (also for diagnosis)
- Appropriate antibiotic therapy
- Eradication of the primary source
Complications and outcome

Improved over the last decades gradually

70% good outcome (minimal neurologic sequelae)

Mortality

deaed from 40% in 1960 to 15% in the past decade

Hydrocephalus ± ventriculitis ± pyocephalus

mortality up to 85%
NEUROCYSTICERCOSIS AND OTHER HELMINTHIC DISEASES
ACUTE BACTERIAL MENINGITIS
BRAIN ABSCESS
ACUTE VIRAL ENCEPHALITIS
CHRONIC MENINGITIS INCL GRANULOMA (TB)
CEREBRAL MALARIA AND OTHER PROTOZOAL DISEASES

FREQUENT CAUSES OF
- SYMPTOMATIC EPILEPTIC SEIZURES IN THE ACUTE PHASE
- SYMPTOMATIC POSTENCEPHALITIC EPILEPSIES
Diagnosis **Cerebral Malaria:***
1) History (of exposure)
2) Impairment of consciousness, „severe prostration“, **epileptic seizures**, focal neurological signs and symptoms.
3) Positive blood smear
4) **Malaria retinopathy**
Exactly this excitotoxic cascade may be responsible for provoking overt or subtle epileptic seizures in patients with CNS infection thereby deteriorating the prognosis of these patients.

Therefore:

➔ avoid neuroleptics and barbiturates

➔ be generous with sedatives/anticonvulsants (benzodiazepines, midazolam, even ketamine)

➔ avoid hyperpyrexia

majority: cerebral malaria no benefit
CEREBRAL MALARIA

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Thank you