**Management of healthcare-associated infection (HAI) cases with neuromeningeal involvement in decentralized areas in Senegal**

Abstract

**Introduction:**

Healthcare-associated infections (HAIs) with neurological involvement are rare but constitute an absolute medical emergency. Early diagnosis and the initiation of appropriate antibiotic therapy are major challenges in their management. We report the results of an investigation into 4 cases of postoperative nosocomial meningoencephalitis in a rural area.

**Methodology:**

This is a descriptive observational study involving any patient residing in the study area and treated for nosocomial meningoencephalitis. The exposure factors included recent hospitalization, recent surgery, and obstetric care. The collected data (case notification forms, patient records, and IPC assessment tools) were analyzed using MS Excel® and/or Epi-Info®.

**Results :**

A total of 69 patients underwent surgical procedures. Four patients who had undergone a low transverse cesarean section developed meningoencephalitis. They were aged 25, 27, 39, and 40 years. One patient was asthmatic and had hypertension. The average incubation period was 12 days [2-20 days]. All four patients presented with meningeal syndrome and impaired consciousness. Seizures and motor deficits were observed in two patients. Cerebrospinal fluid (CSF) analysis suggested a bacterial infection, but no specific pathogen was isolated. However, environmental samples from the direct care area revealed the presence of methicillin-resistant Staphylococcus aureus (MRSA), Klebsiella pneumoniae subspecies, and non-carbapenemase-producing Pseudomonas. Despite early empiric antibiotic therapy and symptomatic treatment, 3 patients died. Therapeutic adjustment based on the antibiogram led to the recovery of one patient. All four infants are alive and in good health.

**Conclusion:**

We reported four cases of healthcare-associated infections (HAIs) in patients exposed to the same risk factors (low transverse cesarean section in the same operating room, using the same products and anesthetic practices) in a context of non-compliance with infection prevention and control (IPC) measures.

**Keywords: HAI, Meningoencephalitis, Antibiotic therapy, IPC**

**Introduction**

Meningitis outbreaks occur worldwide, particularly in sub-Saharan Africa. Meningitis can be caused by numerous pathogens, including bacteria, viruses, fungi, and parasites. Bacterial meningitis is especially concerning, with an estimated mortality rate of 1 in 10 people and 1 in 5 experiencing severe complications. These infections can be community-acquired or nosocomial. According to the World Health Organization (WHO), 5 to 10% of hospitalized patients develop nosocomial infections, with a mortality rate of approximately 4%. Healthcare-associated infections (HAIs) contribute to increased direct and indirect healthcare costs [1]. In Africa, the prevalence of HAIs is poorly studied despite their impact on patient safety. It ranges between 10% and 60%, and these infections represent the third leading cause of maternal mortality, the second leading cause of early neonatal mortality, and the primary cause of postoperative morbidity [2]. This prevalence is estimated at 10.9% in Senegal, 12% in Côte d'Ivoire, 10% in Benin, and 14% in Mali [3]. Poor hygiene conditions, lack of staff training, insufficient hygiene resources, and non-compliance with standards could contribute to the emergence of nosocomial infections.

Nosocomial neuro-meningeal infections are rare, but their morbidity and mortality rates are high. The disease can cause lasting damage, and when it occurs in brain-injured patients in intensive care or postoperatively, the neurological functional prognosis can quickly be at risk, often progressing to septic shock. Thus, healthcare-associated infections (HAIs) with neuro-meningeal involvement are absolute medical emergencies. Early diagnosis and the prompt initiation of appropriate empiric antibiotic therapy are critical for the effective management of these conditions [4].

In Senegal, the first national survey on nosocomial infections, conducted in 2007 by the Directorate General of Health under the Ministry of Health (MOH), revealed that the volume of antimicrobial prescriptions, combined with low hygiene standards observed during care delivery, is the primary cause of the emergence of antimicrobial resistance (AMR) [5]. The Ministry of Health has established infection control committees (CLIN) in all healthcare facilities in Senegal. These committees play a vital role in overseeing and implementing infection prevention and control (IPC) activities in hospitals. As part of the actions of this committee, we report the findings of an investigation into 04 cases of postoperative nosocomial meningoencephalitis.

**Methodology:** A field investigation was conducted by a multidisciplinary team at a health district level following the notification of a suspected case of nosocomial meningitis. The study population included all patients residing in and receiving care at healthcare facilities (health centers, health posts, or hospitals) within the implicated health district who had undergone surgical procedures between September 1, 2023, and January 16, 2024 (the date of the first notification).

A case of nosocomial meningitis was defined as any patient who had undergone surgery and presented with clinical signs and laboratory confirmation consistent with meningitis (cerebrospinal fluid (CSF) leukocyte count > 5 leukocytes/mm³, with or without the presence of bacteria identified by Gram staining or culture, or a positive result for soluble antigen detection or PCR in the CSF).

The database was compiled from the review of management tools, active case finding for similar or suspected cases or deaths covering the investigation period, as well as interviews and visits to care units.

We collected various variables, including socio-demographic characteristics, clinical and paraclinical data, as well as exposure factors. The data were compiled and analyzed using MS Excel® and/or Epi-Info®. Ethical considerations were respected throughout the process.

**Results:** A total of 69 patients underwent surgical procedures in the operating rooms of the implicated health district during the study period. Fourteen suspected cases were identified during the study period. Four (04) patients developed meningoencephalitis, as per the case definition (Table I), following a low transverse cesarean section (CBT). The average incubation period was 12 days [range: 2 to 20 days]. All patients presented with fever, headaches, neck stiffness, and altered consciousness. Seizures were observed in two of the patients. Two of the four patients exhibited motor deficits.

No pathogen was definitively identified in the blood or cerebrospinal fluid (CSF) samples. In the working environment of the anesthesiologists and intensivists, samples revealed the presence of Staphylococcus haemolyticus, Staphylococcus epidermidis, and Kocuria kristinae. On the operating table, a strain of Sphingomonas paucimobilis (a ubiquitous soil and water bacterium with low virulence but known to cause nosocomial infections) was isolated.

In the operating room, methicillin-resistant Staphylococcus aureus (MRSA), non-carbapenemase-producing Pseudomonas, and Klebsiella pneumoniae subspecies were isolated from the direct care environment, including pre- and postoperative bedding, dressing tables, and the pre-filled anesthesia syringe that was reused multiple times for all four patients.

In addition to symptomatic and adjuvant treatment, all four patients received empiric antibiotic therapy with a third-generation cephalosporin combined with an aminoglycoside. For the fourth patient, the antibiotic therapy was adjusted based on the antibiogram, with the introduction of vancomycin and imipenem.

The outcome was marked by the death of the first three patients. The last patient was declared cured after a prolonged hospitalization.

**Table I: Description of cases of nosocomial meningoencephalitis post CBT**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Settings** | **Values/Results** | | | |
|  | **CASE 1** | **CASE 2** | **CASE 3** | **CASE 4** |
| Date of birth/Age | 45 years old | 27 years old | 39 years old | 25 years old |
| Sex | F | F | F | F |
| Surgical, medical and obstetric history | HTA | None | None | Asthma |
| Date of intervention/Care | 12/04/2023 | 12/18/2023 | 12/21/2023 | 12/18/2023 |
| Incubation period | 20 days | 02 days | 18 days | 09 days |
| Description of symptoms | -Meningeal syndrome  -Drowsiness  -Fever : 38.5° | -Syndrome  Meninges  -Drowsiness  -Convulsion  -Fever : 38.2° | -Meningeal syndrome  -Fever: 38.5° | -Meningeal syndrome  -Intracranial hypertension  -Infectious syndrome |
| Direct examination | Negative | Negative | Not done | Negative |
| PCR | Negative | Negative | Not done | Negative |
| Culture | Negative | Negative | Not done | Negative |
| Antibiotic treatment | Ceftriaxone  Gentamicin | Ceftriaxone  Gentamicin | Death on arrival | Ceftriaxone  Gentamicin  Ampicillin  Vancomycin  Imipenem |
| Outcome | Death | Death | Death | Alive |
| Concept of obstetric care in the period | Surgical wound dressing | Surgical wound dressing | Surgical wound dressing | Surgical wound dressing |
| Recent hospitalization history | YES | YES | YES | YES |
| Notion of recent surgery and type of surgery | Cognitive behavioral therapy | Cognitive behavioral therapy | Cognitive behavioral therapy | Cognitive behavioral therapy |

**Discussion**:

After spinal anesthesia, the incidence of infectious complications is extremely low in the literature, ranging from one to seven per 100,000 procedures [6]. Among these complications, meningitis and epidural abscesses are the most frequently reported. This incidence may have been overestimated due to cases of aseptic meningitis [6]. The occurrence of healthcare-associated infections (HAIs) with neuro-meningeal involvement following spinal anesthesia is a rare event, with an estimated incidence of less than 4.5 cases per 100,000 procedures [7]. We report a series of 4 cases of nosocomial meningoencephalitis following cesarean sections.

In our patients, the average incubation period was 12 days [range: 2–20]. Shorter incubation periods have been reported in studies by Nabil Frikha in Tunisia (4 to 6 hours) [5], Muzein in Morocco (6 hours) [10], and Mouchrif in Tunisia (26 hours) [7].

The clinical symptoms of meningitis following spinal anesthesia are quite consistent. The combination of headaches, hyperthermia, frank meningeal signs, and possibly altered consciousness after spinal anesthesia should immediately raise suspicion of meningitis and prompt a diagnostic lumbar puncture [8]. All our patients presented with the same symptoms described in the literature, including meningeal syndrome (100%) and fever (100%). Two patients experienced drowsiness, seizures (50%), and one patient had intracranial hypertension (25%). Similar symptoms were described by the Valdoleiros team, who reported fever (90%), seizures (15.7%), and focal deficits (7.1%) (hemiparesis). Meningoencephalitis can complicate into sepsis and lead to neurological sequelae, which may be permanent.

We noted 03 deaths out of 04 in our study. No sequelae were observed in the last patient. The Tunisian study by Frikha [9] reported no sequelae in their study. However, in a prospective study conducted in the Netherlands on acute bacterial meningitis between October 1998 and April 2002, among the sequelae, hemiparesis was found in 4%, quadriparesis in 1%, and aphasia in 2% of cases [10].

CSF analysis indicated meningitis with elevated protein levels, glucose levels, and significant neutrophilic pleocytosis. Direct examination was negative. Similar findings were reported by Frikha in Tunisia [9]. All our blood and CSF cultures were negative. The Valdoleiros team, however, reported 12.9% positive cultures [11]. Molecular biology testing by PCR on the CSF was negative. The detection of bacterial 16S ribosomal RNA in the CSF has a relatively good negative predictive value. However, in Zarrouk's study of 5 postoperative bacterial meningitis cases confirmed by culture, PCR was negative in 3 cases, partly due to a low inoculum [12].

An epidemiological investigation involving multidisciplinary stakeholders was conducted on 69 surgeries performed, with 14 suspected cases. The investigation included interviews, evaluation of care practices, and a field study with environmental sampling in the patient care environment. Environmental investigation revealed the presence of Klebsiella pneumoniae subspecies and non-carbapenemase-producing Pseudomonas, for which one of our patients was treated.

An Egyptian series reported 8 cases of Pseudomonas aeruginosa meningitis following spinal anesthesia. The most frequently identified pathogens are usually Gram-positive cocci, primarily staphylococci or alpha-hemolytic streptococci, most often of the salivarius type [13].

Hamza reports that one of the potential entry points exploited by pathogens is the non-compliance with infection prevention and control measures, such as inadequate hand hygiene, ineffective sterilization, insufficient disinfection, and inadequate aseptic techniques [14]. Other possible causes include hematogenous spread in septicemic patients or those with asymptomatic bacteremia due to microscopic bleeding during spinal anesthesia administration or contamination in the medication or equipment used [15].

**Conclusion:** We reported four cases of healthcare-associated infections (HAIs) in patients exposed to the same risk factors (low transverse cesarean section in the same operating room, using the same products and anesthetic practices) in a context of non-compliance with infection prevention and control (IPC) measures.

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