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Infection rate of emergency bolt-kit vs. non-emergency conventional implanted silver bearing external ventricular drainage catheters

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ABSTRACT

Background: Bolt-kit systems are increasingly used as an alternative to conventional external cerebrospinal fluid (CSF) drainage systems. Since 2009 we regularly utilize bolt-kit external ventricular drainage (EVD) systems with silver-bearing catheters inserted manually with a hand drill and skull screws for emergency ventriculostomy. For non-emergency situations, we use conventional ventriculostomy with subcutaneous tunneled silver-bearing catheters, performed in the operating room with a pneumatic drill. This retrospective analysis compared the two techniques in terms of infection rates.

Methods: 152 patients (aged 17–85 years, mean = 55.4 years) were included in the final analysis; 95 received bolt-kit silver-bearing catheters and 57 received conventionally implanted silver-bearing catheters. The primary endpoint combined infection parameters: occurrence of positive CSF culture, colonization of catheter tips, or elevated CSF white blood cell counts (>4/μl). Secondary outcome parameters were presence of microorganisms in CSF or on catheter tips. Incidence of increased CSF cell counts and number of patients with catheter malposition were also compared.

Results: The primary outcome, defined as analysis of combined infection parameters (occurrence of either positive CSF culture, colonization of the catheter tips or raised CSF white blood cell counts >4/μl)was not significantly different between the groups (58.9% bolt-kit group vs. 63.2% conventionally implanted group, $p = 0.61$, chi-square-test). The bolt-kit group was non-inferior and not superior to the conventional group (relative risk reduction of 6.7%; 90% confidence interval: −19.9% to 25.6%). Secondary outcomes showed no statistically significant difference in the incidence of microorganisms in CSF (2.1% bolt-kit vs. 5.3% conventionally implanted; $p = 0.30$; chi-square-test).

Conclusions: This analysis indicates that silver-bearing EVD catheters implanted with a bolt-kit system outside the operating room do not significantly elevate the risk of CSF infection as compared to conventional implant methods.

1. Introduction

External ventricular drainage (EVD) catheters are frequently used in emergency situations for treatment of patients with raised intracranial pressure (ICP). Catheter-related infection (CRI) is a common complication and major threat in these patients. Several attempts have been made to prevent colonization along the catheter track, e.g., use of EVD catheters impregnated with an insoluble silver salt to reduce CRI [1–5].

The standard procedure consists of burr hole trephination with implantation of a subcutaneous tunneled EVD [6,7]. Alternatively, bolt-kit EVD catheters can be placed at bedside; a burr hole is made with a hand drill and the EVD is fixed with a skull screw. In comparison to conventional methods, the bolt-kit EDV has the advantage that insertion is faster and can be performed outside the operation room and is therefore often preferable for critically ill patients. Theoretically, this method bears the risk of a higher CRI rate compared to the conventional technique because implantation is not performed in the aseptic environment of the operating room and tunneling is not performed. Tunneling is thought to reduce the risk of colonization along the catheter. Given the good clinical results of conventional silver-bearing EVD catheters, we wanted to make a quantitative comparison of infection rates in

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patients with silver-bearing bolt-kit catheters in comparison to conventional silver-bearing EVD catheters. This report describes a retrospective analysis to compare the two implantation techniques with regard to infection rates.

2. Materials and methods

This retrospective analysis was performed at the Department of Neurosurgery, Inselspital, Bern University Hospital and University of Bern, Switzerland. The institutional review board approved this retrospective chart study. All patients 16 years or older who were admitted to the Department of Neurosurgery and required placement of an EVD were analyzed. We reviewed the patients' charts, microbiology reports and hospital databases of all patients who received an EVD between January 2009 and December 2011.

Exclusion criteria included the use of conventional silicone catheters and antibiotic-impregnated catheters. We excluded these patients because bolt-kit catheters are only available as silver-bearing catheters. Further exclusion criteria were a known or suspected cerebrospinal fluid (CSF) infection at implantation site, requirement for the placement of more than one EVD catheter, and an EVD placement for less than 24 h.

2.1. Patient groups

Patients were analyzed after they were determined to have met all inclusion and exclusion criteria. Two patient groups were compared. The conventional group had subcutaneous implanted silver-bearing EVD catheters (Silverline-catheter®; Spiegelberg GmbH & Co. KG; Hamburg, Germany). In the other group a bolt-kit silver-bearing EVD catheter system (Silverline-Bolt-Kit-catheter®; Spiegelberg GmbH & Co. KG; Hamburg, Germany) was used. Both catheter types are identically equipped with an intraparenchymal/intraventricular ICP measurement system with an air-pouch mounted on the tip of the drainage catheter (Fig. 1). This air-pouch is connected via a separate lumen to the ICP monitor. There is no communication between the ICP measurement system and the brain parenchyma or the ventricular system. Conventional ICP measurement is also possible via the drainage catheter.

Both groups were analyzed for significant differences with respect to all clinical characteristics, including age and sex. Surgery protocols were reviewed for the reason and the site of catheter implantation. Intensive care and neuro-intermediate care unit protocols were reviewed for administration of antibiotics, glucocorticoids, duration of EVD catheter placement and the reason for catheter removal.

2.2. Insertion of conventionally implanted EVD catheters

Conventional silver-bearing catheter insertion and tunneling was done in the operating room using standard protocols. Skin preparation before surgery was done with povidine-iodine (Betadine®, Mundipharma, Basel, Switzerland). Usually, a linear skin incision and burr-hole trephination was done 1 cm in front of the coronary suture in the midpupillary line using an 8 mm burr hole. In all patients, the subcutaneous tunneled length was 7 cm. Irrigation with gentamicin (160 mg in 1000 ml of irrigation solution) was used in all patients.

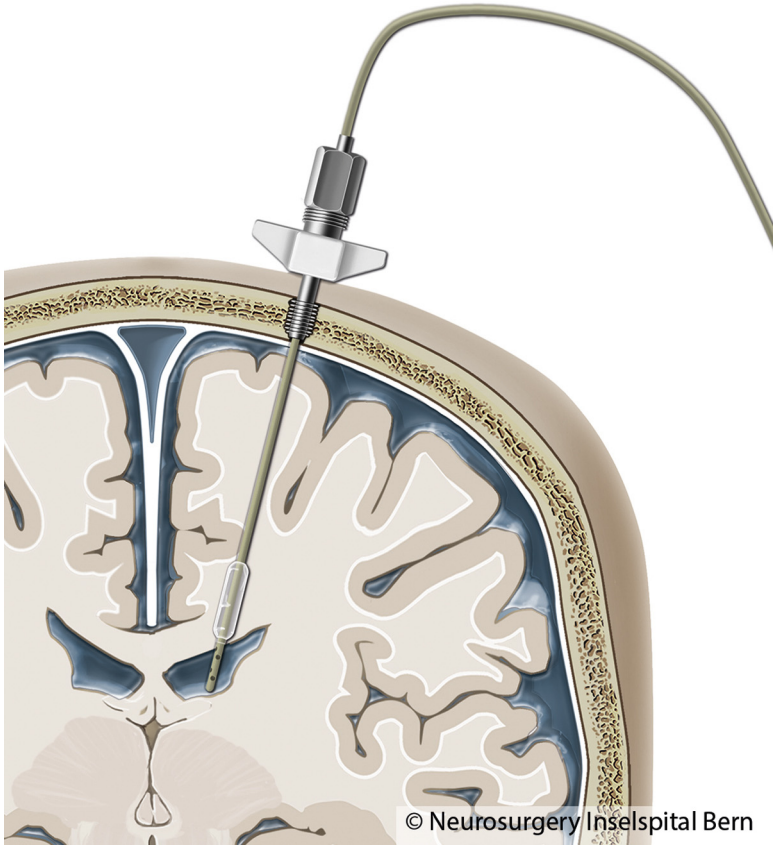

Fig. 1. Schematic drawing of the bolt-kit EVD catheter fixated at the Kocher's point perpendicular to the bone on the right side. The air pouch near the catheter tip is used for intraventricular/intraparenchymal ICP measurement. The air supply goes along the EVD catheter in a separate lumen. There is no communication between the ICP measurement system and the brain parenchyma or the ventricular system.