External ventricular drainage complications



- Research Progress of External Ventricular Drainage Catheterization Techniques
- BASILAR ARTERY STENOSIS: TECHNICAL TIPS TO PREVENT AND TREAT HEMORRHAGE DURING ANGIOPLASTY
- Active Cerebrospinal Fluid Exchange vs External Ventricular Drainage in the Neurocritical Care Unit: An International, Retrospective Cohort Study
- Risk factors for the development of hydrocephalus in traumatic brain injury: a systematic review and meta-analysis
- Triple sheath neuroendoscopic combination technique for managing complete intraventricular hemorrhage casting in patients with cerebral hemorrhage
- Surgical Nuances in Ultrasound-Guided Percutaneous Distal Catheter Placement in Pediatric Ventriculoatrial Shunts
- Development and validation of a nomogram for predicting intracranial infection after intracranial aneurysm surgery
- Hydrocephalus in surgically treated glioblastoma patients To treat or not to treat?

Acutely increased intracranial pressure (ICP) is frequently managed by external ventricular drainage (EVD). This procedure is life-saving but marred by a high incidence of complications. It has recently been indicated that bolt-connected external ventricular drainage (BC-EVD) compared to the standard technique of tunnelled EVD (T-EVD) may result in less complications ¹⁾.

Intracranial hemorrhage

see Intracranial hemorrhage after ventriculostomy.

Infection

see Healthcare-associated ventriculitis.

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Misplacement

see Ventricular catheter misplacement.

Obstruction

Ventricular catheter obstruction.

The purpose of this study was to investigate whether a surgeon's experience affects the associated complication rate. Methods This retrospective study included all adult patients undergoing EVD insertion at a single centre between July 2013 and June 2015. Medical records were retrieved to obtain details on patient demographics, surgical indication, risk factors for infection and use of anticoagulants or antiplatelets. Surgeon experience, operative time, intraoperative antibiotic prophylaxis, need for revision surgery and EVD associated infection were examined. Information on catheter tip position and radiological evidence of intracranial haemorrhage was obtained from postoperative imaging. Results A total of 89 patients were included in the study. The overall infection, haemorrhage and revision rates were 4.8%, 7.8% and 13.0% respectively, with no significant difference among surgeons of different experience. The mean operating time for patients who developed an infection was 22 minutes while for those without an infection, it was 33 minutes (p=0.474). Anticoagulation/antiplatelet use did not appear to increase the rate of haemorrhage. The infection rate did not correlate with known risk factors (eg diabetes and steroids), operation start time (daytime vs out of hours) or duration of surgery although intraoperative (single dose) antibiotic prophylaxis seemed to reduce the infection rate. There was also a correlation between longer duration of catheterisation and increased risk of infection. Conclusions This is the first study demonstrating there is no significant difference in complication rates between surgeons of different experience. EVD insertion is a core neurosurgical skill and junior trainees should be trained to perform it ²⁾.

Patients were prospectively enrolled in the CLEAR III trial after placement of an EVD for obstructive intraventricular hemorrhage and randomized to receive recombinant tissue-type plasminogen activator or placebo. We counted any detected new hemorrhage (catheter tract hemorrhage or any other distant hemorrhage) on computed tomography scan within 30 days from the randomization. Meta-analysis of published series of EVD placement was compiled with STATA software.

Growing or unstable hemorrhage was reported as a cause of exclusion from the trial in 74 of 5707 cases (1.3%) screened for CLEAR III. The first 250 patients enrolled have completed adjudication of adverse events. Forty-two subjects (16.8%) experienced \geq 1 new bleeds or expansions, and 6 of 250 subjects (2.4%) suffered symptomatic hemorrhages. Eleven cases (4.4%) had culture-proven bacterial meningitis or ventriculitis.

Risks of bleeding and infection in the ongoing CLEAR III trial are comparable to those previously reported in EVD case series. In the present study, rates of new bleeds and bacterial meningitis/ventriculitis are very low despite multiple daily injections, blood in the ventricles, the use

of thrombolysis in half the cases, and generalization to >60 trial sites ³⁾.

Bolt-connected external ventricular drainage complications

A study aimed at identifying risk factors for the main complications following bolt-connected external ventricular drain (EVD) insertion.

This was a single-centre cohort study. All patients who underwent bolt-connected EVD placement between March 2015 and February 2024 were included. The complications analysed were infection, haemorrhage, misplacement, obstruction, and accidental pull-out. The need for EVD replacement was also recorded. Univariable and Cox regression multivariate analyses were performed.

A total of 119 procedures were analysed. The duration of ventriculostomy (OR 1.14; 95% CI 1.02-1.27) and the occurrence of cerebrospinal fluid leak (OR 409.86; 95% CI 1.36-12,353.36) or system obstruction (OR 31.44; 95% CI 2.04-484.85) were confirmed to be independent risk factors for infection. No risk factors were identified for misplacement or obstruction. Thicker catheters (OR 25.56; 95% CI 2.28-286.33) and antiplatelet or anticoagulant use (OR 7.29; 95% CI 1.75-30.41) were found to be independent risk factors for EVD-related haemorrhage. Men showed a 72% increased risk of accidental EVD pull-out. Finally, involuntary pull-out (OR 79.36; 95% CI 8.32-756.99), misplacement (OR 39.38; 95% CI 3.21-482.64), and obstruction (OR 31.55; 95% CI 2.70-368.40) were found to be independent risk factors for a new drain replacement.

They have confirmed the duration of ventriculostomy, cerebrospinal fluid leak, and catheter obstruction to be independent risk factors for infection. Thicker catheters and antiplatelet or anticoagulant drug use were identified as independent risk factors for EVD-related haemorrhage. Male gender increased the risk for involuntary catheter pull-out. Finally, accidental removal, obstruction, and misplacement were confirmed as independent risk factors for re-inserting a new EVD. Neither surgeon's experience nor bedside placement in the intensive care unit increased the risk.

The study has identified the risk factors for the most common complications associated with a specific type of ventricular catheter (bolt-connected EVDs), which allows the targeting of preventive measures. This is the first study to have analysed this specific group of drains, which are increasingly being used in clinical practice ⁴.

Here is a critical review of the study **"Risk factors for complications in bolt-connected external ventricular drains"** by Gutiérrez-González et al. (2025):

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Study Overview

This single-centre cohort study investigates **risk factors for complications associated with boltconnected external ventricular drains (EVDs)**, a device increasingly used in neurosurgical practice. The authors retrospectively analysed 119 procedures performed over a nine-year period (2015–2024), evaluating complications such as **infection**, **haemorrhage**, **misplacement**, **obstruction**, and **accidental pull-out**, alongside the need for **EVD replacement**.

Strengths

1. Specific Device Focus

This is reportedly the **first study** to focus specifically on **boltconnected** EVDs, differentiating it from prior literature on tunneled or standard EVDs. As these devices gain popularity due to their minimally invasive and secure fixation properties, this focus fills a meaningful knowledge gap.

2. Statistical Rigor

The use of **both univariable and multivariate Cox regression** strengthens the reliability of associations and adjusts for potential confounders.

3. Clinically Relevant Outcomes

By identifying **modifiable risk factors** such as catheter thickness and duration of ventriculostomy, the study contributes actionable insights that may guide procedural planning and postoperative care.

4. Comprehensive Complication Spectrum

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The inclusion of multiple complications—**infection, haemorrhage,
misplacement, obstruction, pull-out**—and their downstream consequence
(i.e., **need for re-insertion**) provides a holistic view of EVD-related
risks.
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Limitations

1. Small Sample Size

Despite the long study period, the cohort of **119 patients** is relatively small for multivariate modelling, particularly given the **wide confidence intervals** (e.g., OR 409.86 with CI 1.36–12,353.36 for CSF leak as a risk for infection), suggesting **statistical instability** and potential overfitting.

2. Single-centre Retrospective Design

This limits **external validity**. Institutional protocols, catheter brands, and placement techniques may not be generalizable across centres. The retrospective nature also invites **information bias**, especially in detecting subtle events like minor catheter misplacement.

3. Lack of Granular Data on Infection Prevention Measures

It's unclear how consistently antisepsis protocols, antibiotic prophylaxis, or sterile field maintenance were applied and recorded-key confounders in infection risk analysis.

4. Gender as a Risk Factor

The finding that **male sex increased accidental pull-out risk by 72%** lacks a plausible mechanistic explanation. Without behavioural or anatomical hypotheses, this might represent a **spurious association** or unmeasured confounding.

5. No Evaluation of Long-term Outcomes

The study does not assess whether complications impacted **neurological outcomes, length of stay**, or **mortality**, limiting clinical interpretability.

Implications for Practice

* **Avoid prolonged ventriculostomy** when possible. * **CSF leaks and catheter obstruction** should be managed aggressively given their strong association with infection. * **Thinner catheters** might reduce haemorrhage risk, but this must be balanced with efficacy. * Consider patient-specific risk factors (e.g., anticoagulation) during planning. * Proactively **secure catheters**, particularly in male patients, to reduce pull-out. * **Surgeon experience** and **bedside placement** were not associated with worse outcomes—supporting ICU-based EVD insertion by trained staff.

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Conclusion

This study is a **valuable initial contribution** to understanding the complications associated with **bolt-connected EVDs**, providing insight into **modifiable risk factors**. However, due to **statistical limitations**, **retrospective design**, and **limited generalizability**, its findings should be viewed as **hypothesis-generating** rather than definitive. Further **prospective multicentre studies** are needed to validate these associations and shape practice guidelines.

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