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A Narrative Review of the Published Literature, Hospital Practices, and Policies Related to External Ventricular Drains in the United States: the External Ventricular Drain Publications, Practices and Policies (EVDPop) Study

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Abstract

External ventricular drain (EVD) placement and management pose risks to neurocritically ill patients. Yet, little is known about EVD management or hospital EVD management practices and policies in U.S. hospitals. A narrative review was conducted to describe EVD-related publications reported in PubMed and Embase between 1953 and 2019, and a survey was used to examine U.S. hospital EVD practices and policies, including adherence to EVD guideline recommendations. Overall, 912 relevant articles were published between 1953 and 2019 (average 21, range 0–102 articles, per year), primarily related to indications for EVD placement ($n = 275$, 30.2%), EVD-associated complications ($n=206$, 22.6%), and EVD care ($n=200$, 21.9%). The number of EVD publications increased over time ($R^2 = 0.7$), and most publications addressed EVD-associated infection ($n=296$, 73.4%) and EVD insertion ($n=195$, 45.2%). Survey responses were received from 30 hospitals (37.5% response rate), and reported use of antimicrobial-impregnated catheters in 80% of hospitals, pre-insertion antibiotic administration in 70%, collection of cerebrospinal fluid samples for suspicion of ventriculitis in 73.3%, tracking of EVD-associated infection in 86.7%, routine EVD clamping during transport in 66.7%, and monitoring of intracranial pressure during transport in 33.3%. Adherence to hospital policies was high for recommendations related to flushing an EVD and changing cerebrospinal fluid drainage systems (100% [range 0%–100%] each), but low for intra-hospital transportation (16.7% [0%–83.3%]), EVD removal (0% [0%–66.7%]), patient and family education (0% [0%–100%]), and administration of intraventricular

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medication (0% [0%–100%]). In summary, the published literature related to EVD insertion and maintenance, and reported EVD hospital practices and policies, primarily focus on reducing EVD-associated infections. Still, overall adherence of hospital EVD policies to guideline recommendations is modest. To promote a culture of EVD safety, clinicians should focus on reducing all EVD-associated adverse events.

Keywords

external ventricular drain; ventriculostomy; insertion; maintenance; policy; protocols; United States

INTRODUCTION

An external ventricular drain (EVD) or ventriculostomy is an invasive device that is inserted into the ventricular system of the brain to divert cerebrospinal fluid (CSF) in patients with acute symptomatic hydrocephalus.^{1,2} Additionally, placement of an EVD is considered a gold-standard technique for the measurement of intracranial pressure (ICP).³ A nationwide inpatient sample database study conducted between 1997 and 2001 reported that 20,586 to 25,634 patients receive an EVD annually in the United States (U.S.),⁴ and that EVD placement and management poses risks to critically ill neurological patients. According to data from the nationwide inpatient sample from 2000 through 2011, the mean annual rate of ventricular infection in patients with aneurysmal subarachnoid hemorrhage was 7.3 per 100 patients.⁵ The incidence of any hemorrhage after EVD placement was up to 41%, and of symptomatic hemorrhage up to 14%.⁶ Yet, little is known about EVD management, hospital EVD management practices, and EVD policies in U.S. hospitals.

Published guidelines on EVD management vary in their focus. Guidelines and recommendations from the Neurocritical Care Society focus on reduction of EVD-associated infection and hemorrhage,² whereas the American Association of Neuroscience Nurses clinical practice guidelines focus on standards of nursing care for patients with indwelling EVDs.⁷ In contrast, guidelines from the Society for Neuroscience in Anesthesiology and Critical Care (SNACC) provide recommendations on EVD management throughout the perioperative period, and also address the management of EVDs during intra-hospital transport.⁸ However, whether hospital EVD policies adhere to these national and international guideline recommendations is not known.

In order to promote a culture of EVD safety, attempts have been made to reduce the rates of EVD-associated complications such as infection,^{9–13} malposition, and intraparenchymal and intraventricular hemorrhage. Surveys of EVD practices within neurocritical care units in Thailand,¹⁴ and of EVD practices amongst neurosurgeons in the US,¹⁵ found differences in EVD insertion and management practices. These include differences in those personnel inserting EVDs, the frequency of antibiotic use and CSF sampling, and in ICP monitoring during intra-hospital transportation.¹⁴ Given the large number of patients who receive EVDs, and the potential complications with EVD management, we hypothesized that EVD practices and policies may be influenced by EVD publications and guidelines. Therefore, the aim of this study was to understand hospital practices and policies by examining

EVD publications, and practices and policies, including adherence to EVD guideline recommendations, across hospitals in the U.S.

METHODS

The University of Washington institutional review board reviewed and approved the study (STUDY00007955).

Literature review

A literature search was conducted using PubMed and Embase search engines. The keywords used were: ventriculostomy, ventricular drain, external ventricular drain, intraventricular catheter, and external ventricular drain. The literature search was conducted on November 30, 2019 and included articles published between January 1, 1953, and November 30, 2019. Title, abstract, and full-text screening was performed by authors TT and AL. Articles were included if they were addressed the following: i) indications for EVD insertion, ii) EVD-associated complications, and iii) EVD care topics, including - target audience and goal, preparation of a patient for EVD insertion, EVD insertion technique, EVD maintenance, EVD dressing change, flushing of EVD, changing CSF drainage system or drainage bag, CSF sampling, administration of intraventricular medication, EVD management during intra-hospital transport, EVD removal, EVD management in special situations, patient and family education, and EVD-specific documentation of ICP as well as CSF output and color. We grouped EVD-associated complications into four categories: infection, hemorrhage, malposition, and other. We excluded studies performed in animals, and articles without full-text or in a non-English-language. Book chapters and conference/meeting abstracts were also excluded. Upon preliminary review, it was evident that some articles pertain to more than one EVD care topic. In this case, articles were categorized under their respective EVD care topics. For example, an article describing EVD indication and EVD-associated infections would be grouped as “insertion” and “infection.”

Survey of hospital EVD practices

A multi-center survey-based study – the External Ventricular Drain Publications, Practices and Policies (EVDPP) study - was conducted between July and September, 2019. Study sites were identified from a list of neuroanesthesia and neurocritical care fellowship program directors advertised on the SNACC¹⁶ and United Council for Neurologic Subspecialties websites.¹⁷ After contacting program directors by email, we identified a single point of contact to provide hospital-specific data. We collected only one response per hospital.

A 33-question survey was designed to examine common hospital EVD insertion and maintenance/management practices. The survey was implemented using the Research Electronic Data Capture (REDCap) system hosted by the University of Washington’s Institute of Translational Health Sciences REDCap electronic data capture tools.¹⁸ Survey responders were de-identified for 18 Health Insurance Portability and Accountability Act identifiers. The survey underwent an internal peer review process for content and reliability by experts. Questions included in the survey pertain to facility characteristics, EVD insertion, maintenance and transportation practices, EVD quality improvement metrics, and

written EVD protocols. These were tested in a prior study amongst hospitals in Thailand¹⁴ and are presented in the supplementary material (Supplementary Digital Content 1: EVD PoP study survey questions). Survey participants were also provided with an option to share their hospital's written EVD protocol. A link to the survey was emailed to the neurocritical care and neuroanesthesia clinician, followed by three reminders over five weeks. Data presented are de-identified at the hospital level.

Adherence to EVD guidelines and recommendations

To examine the adherence to the recommendations from the Neurocritical Care Society,² American Association of Neuroscience Nurses⁷ and SNACC,⁸ we compiled a list of 73 recommendations on 13 EVD care topics (Supplementary Digital Content 2: External ventricular drain guideline recommendations). Authors KY & PC performed a blinded review of hospital policies with a blend of published guidelines; any conflict was resolved (with AL acting as arbiter as required) and every hospital was assigned a final score. Each recommendation included was allocated 1 point; the total possible minimum score was zero and the maximum was 73. Additionally, we examined adherence of reported practices to institutional policy standards.

Statistical Analysis

Literature review—The final articles included in the analysis were described by: 1) type of study design, i.e.: case reports, case series, retrospective cohort studies, prospective observational, randomized control trials, and systematic review/meta-analysis), 2) number and proportion of articles by EVD care topics presented as counts (percentage); the percentage was calculated by the number of papers pertaining to each domain divided by the total number included in that category, and 3) the average (minimum and maximum) number of publications per year. The overall increase in the number of articles between 1953 and 2019, and the increase in articles in specific care topic areas (EVD care and EVD-associated complications), was analyzed by linear regression using the coefficient of determination (R^2 value).

EVD practices and the adherence to EVD guidelines and recommendations—Descriptive analysis was performed to explore EVD practices. Data are presented as counts (percentage). In order to examine the adherence of hospital policies to consensus statements/guidelines, we first calculated the total composite score for each hospital. Then we calculated the overall EVD recommendation adherence by dividing the total score by 73. The study sample adherence are expressed as median% (minimum% and maximum%). Thereafter we calculated overall adherence scores in each of the 13 EVD care topics, which are also expressed as median% (minimum% and maximum%).

RESULTS

Literature review

Overall, we identified 2,445 EVD-related publications published between January 1, 1953, and November 30, 2019, of which 912 (37.1%) articles met our inclusion criteria (Figure 1). There was a moderate increase in published EVD-related research ($R^2 = 0.7$) at an average of

21 (range 0–102) articles per year. Between 1999 and 2019, an average of 40 (range 7–102) articles were published each year ($R^2=0.86$), while between 1977 and 1998, an average of 3 (range 0–8) articles were published each year ($R^2=0.67$) (Figure 2).

The most prevalent clinical study design was a retrospective cohort study ($n=330$, 36.2%), followed by single patient case reports ($n=243$, 26.6%), prospective observational studies ($n=207$, 22.7%), narrative review articles ($n=52$, 5.7%), randomized controlled trials ($n=33$, 3.6%), systematic review/meta-analyses ($n=23$, 2.5%), case series ($n=19$, 2.1%), and clinical guidelines ($n=3$, 0.5%).

Of the 912 articles included in the review, 275 (30.2%) related to the indications for EVD placement, 206 (22.6%) to EVD-associated complications, and 200 (21.9%) to EVD care alone. Overall, 231 (25.3%) articles included some combination of topics, such as indications, EVD care and complications.

Publications related to EVD care—Overall, 431 (47.3%) articles related to EVD care, and there was a moderate increase in publication of such articles over time ($R^2 =0.62$). Amongst these, the most common care topic reported was EVD insertion ($n=195$, 45.2%), followed by EVD maintenance ($n =102$, 23.7%) and administration of medication via an EVD ($n =91$, 21.1%). Other EVD care topics included pertinent information related to target audience and goal of policy ($n= 33$, 7.7%), EVD removal ($n=47$, 10.9%), CSF sampling ($n=34$, 7.9%), preparation for EVD insertion ($n=22$, 5.1%), dressing change ($n=13$, 3%), and management of special situations ($n=5$, 1.2%). Articles relating to flushing an EVD ($n=8$, 1.9%), changing the CSF collecting system ($n=4$, 0.9%), intra-hospital transportation ($n=6$, 1.4%), ICP and CSF (output, color) data documentation ($n=3$, 0.7%), and patient and family education ($n=0$, 0%) were rarely or never reported. Sixty-eight (15.8%) articles related to EVD care pertained to more than one EVD care topic.

Publications related to EVD-associated complications—Overall, 403 (44.2%) articles reported EVD-associated complications. There was a moderate growth in articles related to EVD-associated complications over time ($R^2 =0.76$). Twenty-seven (6.7%) articles pertained to more than one EVD complication. The most commonly reported complications were EVD-associated infection ($n=296$, 73.4%), hemorrhage ($n=65$, 16.1%) and malposition ($n=40$, 9.9%) (Figure 3). EVD-obstruction or under-drainage ($n=12$, 3%), disconnection ($n=5$, 1.2%), over-drainage ($n=6$, 1.5%), accidental intraventricular injection ($n=7$, 1.7%), pseudoaneurysm or traumatic aneurysm ($n=5$, 1.2%), neural tract injury ($n=3$, 0.7%), intracranial calcification ($n=1$, 0.2%), tension pneumocephalus ($n=1$, 0.2%), and increased ICP during transport ($n=1$, 0.2%) were less frequently reported complications.

Survey of EVD practices

Eighty neurocritical care clinicians (1 clinician representative per hospital) received the survey, and 30 responded (37.5% response rate). Of the hospitals included in the survey, most (43.3%) were in the Northeastern U.S. All reported having dedicated neurocritical care units, and the majority (96.7%) admitted 40 or more patients with aneurysmal subarachnoid hemorrhage annually. Reported indications for EVD placement were aneurysmal subarachnoid hemorrhage (96.7%), non-traumatic intracerebral hemorrhage

(80%), ventriculoperitoneal shunt malfunction or infection (60%), traumatic brain injury (43.3%), brain tumors (20%), CSF leak (10%), and acute ischemic stroke (3.3%). The characteristics of participating hospitals are presented in the supplementary material (Supplementary Digital Content 3: Table showing the characteristics of the 30 hospitals participating in the EVDPop study).

ReporteVD insertion, maintenance, and quality improvement practices—EVDs were reported to be commonly inserted by residents in neurosurgery training programs (93.3%), followed by attending neurosurgeons (46.7%). EVDs were frequently placed in the ICU (96.7%) or the operating room (93.3%), using anatomical landmarks (100%) and were routinely (90%) tunneled under the skin. Commonly reported pre-insertion platelet count requirements were greater than or equal to 100,000/cu.ml (63.3%) (Table 1).

External ventricular drains were managed only in the ICU in 80% of hospitals or on the ICU or floor in 20%. The EVD setting was usually expressed in centimeters of water (76.7%). Antimicrobial catheters were used by the majority of respondents (80%), and most (70%) reported administering only a one-time antibiotic dose before EVD insertion. Administration of daily antibiotics until removal of EVD was infrequent (10.3%), and antibiotics were not administered in 20% of hospitals. Cerebrospinal fluid sampling was undertaken only when there was clinical suspicion of infection in 73.3% of hospitals, twice weekly in 13.3%, or weekly in 3.3%. Ten percent of hospitals never send CSF samples for analysis. Most hospitals (93.1%) reported not changing the site of the EVD catheter routinely. EVD-associated infection was the most common quality improvement metric tracked (86.7%), followed by catheter malposition (33.3%), hemorrhage (33.3%), CSF over-drainage (23.3%), and unintended removal or disruption of the EVD system (6.7%). 13.3% of institutions did not track any quality improvement metric. 56.7% of institutions reported an EVD infection rate of 1–5% in the prior year, 36.7% reported infection rate of less than 1%, and the remainder (6.7%) an infection rate of 5.1–10%.

Reported EVD practices during intra-hospital transport—Seventy-seven percent of the hospitals reportedly did not have a standardized written protocol for conducting EVD clamp trials prior to initiation of intra-hospital transport. The EVD was always (66.7%) or sometimes (33.3%) clamped during intra-hospital transport, and ICP was monitored sometimes (56.7%), always (33.3%), or never (10%) during transport.

Adherence to EVD recommendations—Twenty hospitals (66.7%) reported having a written hospital EVD protocol, of which, 17 (85%) were submitted for examination. An educational tool for CSF drainage was incorporated into one hospital policy. Separate protocols addressing EVD insertion in the ICU, operating room and the emergency department were included in 15%, 10% and none of the policies, respectively. The guidelines that were referenced in the hospital policies were those from the American Association of Neuroscience Nurses (70%), Neurocritical Care Society (30%) and SNACC (5%); a minority of the policies referenced an EVD manufacturer brochure (5%).

The average overall EVD recommendation adherence score was 57.5% (minimum 27.4% to maximum 80.2%); we did not identify 100% adherence to recommendations in any

hospital policy. Adherence scores to individual EVD recommendations are shown in Table 2. Amongst the 13 EVD care topic areas, the 3 with the highest adherence scores were flushing of the catheter (100% [0%–100%]), changing the drainage bag (100% [0%–100%]) and changing the dressing (83.3% [0%–100%]). We found only one hospital in which reported practice were not consistent with institutional standards, specifically in relation to the practice of monitoring ICP as well as clamping the EVD during intra-hospital transport.

DISCUSSION

This study was performed to understand better EVD-related publications and U.S. hospital practices and policies for EVD management. The main findings of the study are: 1) there has been a moderate growth in EVD-related publications over the years, mostly in the form of retrospective studies, 2) publications, reported practices and hospital policies focus mainly on the prevention of EVD-associated infection, and 3) the overall adherence of hospital EVD policies to national and international EVD guideline recommendations is modest at best. Based on our findings, we propose a template for the development of hospital EVD policies (Table 3).

According to our review of the literature, EVD-associated infection is the most commonly reported EVD-related complication. Therefore, it is not surprising that most hospital policies address how to reduce infection rates and that practitioners prioritize infection over other EVD-related complications as a quality of care measure. As our study shows, the majority of policies call for attention to sterile technique during the preparation of the EVD system, and during EVD insertion. This is aligned with the newly proposed performance measure from the Neurocritical Care Society¹⁹, which calls into action the reporting of an EVD insertion bundle to reduce infection. Additionally, our study shows that hospital policies rarely emphasize the prevention of hemorrhagic complications, and seldom provide any guidance on strategies for anticoagulation and antiplatelet reversal during EVD insertion or management. This may be because few published studies report on hemorrhagic complications. Likewise, increased ICP during intra-hospital transport of patients with indwelling EVDs is seldom reported in the literature, likely leading to EVD policies that omit recommendations on transport-related issues.

A survey study in Thailand found that non-antimicrobial EVD catheters were placed in 98% of the hospitals, and that intravenous antibiotics were administered daily until EVD removal in 62%.¹⁴ We found that, unlike the practices described in Thailand¹⁴ or the previously self-reported U.S. practices,¹⁵ the practices of use of antimicrobial catheters, administration of antibiotics prior to EVD insertion, tunneling of catheters, not routinely changing catheters, and sending CSF only on clinical suspicion of ventriculitis are in fact most aligned with the recommendations from the Neurocritical Care Society.² Better adherence in the U.S. may be due to the greater availability of antimicrobial catheters. As our data show, reported EVD practices are also aimed primarily at reducing EVD-associated infections as well as hospital-acquired infections such as *Clostridium difficile*.²⁰

We found that EVD clamp trials may not be routinely performed prior to intra-hospital transport and that ICP is not routinely monitored while EVDs remain clamped during

transport. Traditionally, the practice of clamping the EVD is recommended to avoid over drainage of CSF during intra-hospital transport.⁷ However, our prior data shows that patients with higher baseline ICP, higher hourly CSF output, and those with EVDs open to continuous CSF drainage are at higher risk for EVD clamping-associated intracranial hypertension during transport.²¹ Those data influenced the SNACC guidelines on the perioperative management of patients with EVDs.⁸ Based on these guidelines, a pre-transport EVD clamp trial may allow neurocritical care clinicians to identify patients at-risk of developing intracranial hypertension. Patients who tolerate a pre-transport clamp trial may be transported with the EVDs clamped with continuous ICP monitoring; those who do not should be transported with the EVD open for continuous CSF drainage with attention paid to over-drainage. Physiological monitoring that was in place in the ICU must always be continued during transport. Similar to heart rate, electrocardiogram, pulse oximetry, end-tidal carbon dioxide, and blood pressure, all of which are routinely monitored during transport, ICP should be a core monitor during transport of neurocritically ill patients.

This study finds only modest adherence to national and international EVD guideline recommendations. The EVD care topics with greatest adherence to recommendations were flushing of the EVD and changing of the CSF drainage bag. The EVD care topics with least adherence were intra-hospital transportation, administration of intraventricular medication, EVD removal, and patient and family education. The reasons for such wide variation in adherence to recommendations are not clear, but our study findings are clinically relevant as policies may be viewed as the basis for which hospital quality metrics may be created. Given the large variation in EVD policy content, our proposed policy template (refer to Table 3 for EVD care topic keywords and to Supplementary Digital Content 4 for an external ventricular drain insertion and maintenance policy and procedure, the Harborview Medical Center Policy Development Guide) can be used by hospitals to streamline EVD care.

One of the strengths of our study is that reported practices are verified by written EVD policies and procedures. Hospital data regarding EVD management practices have not been reported previously, and our study is the first to address this deficiency. This study also has some limitations. The literature search was limited to the PubMed and Embase databases; this may have potentially missed some publications in the Ovid/Medline database, which is not available at the University of Washington. In addition, growth in the EVD literature was not compared to that in other areas of neuroanesthesia and neurocritical care over the same time period. Moreover, admission numbers and EVD-infection rates were self-reported, and these may not be accurate. Finally, the small hospital sample size may limit generalization of our findings and of our understanding of EVD management practices and policies.

CONCLUSION

The published literature related to EVD insertion and maintenance, and reported EVD practices and hospital policies, primarily focus on reducing EVD-associated infections. Still, overall adherence of hospital EVD policies to EVD national and international guideline recommendations is modest. To promote a culture of EVD safety, clinicians should focus on reducing all EVD-associated adverse events.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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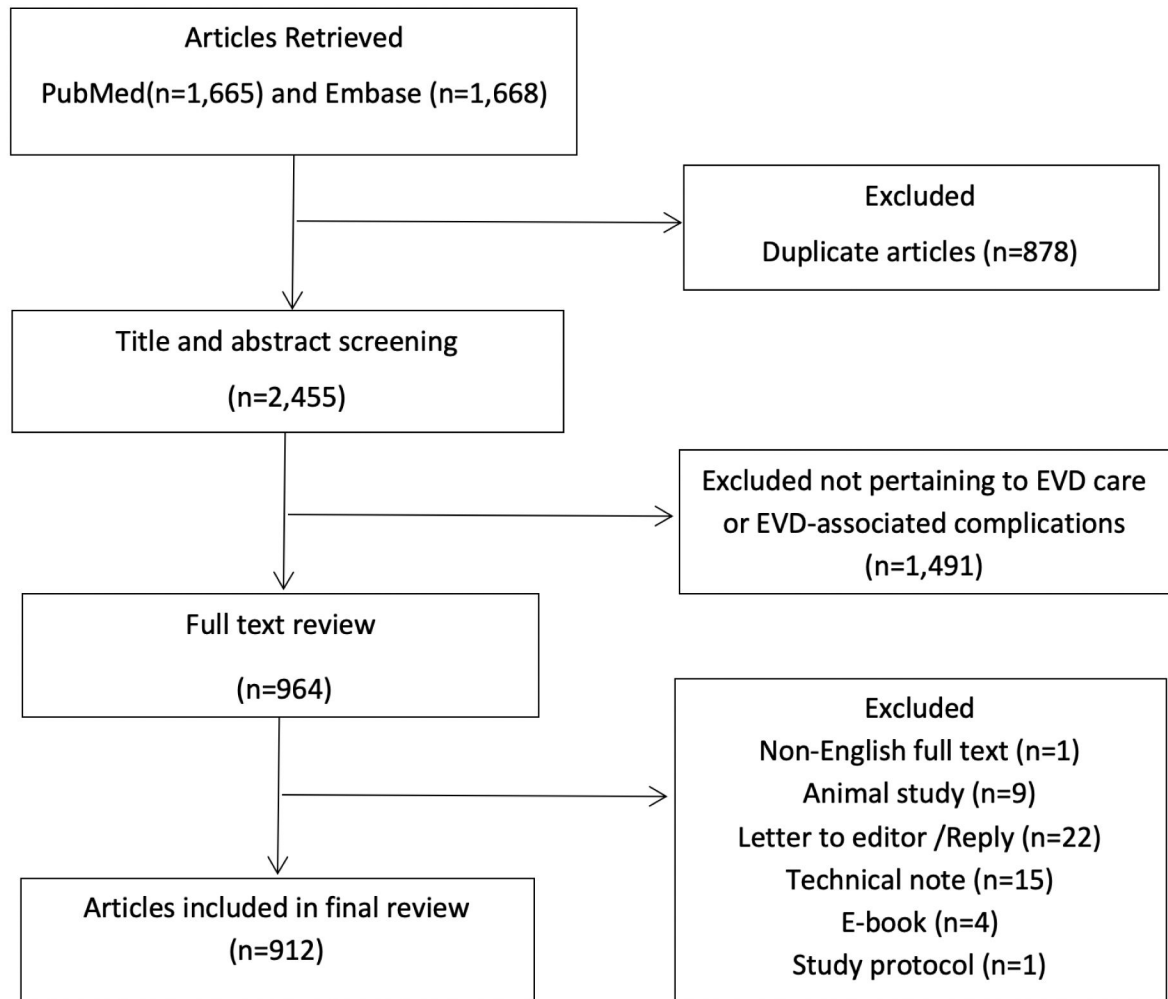


Figure 1.
Flow diagram highlighting External Ventricular Drain Related Literature Review
E, electronic; EVD, external ventricular drain

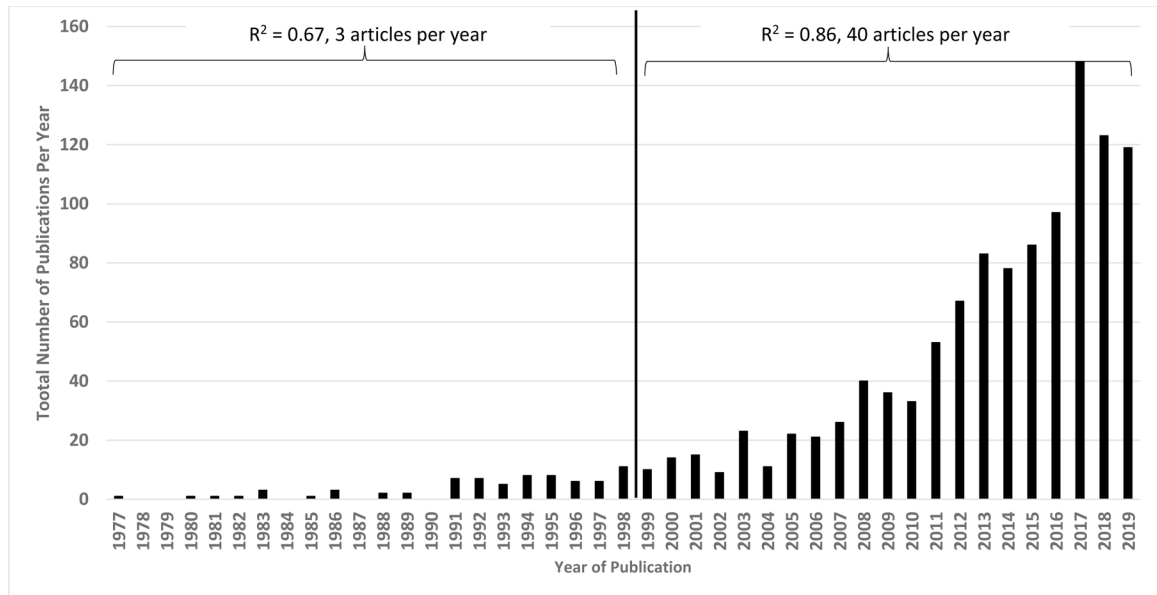


Figure 2.
 Temporal trends in external ventricular drain related publications by the rate of publications per year
 (n = 912)

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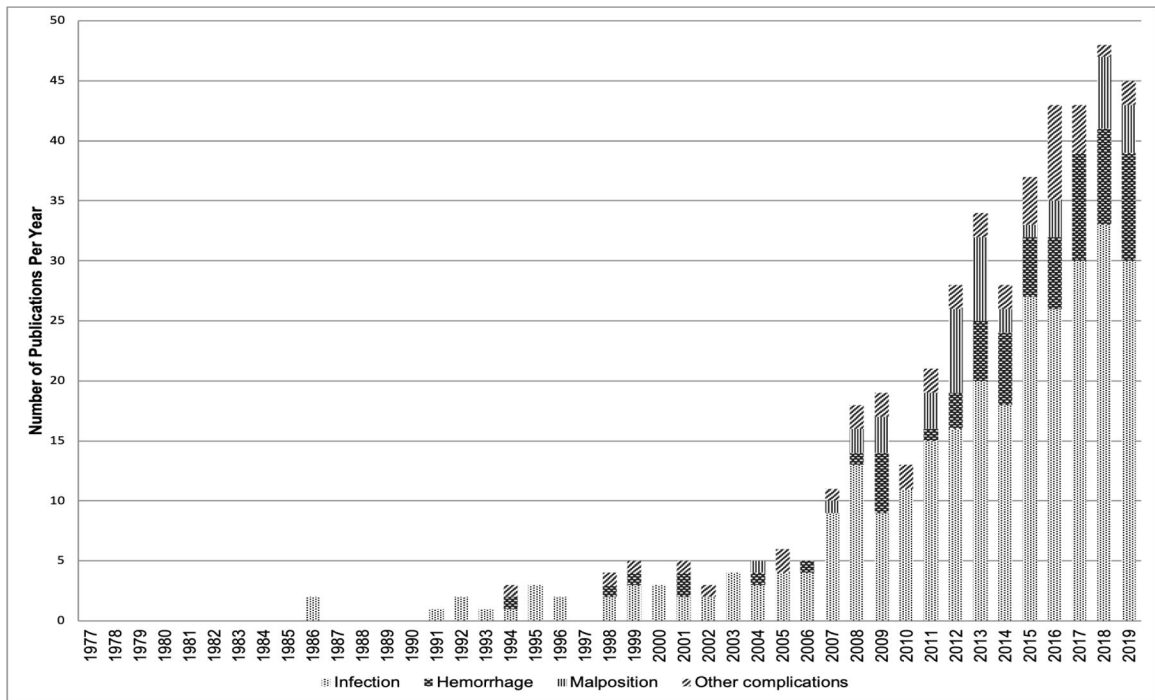


Figure 3. Temporal trends in publications related to external ventricular drain associated complications by the year of publication

Table 1

External Ventricular Drain Insertion Practices in 30 U.S. Hospitals Participating in the EVDPoP Study

	n (%)
Personnel inserting EVD	
Resident in a neurosurgery training program	28 (93.3)
Attending neurosurgeon	14 (46.7)
Fellow in a neurosurgery training program	8 (26.7)
Advance practice providers (Nurse practitioners, physician assistants)	1 (3.3)
Intensivist physician	1 (3.3)
Location in the hospital where EVD is inserted	
Intensive care unit	29 (96.7)
Operating room	28 (93.3)
Emergency room	18 (60)
Step-down Unit	1 (3.3)
Ward	0 (0)
Insertion technique	
Anatomical landmarks	30 (100)
CT navigation assisted	12 (40)
Other	0 (0)
Catheter always tunneled under the skin (yes)	27 (90)
Use of antimicrobial impregnated EVD catheter type (yes)	24 (80)
Pre-EVD placement platelet count requirement	
Greater than or equal to 75,000/cu.ml	3 (10)
Greater than or equal to 100,000/cu.ml	19 (63.3)
No platelet count specified	6 (20)
Other *	2 (6.7)

CT, computerized tomography; EVD, external ventricular drain; EVDPoP, External Ventricular Drain Publications, Practices and Policies

* indicates 90,000/cu.ml

Table 2

Adherence to external ventricular drain recommendations amongst 17 hospital policies

	Adherence to recommendations Median [minimum -maximum]
Flushing ventricular catheter	100% [0%–100%]
Changing CSF drainage system or drainage bag	100% [0%–100%]
Dressing change	83.3% [0%–100%]
EVD set up	81.8% [18.2%–100%]
Documentation related to EVD	80% [0%–100%]
Management of special situations	71.4% [0%–85.7%]
EVD maintenance	70% [30%–80%]
CSF sampling	50% [0%–100%]
EVD Insertion	50% [0%–78.6%]
Intrahospital transportation	16.7% [0%–83.3%]
Administration of intraventricular medication	0% [0%–100%]
Patient and family education	0% [0%–100%]
EVD Removal	0% [0%–66.7%]

CSF, cerebrospinal fluid; EVD, external ventricular drain

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Table 3**Proposed External Ventricular Drain Policy and Procedure Template**

Elements	Keywords
1. EVD set up	Sterile, Flushless transducer, Dedicated IV pole, a reference point
2. EVD Insertion	Sterile, Type of catheter, Tunneling, Landmarks, Antibiotic, Coagulation profile, Platelet count, Anticoagulant reversal, Antiplatelet agent reversal
3. EVD Maintenance	Stopcock, Head of bed, Level of Burette, CSF output and characteristics, Setting in cmH ₂ O/mmHg, Alert physicians for pre-determined lower and higher limits of the cerebrospinal fluid drain, and ICP values
4. Dressing change	Frequency, Sterile, Type of dressing
5. Flushing ventricular catheter	Personnel, Technique
6. Changing CSF drainage system or drainage bag	Technique, Frequency
7. CSF sampling	Frequency, Clinical indication, Technique
8. Administration of intraventricular medication	Personnel, Technique
9. Intrahospital transportation	ICP monitor, EVD management (clamp or open), Pre-transport clamp trial
10. EVD Removal	Anticoagulant reversal, Medication hold, Criteria for weaning EVD
11. Management of special situations	Lost or damped waveform, CSF leak, Disconnect, Overdrainage, Underdrainage, Change in the characteristic of CSF
12. Patient and family education	Nursing communication prior to a change in the head of bed position, or the initiation of activity
13. Documentation related to EVD	CSF output, ICP, Neurological examination, Insertion site, Complications

CSF, cerebrospinal fluid; EVD, external ventricular drain; ICP, intracranial pressure; IV, intravenous