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Reduction of drain-associated cerebrospinal fluid infections in neurosurgical inpatients: a prospective study

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SUMMARY

Background: External cerebrospinal fluid (CSF) diversion via a drain is associated with a variable risk of associated infections which cause significant morbidity.
Aim: To establish whether simple interventions can reduce the incidence of such infections at a single centre.
Methods: A retrospective review of all patients undergoing an external CSF diversion procedure was carried out to determine the historical rate of infection. Following an institutional protocol which included standards on drain insertion, care, sampling and antibiotic prescribing a prospective study was carried out to observe whether infection rates had changed and which factors continued to predict drain-related infections.
Findings: Retrospective analysis identified 234 procedures in 159 patients over a two-year period. There were 54 drain-related infections, a rate of 21.5 per 1000 drainage days. Duration of CSF drainage [odds ratio (OR) = 1.15, $P < 0.05$] and the number of CSF samples taken per drain (OR = 5.98, $P < 0.05$) were independently associated with infection. In the prospectively gathered phase, 132 procedures were recorded in 107 patients over a one-year period. There were 18 infections, a rate of 13.7 per 1000 drainage days. The only independent prognostic factor was duration of CSF drainage (OR = 1.20, $P < 0.05$). Coagulase-negative staphylococci were the most commonly isolated type of organism in both series.
Conclusion: Ensuring drains are removed promptly as soon as CSF diversion is no longer required may reduce the rate of nosocomial infections in this population despite multiple confounding factors. Institutional guidelines may promote best practice in this regard.

Introduction

Cerebrospinal fluid (CSF) diversion is a widespread procedure in neurosurgical practice either by external ventricular drain (EVD), lumbar drain or externalized ventricular–peritoneal shunts (EVS) (Figure 1 and Appendix 1). Such procedures by definition provide a communication of the

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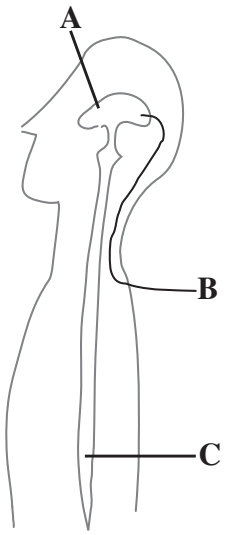

Figure 1. Routes of cerebrospinal fluid drainage. (A) External ventricular drain passed directly into lateral ventricle. (B) Externalized shunt: normally running from lateral ventricle to peritoneum but which may have distal end removed from abdomen and tunnelled out from the chest wall in the event of distal block. (C) Lumbar drain, inserted into the subarachnoid space in the spine below the level of the cord as for a lumbar puncture.

CSF space with the environment and are therefore associated with significant and unavoidable risks of iatrogenic infection. The rates of such drain-associated infections among neurosurgical patients on general wards, high-dependency units and intensive care units (ICUs) are reported to be between 0 and 45%.[1—15] Studies vary in their definitions of infection, inclusion criteria and populations studied, making comparison of preventive measures difficult. The authors sought to establish the historical frequency of this event at a single institution in the UK by retrospectively reviewing cases over a two-year period. Next, current practice was assessed following the introduction of a number of practical and institutional measures aimed specifically at reducing drain-associated infections. Data were prospectively gathered on all patients undergoing CSF diversion procedures over a one-year period in order to determine current rates of infection and which factors, if any, continued to be risks for drain-associated CSF infection in neurosurgical patients.

Methods

Drain insertion technique

All external ventricular drains were inserted in the operating room under strict aseptic conditions with aqueous betadine skin preparation unless allergic. Prophylactic antibiotics were given at induction as per an agreed protocol: cefuroxime 1.5 g i.v. as default, teicoplanin 400 mg i.v. if the patient was penicillin allergic, and vancomycin 1 g i.v. if patient had known meticillin-resistant *Staphylococcus aureus* colonization on admission nasal or additional groin swabs. Prolonged (meaning anything beyond the antibiotic dose given at induction) prophylactic antimicrobials are not given during external CSF diversion at our institution. Drains were inserted through an adult-sized perforator burrhole at Kocher's point and tunnelled out under the skin before securing with silk sutures and connecting to an external collecting system (Codman & Shurtleff, Inc., Raynham, MA, USA). Bactiseal™ (impregnated with 0.15% clindamycin and 0.054% rifampicin; Codman, Massachusetts, USA), Silverline™ (silver ion-coated; Spiegelberg, Hamburg, Germany) and plain latex catheters are available and at that time were used according to surgeon preference (silver ion-coated catheters are now first choice). Externalized shunts were tunnelled out in theatre with the same antibiotic prophylaxis as EVD insertion and connected to the same external drain collecting system. Lumbar drains were routinely inserted on the ward or ICU under aseptic conditions without antibiotic prophylaxis. Chlorhexidine skin prep (2% chlorhexidine gluconate/70% isopropyl alcohol) was applied and a standard introducing kit (Codman & Shurtleff, Inc.) used for insertion before connecting to the same external collecting system.

Drain care on the ward and ICU

Following the retrospective phase of the study, practice changed with a 'care bundle' of measures aimed at reducing drain-associated infections. A protocol was established by a working party and internally publicized for best practice regarding CSF drains. A sample of CSF was to be sent at insertion of the drain for cell count, Gram stain and culture. Further samples were only to be taken where there was a clinical indication of infection in line with Centers for Disease Control and Prevention (CDC) criteria (fever, stiff neck, meningeal irritation, headache, cranial nerve signs).[16] Drains were not to be routinely sampled for surveillance. In the event of CSF infection, antibiotic choice was discussed with the microbiology department and the drain sampled every four days until clear of infection. Any drain which was to be converted or replaced by a permanent shunt was sampled 48 h prior to that procedure to ensure that CSF was clear even if the drain had not been infected. Throughout the period following these changes individual clinicians maintained autonomy to breach protocols in managing patients if deemed clinically appropriate, for example sampling CSF when there was clinical suspicion alone of infection or waiting longer than 48 h from a clear CSF sample to implant a permanent shunt if the patient was not well enough for theatre. The guidance was thought to be most relevant to the ward and junior staff including trainees who were mostly responsible for managing these devices. Only specific trained staff members (senior ICU nurses, junior doctors who had been observed or trained and specialist neurosurgery trainees) were allowed to take CSF samples and a protocol with numbered steps for aseptic sampling via the specially designed port on the drainage system were printed and made available on the hospital intranet (see Appendix 1). Finally antimicrobial prescribing was supplemented by a once weekly microbiology round with a specialist consultant in microbiology, pharmacist, neurosurgeon and infection control nurse specialist to review all charts of patients on antimicrobials and update the treating team with culture results and sensitivities.