

Adult bacterial meningitis—a quality registry study: earlier treatment and favourable outcome if initial management by infectious diseases physicians

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Abstract

Acute bacterial meningitis (ABM) is challenging for the admitting physician because it is a rare but fulminant disease, usually presenting without typical symptoms, and rapid treatment is pivotal. The purpose of this study was to evaluate the effect of initial management by infectious diseases (ID) physicians vs. non-ID physicians. A total of 520 consecutive adults (>17 years old), 110 with initial ID management and 410 with non-ID management, registered in the Swedish quality registry for community-acquired ABM January 2008 to December 2013, were analysed retrospectively. Primary outcome was appropriate treatment with antibiotics and corticosteroids <1 hour from admission. Secondary analyses were mortality during hospital stay and persisting neurological and hearing deficits at follow-up after 2 to 6 months. Differences in diagnostic treatment sequences also were analysed. Appropriate treatment <1 hour from admission was achieved significantly more often (41%) by ID physicians vs. non-ID physicians (24%) with an odds ratio (OR) of 2.4 (95% confidence interval [CI]: 1.40 to 4.14; $p < 0.01$) adjusted for confounders. The door-to-antibiotic time was significantly shorter, and significantly more patients were administered corticosteroids together with the first doses of antibiotics in the ID group. A trend of decreased mortality (4.5% vs. 8.0%) and sequelae at follow-up (24% vs. 44%; adjusted OR 0.55: 95% CI 0.31 to 1.00; $p = 0.05$) were observed in the ID group vs. the non-ID group. Antibiotics were started without prior neuroimaging more often in the ID group (86% vs. 57%; $p < 0.001$). Initial management at the emergency department by ID physicians is associated with earlier appropriate treatment, more appropriate diagnostic treatment sequences and favourable outcome.

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Introduction

Acute bacterial meningitis (ABM) is a rare but potentially life-threatening disease, especially if of nonmeningococcal aetiology, with a mortality of 5% to 30% and a high risk of neurological deficits despite modern treatment and advanced intensive care [1–5]. Impaired mental status, older age,

comorbidity, nonmeningococcal aetiology and fulminant disease are reported risk factors for poor outcome [5–8]. Recent studies also have indicated that delayed antibiotic treatment constitutes a major risk factor for poor outcome [1–3,7–11] and a large randomized clinical trial has demonstrated significantly lower mortality if corticosteroid treatment was added [12]. Thus, early appropriate treatment with antibiotics and corticosteroids in meningitis doses are pivotal in ABM, and current recommendations state that this should be administered within 1 hour from admission [7,8,13–16]. However, median time from admission to start of treatment is reported to be 2 to 4 hours [1–3,10,11]. This doctor's delay has been associated with difficulties in recognising ABM due to absence

of typical symptoms in many cases as well as inappropriate diagnostic treatment sequences [1,3,7,8,10,17]. The sequence of computed tomography (CT) of the brain followed by lumbar puncture (LP) followed by treatment is common and has been identified as a risk factor for mortality [3,7,8].

In Sweden, infectious diseases (ID) constitute a separate speciality, requiring 5 years of postgraduate training and examinations. Adults with ABM are usually treated at ID clinics, but the initial management is often performed by physicians of other specialities. Earlier studies have indicated that ID specialists are valuable in the management of blood stream infections, endocarditis, pneumonia, and urinary tract infections [18–23]. However, the value of an ID physician in the primary management of admission of adults with ABM is unknown. The objective of the present study was to investigate differences in initial management of patients with ABM by ID physicians (ID group) vs. non-ID physicians (non-ID group). The primary outcome was administration of appropriate antibiotics and corticosteroids within 1 hour from admission. Secondary outcome was time from admission to start of antibiotic treatment. Additionally, differences in diagnostic treatment sequences were analysed. Finally, we assessed the effect of medical speciality on mortality during hospital stay and sequelae at follow-up after 2 to 6 months.

Material and methods

Patients

All adult patients (>17 years old) with community-acquired ABM, treated at all 27 Swedish ID clinics located at larger Provincial or University hospitals, are eligible for inclusion in the Swedish quality registry of bacterial meningitis (SQRM). On admission, patients with suspected ABM are triaged to an ID or a non-ID physician mainly based on local traditions. ID physicians are present at the emergency room around the clock at four of the eight University hospitals, but only from 8 AM to around 10 PM in the other hospitals. The ABM diagnoses are defined by specialists in ID, and based on clinical conventional diagnostic criteria with or without cerebrospinal fluid (CSF) analyses. Patients with meningococcal disease without meningitis were not included. The study comprised ABM patients registered in SQRM during the period January 2008 to December 2013. Episodes were defined as community-acquired if the patient had not been hospitalized within 30 days before admission. During the 6-year period, 623 adults with community-acquired ABM were registered, representing about 85% of all adult cases with ABM in Sweden according to data from the National Board of Health and Welfare in Sweden (personal communication). Data on the primary managing

physician were available in 520 (83.5%) cases. Of these, initial management at the emergency departments was performed by ID physicians in 110 (21.2%; ID group). The remaining 410 cases (non-ID group) were initially managed by internal medicine physicians (n = 213), emergency physicians (n = 150), neurologists (n = 10) or other physicians (n = 37). The proportions of patients with initial ID management were similar in university (21.8%) as in other hospitals (19.9%).

LP was performed in 479 cases, and positive culture and/or polymerase chain reaction and/or microscopy and/or antigen detection in CSF were obtained in 390 (75.0%) of the 520 patients. Positive blood cultures were detected in 333 (64.0%) patients. In 48 patients (9.2%) the cultures were negative and the aetiological diagnosis was unknown. In 40 of these 48 patients, CSF findings (leukocyte count, glucose, protein or lactate levels) supported the ABM diagnosis. In the remaining eight patients, the diagnosis was based on clinical findings alone.

Study variables

From the registry, sex, age, clinical findings, aetiology, corticosteroid and antibiotic treatment, mortality and sequelae were obtained (Table 1). Mental status was assessed by the initial managing physician as soon as possible on admission at the emergency department and recorded as the reaction level scale [24,25] and/or the Glasgow coma scale. The time point for admission was defined as the time for triage at admission, and the door-to-antibiotic time was registered as definite intervals: 0 to 0.5, 0.5 to 1, 1 to 2, 2 to 3, 3 to 4, 4 to 6, 6 to 8, 8 to 12 or >12 hours.

Corticosteroid treatment concomitant with the start of antibiotics was defined as administration of dexamethasone or betamethasone in ABM doses within 1 hour from the start of antibiotics. Appropriate antibiotic treatment was defined as intravenous β -lactam antibiotics administered in doses for meningitis, for which the isolated bacteria were sensitive. In patients with unknown aetiology, third-generation cephalosporin \pm ampicillin or meropenem was defined as appropriate.

Mortality was recorded during hospital stay, and neurological and hearing deficits were evaluated at follow-up 2 to 6 months after discharge. Neurological sequelae were specified as headache, cognitive dysfunction/dementia, vertigo or fatigue causing limitations of daily activity, epileptic seizures, ataxia or persistent neurological deficits. Hearing disability was defined as new onset of impairment, and audiometry was performed at the discretion of the physician. The diagnostic sequence of cerebral CT scan in relation to LP and start of antibiotic treatment was registered.

Statistics

Two-tailed χ^2 test was used for categorical data. Mann-Whitney test was conducted to compare continuous variables. Logistic

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