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Outbreak of Bacterial Meningitis Among Patients Undergoing Myelography at an Outpatient Radiology Clinic

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Abstract

Purpose: To investigate an outbreak of bacterial meningitis at an outpatient radiology clinic (clinic A) and to determine the source and implement measures to prevent additional infections.

Methods: A case was defined as bacterial meningitis in a patient undergoing myelography at clinic A from October 11 to 25, 2010. Patients who underwent myelography and other procedures at clinic A during that period were interviewed, medical records were reviewed, and infection prevention practices were assessed. Case-patient cerebrospinal fluid (CSF) specimens, oral specimens from health care personnel (HCP), and opened iohexol vials were tested for bacteria. Bacterial isolates were compared using pulsed-field gel electrophoresis. A culture-negative CSF specimen was tested using a real-time polymerase chain reaction assay.

Results: Three cases were identified among 35 clinic A patients who underwent procedures from October 11 to 25, 2010. All case-patients required hospitalization, 2 in an intensive care unit. Case-patients had myelography performed by the same radiology physician assistant and technician on October 25; all patients who underwent myelography on October 25 were affected. HCP did not wear facemasks and reused single-dose iohexol vials for multiple patients. *Streptococcus salivarius* (a bacteria commonly found in oral flora) was detected in the CSF of 2 case-patients (1 by culture, 1 using real-time polymerase chain reaction) and in HCP oral

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specimens; 1 opened iohexol vial contained *Staphylococcus epidermidis*. Pulsed-field gel electrophoresis profiles from the case-patient *S salivarius* and the radiology physician assistant were indistinguishable.

Conclusions: Bacterial meningitis likely occurred because HCP performing myelography did not wear facemasks; lapses in injection practices may have contributed to transmission. Targeted education regarding mask use and safe injection practices is needed among radiology HCP.

Keywords

Myelography; bacterial meningitis; infection prevention; outbreak

INTRODUCTION

Bacterial meningitis represents an uncommon but serious adverse event after myelography [1-16]. Numerous reports have attributed these infections to lapses including nonadherence to facemask (eg, may be labeled as surgical, medical procedure, or isolation mask) use among health care personnel (HCP) performing myelograms [1,3,9-13,15]. On October 27, 2010, an orthopedic surgeon notified the Missouri Department of Health and Senior Services (DHSS) regarding 3 patients hospitalized with suspected meningitis after undergoing myelography at an outpatient radiology clinic (clinic A) on October 25. One patient had viridians streptococci detected in the cerebrospinal fluid (CSF). In this report, we summarize findings from an investigation conducted to determine the cause and extent of the outbreak and implement measures to prevent additional infections.

METHODS

Case Definition

Among clinic A patients undergoing a myelogram from October 11 to 25, 2010, a confirmed case of bacterial meningitis was defined as a patient with CSF culture positive for bacteria or CSF studies suggestive of bacterial meningitis; a probable case of bacterial meningitis was defined as a patient with elevated peripheral white blood cell count and acute onset of fever, headache, and confusion.

Case Finding

Case finding was conducted using 3 strategies. First, we contacted by telephone all patients who underwent myelograms and other procedures at clinic A from October 11 to 25, 2010, to determine if they had developed symptoms within 7 days after the procedure that required medical evaluation. Second, we contacted by telephone infection preventionists at 9 tertiary care hospitals in the surrounding metropolitan area to identify patients hospitalized with bacterial meningitis after myelography and patients who had CSF cultures positive for viridians streptococci during October 2010. Third, we notified public health officials by e-mail and requested information regarding patients with bacterial meningitis after myelography in the surrounding region.

Case-finding activities were limited to procedures performed at clinic A before October 26 because of 2 actions taken by the clinic to prevent further infections from occurring: (1)

upon learning about the 3 patients with suspected meningitis, a physician at clinic A prescribed antimicrobial medications to other patients who underwent procedures on October 25 or 26 to prevent any additional infections, and (2) clinic A immediately implemented preliminary recommendations provided by the Missouri DHSS after an initial site investigation was performed.

Case Characteristics

To determine common characteristics and exposures among cases, medical records of case-patients were reviewed to collect data regarding demographics, medical history, and clinical and laboratory findings.

Clinic A Inspection and Infection Prevention Assessment

Clinic A staff members were interviewed to determine procedures performed, radiographic contrast solution and equipment used for procedures, and facility infection prevention policies. Direct observations of 4 procedures were conducted at clinic A to assess infection prevention practices.

Laboratory Investigation

The Missouri DHSS instructed clinic A to retain all available opened vials of contrast used for procedures on October 25 and 26. Three opened vials of iohexol (2 of 3 vials used on October 25 and 1 vial used on October 26) were collected and sent to the Centers for Disease Control and Prevention (CDC) to undergo sterility testing as described per the US Pharmacopeia [17].

Two CSF isolates from one case-patient (preliminarily reported as viridians streptococci) were sent to the CDC for species identification. A CSF specimen from a culture-negative case-patient was also sent to the CDC for further testing. Oral specimens (ie, saliva and dorsal tongue swab) from clinic A HCP who were epidemiologically linked to case-patients were collected between November 8 and 15, 2010, and sent to the CDC for isolation of common oral streptococcal species as previously described [18]. To determine genetic relatedness, isolates recovered from HCP oral specimens and from the culture-positive case-patient were compared using pulsed-field gel electrophoresis (PFGE) on the basis of methods previously published [19]. Deoxyribonucleic acid (DNA) from the CSF specimen from the culture-negative case-patient was extracted and subjected to a previously described real-time polymerase chain reaction assay used to identify *Streptococcus salivarius* found in oral specimens [20].

RESULTS

Case Finding

Three bacterial meningitis cases (2 confirmed, 1 probable) were identified among 9 patients who underwent myelograms at clinic A from October 11 to 25, 2010. No other postprocedural infections were identified among 21 (81%) of 26 patients interviewed who underwent other procedures (12 of 17 arthrographic studies, 6 other imaging procedures, and

3 joint injections) during the same period. Three patients could not be reached by telephone, and 2 declined to participate in an interview.

All case-patients underwent myelograms performed ≥1.5 hours apart on October 25 by a single radiology physician assistant (RPA), who was assisted by the same technician. Three additional patients underwent other procedures on October 25. Seven (78%) of 9 myelograms were performed by the same RPA during October 11 and 25; the same technician provided assistance during all 9 myelograms.

Case Characteristics

Case-patients were males aged 44 to 67 years who underwent myelograms because of neck or back pain. All case-patients presented within 14 to 27 hours of the procedure to a hospital with symptoms suggestive of meningitis. Diagnostic CSF was obtained from only 2 case-patients. One case-patient's CSF was positive for viridians streptococci, and the other case-patient's CSF was culture negative, but he had received antibiotic therapy 2 hours before CSF collection. All 3 case-patients required intravenous antibiotics, and 2 required treatment in the intensive care unit (Table).

Clinic A Description

Clinic A is a radiology clinic that performs CT and MRI scans, myelograms, arthrograms, therapeutic joint injections, and selective nerve root blocks. Clinic A had contracted with an independent radiology group for the services of 5 radiologists and 3 RPAs who each performed procedures independently at clinic A and at other outpatient radiology clinics and one hospital. Since opening in 2007, clinic A used either iohexol or gadodiamide contrast solution for procedures. Both vials of contrast solution were labeled and approved by the FDA as singledose vials. Myelograms were always performed using arthrography kits, which contained all necessary equipment except for a facemask and spinal needle. Any additional equipment needed for procedures was stored in the same room in which procedures were performed.

Infection Prevention Assessment

Clinic A had no written infection prevention policies and procedures focused on patient safety. Examples of these would include the application of Standard Precautions to injection procedures, such as the appropriate handling and preparation of injectable medications to prevent contamination, the education and training of HCP on recommended injection practices and assessing their adherence to these measures, and monitoring for and reporting infections associated with the clinic. Three technicians, 3 RPAs, and 2 radiologists were interviewed and stated that they were unaware of CDC infection prevention guidelines regarding the use of facemasks and safe injection practices during myelograms [21]. None of the HCP wore facemasks during myelograms, and singledose vials of contrast were occasionally used for multiple patients. RPAs and radiologists followed these same practices at other facilities, except that they wore facemasks when performing procedures at an acute care hospital to comply with the hospital's infection prevention policies. Immediately after the Missouri DHSS provided interim infection prevention recommendations on October 29,

clinic A instituted an unwritten policy requiring facemask use by HCP during procedures and dedicating vials of injectable medication or contrast to single-patient use.

The RPA and technician involved with case-patient myelograms reported that all procedures performed on October 25 were uneventful. These procedures did not require multiple needle insertions, no one in the room seemed sick, and the durations were similar to other procedures the RPA had performed.

Four procedures were observed (2 myelograms and 2 arthrograms) from November 8 to 10, 2010; of these procedures, 1 arthogram was performed by the RPA who was involved with case-patient myelograms. The RPAs and radiologists all wore facemasks, used a sterile drape, and allowed skin antiseptic to dry for ≥1 minute before performing procedures. During myelograms, the radiologist or RPA used approximately 15 mL of iohexol from a 50-mL single-dose vial. All vials of medication or contrast solution were discarded after each procedure. No breaches in infection prevention practices were observed.

Laboratory Investigation

The content of one of the 2 opened vials of iohexol used on October 25 was positive for *Staphylococcus epidermidis*. Bacteria could not be detected in the contents of an opened vial used on October 26.

S salivarius, a bacterial species commonly found in the oral flora, was isolated from the CSF of case-patient 2 and from the oral specimens of the RPA and technician involved with all case-patient myelograms. The *S salivarius* isolates from case-patient 2 and the RPA shared identical PFGE profiles, which markedly differed from the PFGE profile of the technician.

The previously described real-time polymerase chain reaction assay [20] result from the DNA extract prepared from the culture-negative CSF specimen of case-patient 1 was consistent with the presence of *S salivarius* DNA.

DISCUSSION

Several findings from this investigation suggest that droplet transmission of oral flora from a single RPA, due to lack of facemask use, was the primary source of this bacterial meningitis outbreak. All 3 patients who developed bacterial meningitis had myelograms performed on the same day by a single RPA who did not wear a facemask. In addition, 2 of these patients had diagnostic CSF obtained to evaluate for meningitis; *S salivarius*, an organism commonly found in the oral flora, was detected in the CSF of both patients. Furthermore, the *S salivarius* detected in the CSF of these 2 patients was genetically identical to the *S salivarius* detected in the oral flora of the RPA who performed all case-patient myelograms.

Although droplet transmission of oropharyngeal flora was the most likely mechanism for bacterial meningitis, the intermediate pathway by which *S salivarius* entered the CSF of case-patients remains unknown. Possible routes include contamination of case-patients' skin at the site of entry and introduction of bacteria into the CSF during the procedure, contamination of instruments, and extrinsic contamination of vials of medication or radiographic contrast solution (ie, contamination during preparation or administration), as

suggested by the identification of *S epidermidis* in an opened iohexol vial. Reusing a contaminated vial on subsequent patients could then lead to additional cases of meningitis. Although we did not detect *S salivarius* in the iohexol vials, not all vials used for case-patients were available for testing. Previous investigations of post-myelography bacterial meningitis had not identified multiple cases on the same day or vial contamination [1-16] but only noted lack of facemask use [1,3,9,13,15]. In our investigation, the detection of 3 cases on 1 day suggests that additional factors, such as reusing potentially contaminated vials between patients, could have contributed to transmission.

Other suboptimal practices at clinic A included the use of arthrogram kits to perform myelograms. Because these kits did not contain facemasks and spinal needles, the additional steps required to obtain the necessary equipment may have increased the opportunity for potential contamination. Although not all myelogram kits contain facemasks, they include the spinal needle necessary for the procedure. Additionally, the use of single-dose iohexol vials that contained enough solution for multiple procedures may have encouraged HCP to reuse these vials rather than discard them after a single procedure. After the investigation, clinic A consulted an independent infection preventionist to develop written infection prevention policies and procedures and reported monitoring for compliance to these measures.

Inadequate facemask use and the reuse of single-dose vials for multiple patients may be important problems in outpatient radiology clinics. Typically, these facilities are not required to have infection prevention policies or monitor post-procedure infections, and surveys are not conducted in these facilities by regulatory agencies to determine compliance with recommended practices. The absence of infection prevention resources in outpatient settings has been noted in previous outbreaks of infections related to injection procedures [22-28]. Therefore, more stringent regulatory requirements for outpatient settings could lead to increased adherence to infection prevention recommendations.

Since 2007, CDC has recommended that HCP wear facemasks when placing catheters or injecting material into the epidural or subdural spaces (eg, for myelography) [21]. Additionally, HCP performing these spinal procedures should adhere to safe injection practices (eg, dedicating single-dose vials to single-patient use) as part of Standard Precautions [21,29]. After the publication of these recommendations, this is the second reported outbreak of bacterial meningitis resulting from inadequate facemask use during spinal procedures [30]. Awareness of recommended practices regarding facemask use and injection safety was low among HCP at clinic A, and their practices varied on the basis of the setting in which procedures were performed. In response to this outbreak, CDC released a clinical reminder targeting relevant provider groups about the importance of facemask use and safe injection practices when performing spinal procedures [31]. Additional educational efforts may include partnering with key professional societies to reinforce HCP knowledge and best practices through continuing medical education. The ACR has published a position statement recommending that each imaging facility have policies in place to prevent the spread of infection among patients and HCP [32], which is referenced in the ACR and American Society of Neuroradiology practice guideline for the performance of myelography and cisternography [33]. To educate a broader audience of radiology HCP in various health

care settings, updated recommendations about facemask use and safe injection practices should be considered for inclusion in ACR and relevant professional society guidelines. Increased awareness of these recommendations may improve infection prevention in radiology practices across all settings leading to improved patient safety.

This outbreak investigation has some limitations. The small number of cases detected precluded us from conducting an analytic study to identify risk factors for post-myelography bacterial meningitis. However, we epidemiologically linked all case-patients to one RPA and demonstrated that the *S salivarius* isolates recovered from the single culture-positive case-patient and the RPA shared an identical PFGE profile. In addition, the culture-negative CSF from a second case-patient tested positive for the presence of *S salivarius* DNA by the previously described assay [20]. All breaches at clinic A may not have been identified because direct observations were conducted after infection prevention measures were implemented. Nevertheless, it is likely that we identified the most important breaches through the Missouri DHSS's preliminary infection prevention assessment. Finally, all opened vials used for case-patient myelography on October 25 were not tested for sterility; thus, we could not fully evaluate the potential contribution of vial contamination to occurrence of cases.

CONCLUSIONS

Post-myelography bacterial meningitis may be prevented if radiology HCP adhere to recommended facemask use and injection practices. All health care settings, including outpatient radiology facilities, should develop infection prevention policies and procedures and provide ongoing education to HCP to ensure that recommended practices are understood and followed [34].

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Table.

Clinical characteristics, laboratory findings, and hospital courses of case-patients who underwent myelograms at Clinic A, October 25, 2010

	Presenting Symptoms	Time From Myelogram to Presentation (hr)	Temperature on Presentation	Peripheral White Blood Cell Count (cells/mm^3), % Neutrophils, % Bands	CSF Studies: White Cells (cells/μL), % Neutrophils	CSF Studies: Protein (mg/dL)	CSF Studies: Glucose (mg/dL)	CSF Culture	Antibiotics received (Duration in days)	Number of Days in the Hospital‡
Case 1	Headache, nausea, poor concentration	20	37.3°C (99.2°F)	26,800, 91.8%, 0%	3,890, 89%	664	28	No growth†	Vancomycin/ceftriaxone (14 d)	6
Case 2	Headache, photophobia, nausea, vomiting	14	36.3°C (97.3°F)	5,780, 47.5%, 0%	145, 87%	129	61	Viridians streptococci	Vancomycin/ceftriaxone (4 d); penicillin G (10 d)	11
Case 3	Headache, fever, confusion	27	37.6°C (99.6°F)	17,100, 77.0%, 17%	Lumbar puncture was not performed*		10		Vancomycin/ceftriaxone (10 d)	10

Note: CSF = cerebrospinal fluid.

*Lumbar puncture was not performed because admission CT scan was read as possible cerebral edema.

†Case-patient received initial antibiotics ≥2 hours before lumbar puncture.

‡Cases 1 and 2 were admitted to an intensive care unit during a part of their hospitalization.