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Point of View

External Ventricular Drain Dressings, a Gap in the Literature and Clinical Practice

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INTRODUCTION

External ventricular drains (EVDs) are invasive catheters placed in the ventricle of the brain to drain cerebrospinal fluid (CSF) and monitor intracranial pressure. Although these drains are the gold standard of intracranial pressure monitoring, the care of these drains is highly variable. The average placement time for an EVD is 10.7 days but can range anywhere from 1-28 days (Roitberg et al., 2001). While the use of EVDs is low, patients with EVDs are at high-risk for developing an EVD-related infection. Infection rates with EVD range as high as 27% and as low as 0% (Rahamen et al., 2012; Seig et al., 2018; Walek et al., 2021). The methods used to achieve a near 0% infection rate vary (Capatano et al., 2019; Darrow et al., 2018; Flint et al., 2016; Hill et al., 2012; Rahmen et al., 2012; Seig et al., 2018; Walek et al., 2021). The average reported EVD infection rate decreased to 6% with the addition of antibiotic-impregnated catheters (Capatano et al., 2019). There is a paucity of research surrounding EVDs and a lack of formal recommendations for the day-to-day care of these drains globally (Fried et al., 2016; Hepburn-Smith et al., 2016).

The bedside nurse is commonly assigned to change and maintain the EVD dressing. The purpose of the EVD dressing is to keep the insertion site clean and infection-free. In a 2016 review of the literature, Hepburn-Smith and colleagues found evidence for multiple evidence-based practice strategies to manage an EVD dressing and prevent associated infections. The lack of EVD dressing-centered research results in evidence that is often complicated by confounding variables. EVD dressings are often mentioned as a part of a larger care bundle, making it hard to differentiate what intervention aided in a decrease in infection.

EVD dressing change practices vary between hospital facilities. For example, there are variations in cleaning solutions, type of dressing used, dressing change interval, and what healthcare staff member is designated to change the dressing (Hepburn-Smith et al., 2016).

POINT OF VIEW

Personally, we have noticed a variation in EVD dressing change practice from working in three different neuroscience intensive care units. It sparked our curiosity to know why one facility uses an EVD dressing protocol over another. What were the formal recommendations? How does research inform the clinical practice of patients with EVDs? Upon further review, we have identified a gap in the literature. Research is limited as the dressing is rarely at the center of EVD-related research, and when mentioned the EVD dressing is often a part of an EVD infection control bundle with key details of the dressing protocol missing. This makes it hard to determine the impact the dressing has on the rates of ventriculitis.

It has been our experience working in three different academic medical centers neuroscience intensive care units that there has been a common thread of nursing attitudes towards EVDs, their dressing, and the perceived risk of infection. There is often language used in the nursing units that an EVD-related infection is somewhat unavoidable (Hill et al., 2012). Through our literature review, PubMed and CINAL databases were searched from 2001 through 2022. A total of twenty-five articles were reviewed in relation to the inclusion of these keywords in title or abstract: EVDs, EVD dressings, EVD-related infections, ventriculitis, EVD care, EVD maintenance, and nursing care of EVDs. Of those, 18 articles were to be found relevant to the topic. Articles were excluded if they were not in English and not peer-reviewed. Through this review, it is evident that an EVD infection is avoidable. One facility has reported an infection rate of 0.3% over a seven-year period (Flint et al., 2016), which is extremely low.

CONFLICTING FINDINGS

The key factors that need to be included in EVD dressing protocols, guidelines, or policies are frequency of dressing changes, the cleansing agent used at the insertion site, if an adhesive is used, if hair trimming was utilized, which staff member designated to change the dressing, and the specification of sterile technique (Hepburn-Smith et al., 2016). Our extensive literature search was narrowed down to seven articles that reported an infection rate of less than 2% and mentioned the use of an EVD dressing (Table 1).

The main purpose of most of these studies was to examine the EVD care bundle to decrease the rates of ventriculitis. EVD care bundles examine and create guidelines on practices surrounding insertion, CSF sampling, EVD

dressing, catheter type, and antibiotic use. This means there were often substantial changes to other elements of care outside of the EVD dressing. In addition, many of these articles are missing key elements of the dressing change protocol.

- **Cleaning solution.** Chlorhexidine is usually used to prep and sterilize the skin prior to a procedure. The use of chlorhexidine has been questioned (Checketts, 2012) and supported for EVD care (Scheithauer et al., 2014; Scheithauer et al., 2016). Out of the seven articles examined, four of them mentioned the use of chlorhexidine cleaning solution or biopatch (a protective disc impregnated with the chlorhexidine cleaning solution) (Darrow et al., 2018; Flint et al., 2016; Seig et al., 2018; Walek et al., 2021). Other cleaning solutions mentioned were betadine and povidone-iodine (Capatano et al., 2019; Hill et al., 2012). One article did not mention the cleaning solution used (Rahmen et al., 2012). Two of the articles did not utilize a traditional dressing and instead had the EVD open to air with routine cleaning (timing frequency) of the insertion site using chlorhexidine every eight hours and povidone twice daily (Capatano et al., 2019; Walek et al., 2021).
- **Interval of change.** Strong variations of how often the dressings are changed or tended to were noted in the literature with no specific evidence on how often an EVD dressing should be changed. In Table 1, two of the studies mention changing the dressing on an as needed basis (Hill et al., 2012; Flint et al., 2017). Another study changes their dressing every 72 hours (Rahmen et al., 2012). The two studies that do not utilize an EVD dressing have specified cleaning routines of twice a day and every eight hours (Capatano et al., 2019; Walek et al., 2021). The remaining two studies made no mention of how often the EVD dressing is changed (Darrow et al., 2018; Seig et al., 2018).
- **Staff member designated to change.** The staff member designated to change and maintain the EVD dressing varies in the literature. Out of the seven studies analyzed, only three of the studies touch on this. In one study, there was a multidisciplinary task force assembled to identify the gaps of care that could be contributing to their rates of EVD-related infections (Hill et al, 2012). The type of staff member assigned to change the dressing was identified as a barrier to maintaining a clean, occlusive dressing. Initially, the dressings were only changed by the neurosurgical physicians and advanced practice providers, which led to dressing change delays. The task force then decided that the bedside–nurse would be assigned to change the dressings. Of the remaining six articles only three mention the type of staff member in relation

to the EVD dressing (Capatano et al., 2019; Hill et al., 2012; Rahmen et al., 2012).

- **Hair Trimming.** Hair trimming is often not mentioned within the literature and when it is, it is only noted as part of the insertion practice. EVDs are drains placed within the ventricle of the brain for an average duration of about 10 days, but the range has been reported to up to a month (Roitberg et al., 2001). Due to this extended period, the EVD dressing must be changed due to its inability to remain occlusive. Hair growth is a contributing factor to this. Of the seven articles listed in the data table only two of them mention hair trimming as a part of maintaining a clean dressing (Hill et al. 2012, Rahmen et al., 2012). The two articles that capture EVD insertion site care without an EVD dressing there is no mention of hair trimming after placement (Capatano et al., 2019; Walek et al., 2021).
- **Other Factors**. The remaining two factors of an EVD dressing, if an adhesive was used or if sterile technique was specifically stated, were not mentioned in the literature. The written protocols that hospitals used for EVD dressing changes were rarely included within the article. This lack of detailed protocol included within articles is related to the EVD dressing not being sole focus of many research studies. It could very well be a part of the dressing change policy, but since the EVD dressing is very rarely focused on in research, specific details are often lost to the reader.
- **No Dressing Used.** The two most recently published articles in Table 1 have implemented a new style of EVD management, no dressing at insertion site with scheduled cleanings (Capatano et al., 2019; Walek et al., 2021). Upon investigating why this new management style arose, it was ambiguous. The authors stated that there simply was not enough research to support the effectiveness of using an EVD dressing (Capatano et al., 2019). Both articles yielded near 0% infection rates, but the methods to achieve this varied. Cleansing agents differed between the two articles, one using povidone while the other chlorhexidine. The cleansing intervals also differed, once every 12 hours, the other every 8 hours. Walek et al. 2021 reported the results of a 12-year observational study, noting many EVD dressing change practices including the no-dressing protocol. This new management style shows promise and appears safe, but the gap in the literature of not using a dressing is as wide as the literature surrounding using a dressing.

Table 1:

EVD Studies with Near Zero Infection Rates

Research Article Title	Purpose	EVD Dressing Type Used	Missing EVD Dressing Elements	Compounding Variables	Interventions/ changes surrounding EVD dressings	Number of patients in study/ Reported Infection Rate
A Multidisciplinary Approach to End External Ventricular Drain Infections in the Neurocritical Care Unit Hill et al., 2012	A multi-disciplinary team was assembled to identify care gaps and implement changes to determine if overall EVD-related infection rates decreased.	Change as needed Betadine cleansing agent Benzoin to adhere dressing Hair trimming as needed Dressing changed by RN Sterile technique used	None	Revision of the CSF sampling and EVD flushing policy Uniformity is established during EVD insertion, with a focus on gaps in sterility	Responsibility for changing the EVD dressing was changed from the neurosurgical team to the RN Sterile benzoin implemented in place of non-sterile benzoin	Number of patients included in the study: unknown – data reported in EVD days 16/1000 EVD days in April 2008-June 2008 July 2008-June 2009 drop to 4.5/1000 EVD days 2009 drop to 1.3/1000 days 25 months without a reported EVD-related infection (September 2011 – October 2012)

Reducing Ventriculostomy –Related Infections to Near-Zero: The Eliminating Ventriculostomy Infection Study Rahman et al., 2012	A task force responded to increased infection rates and developed an updated care protocol surround-ing EVDs.	EVD dressing changed q72 hours Benzoin to adhere dressing Hair trimming Dressing changed by the neurosurgi-cal team	Cleansing agent used with dressing changes, (DuraPrep used before insertion) Sterile technique not implicitly noted for dressing changes	A delay in prophylactic antibiotics was identified/ addressed. Sterility issues addressed with EVD insertion. Switched to antibiotic EVD catheters/ equipment kits. Changes to CSF sampling protocol	Changed from razors to electric hair trimmers Addressed an issue of equipment: prior EVD used being too small	Number of patients: 2,911 patients Study time period: 4 years A reported decrease in infections from 9.2% to 1.2% in 2006-2007 Dropping to < 1% in 2008-2010 and then 0% in 2011
A Simple Infection Control Protocol Durably Reduces External Ventricular Drain Infections to Near-Zero Levels Flint et al., 2016	A long-term observation following infection control policy change related to EVDs.	EVD dressing changed as needed Chlorhexidin e cleansing agent and Biopatch used Benzoin and SteriStrips to	Hair trimming Staff designated to change the dressing	Infection control protocol included: CSF sampling, EVD insertion elements (tunneling antibiotic catheter), strict EVD manipulation protocols for flushing	Broad hair trimming prior to insertion	Number of patients included in the study: 308 EVD placements (unknown # patients) Study period: 7 years Over 7 years the CSF culture positivity decreased to 0.3% from 9.8%

		adhere dressing Sterile technique				
Creation of an External Ventricular Drain Registry from a Quality Improvement Project Darrow et al., 2018	Analyzed the effective-ness of bundled protocols on the reduction of EVD-related infections.	Chlorhexi-dine Biopatch "Barrier Island" dressing used	EVD dressing interval of change Cleansing agents at the insertion site Hair trimming Staff designated to change dressing Sterile technique not implicitly noted for dressing changes	Changes to: EVD insertion: tunneling EVD catheter, pre-procedural antibiotics standardization CSF sent out every 5 days	Broad hair trimming prior to insertion	Number of patients included in study: unknown – data in EVD days Study period: 5 years retrospective review and 18 months post intervention 2 infections per 1924 EVD days prior to protocol implementation 0 infections per 700 EVD days after protocol implementation
Impact of an External Ventricular Drain Placement	Analyzed the effect of an EVD handling	Chlorhexi-dine Biopatch	EVD dressing change interval	Changes made to the insertion protocol	Skin shaved prior to insertion	Number of patients included in the study: Pre-protocol: 81 EVDs;

and Handling Protocol on Infection Rates: A Meta-Analysis and Single Institution Experience Seig et al., 2018	protocol related to infection rates. A meta-analysis was conducted to formulate protocol implementation.		Cleansing agent used for changes Hair trimming Staff designated to change Sterile technique not implicitly noted for dressing changes	Implementation of a CSF sampling protocol No use of prophylactic antibiotics		Post-protocol: 184 EVDs Post protocol Study period: 15 months post protocol Before protocol implementation infection rate was 12% over eight months, it decreased to 0% over 15 months
Standardized Ventriculostomy Protocol without an Occlusive Dressing: Results of an Observational Study in Patients with Aneurysmal Subarachnoid Hemorrhage Capatano et al., 2019	Reviewed the effective-ness of implementing a standardized placement and manage-ment of EVDs without an occlusive dressing.	No dressing Scalp cleansed with povidone twice daily by nursing staff	Hair trimming	Routine CSF sampling	Dressing protocol prior to interventions not mentioned The previous rate of infection at this facility was not listed	Number of patients included in the study: 91 Study period: 2 years 0 positive CSF cultures per 347 CSF studies drawn (approximately 4 studies obtained per patient; 3 CSF + cultures were considered false positives)

Decreasing External Ventricular Drain Infection Rates in the Neurocritical Care Unit: 12-Year Longitudinal Experience at a Single Institution; World Neurosurgery Walek et al. 2021	Analyzed changes in infection control protocols related to EVD care over twelve years at a single facility.	No dressing Site care q8 hrs with alcoholic chlorhexi-dine Previous policies listed: chlorhexi-dine bio-patch and dressing	Staff designated to change dressing/site care, Hair trimming Prior policy: frequency of dressing change, insertion site cleansing agent, hair trimming, staff designated to change dressing	Interventions were grouped into quarters of time over twelve years, group 1-3+ interventions in the same time frame, making it difficult to determine which was significant	Initial EVD policy not mentioned (before CHG introduction)	Number of patients included in study: unknown Study period: 12 years The interventions that resulted in the most significant drops in infection rates were: stopping routine CSF sampling from CSF reservoir, EVD catheter tunneling, and cutaneous antiseptic use of alcoholic chlorhexidine Final infection results of 12-year observation: 1.98 infections/ 1000 EVD days

CONCLUSION

Considering the importance of ventriculostomy dressing protocols in preventing ventriculostomy-associated infection, there is a paucity of related literature except as part of a larger care bundle. It is hard to determine the scale of impact that the EVD dressing has on infection rates due to limited focused research specifically with EVD dressings. This commentary aims to draw attention to the lack of EVD dressing focus within the clinical and research community. There is no standardization of the EVD dressing throughout healthcare, making patients with EVDs a higher risk for long-term complications or potential infections. We urge fellow clinicians to conduct their own EVD dressing research studies. We also call for creating national data registries that track EVD dressing outcomes so that we can learn from each other the best way EVDs should be dressed. As EVD catheters are invasive and in place for an extended time, optimizing daily care is imperative for this susceptible patient population.

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