National External Ventricular Drain (EVD) Protocol and Database

David Darrow, MD, MPH, PGY-4
Coridon Quinn, MD, PGY-4
Outline

• Motivation
• Literature
• Protocol development
• Comprehensive program
• EVD Consortium
Problem
Problem

Knowledge of infection rate
Lack of standardized protocol
Standardized training of interns/residents
AANS Special Announcement

Published as a Service for Members by the American Association of Neurological Surgeons

Dear Colleague,

In collaboration with the American Association of Neurological Surgeons (AANS) and the Society of Neurological Surgeons (SNS), we are conducting a survey to evaluate the practice of external ventricular drain (EVD) placement across the U.S. The goal is to identify best practice standards in areas where variability exists.

Your input is greatly appreciated, and it will take approximately two minutes to complete the survey. The link to the survey is below. Thank you for your participation.

https://www.surveymonkey.com/s/EVDSURVEY

Sincerely,

The EVD Best Practices Team
Know the Infection Rate

Reported Infection rates
Retrospective review: Chart review
  IRB approved
  Definition of infection
Prospective collection
  Protocol rollout
  Continued IRB
Infection: What is it?

Meningitis or ventriculitis must meet at least one of the following criteria:

1. Patient has organisms identified from cerebrospinal fluid (CSF) by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment (e.g., not Active Surveillance Culture/Testing (ASC/AST)).

2. Patient has at least two of the following:
   i. fever (>38.0°C) or headache (Note: Elements of “i” alone may not be used to meet the two required elements)
   ii. meningeal sign(s)*
   iii. cranial nerve sign(s)*

And at least one of the following:
   a. increased white cells, elevated protein, and decreased glucose in CSF (per reporting laboratory’s reference range)
   b. organisms seen on Gram stain of CSF
   c. organisms identified from blood by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment (e.g., not Active Surveillance Culture/Testing (ASC/AST))
   d. diagnostic single antibody titer (IgM) or 4-fold increase in paired sera (IgG) for organism

3. Patient ≤1 year of age has at least two of the following elements:
   i. Fever (>38.0°C), hypothermia (<36.0°C), apnea, bradycardia, or irritability (Note: Elements of “i” alone may not be used to meet the required two elements).
   ii. meningeal signs*
   iii. cranial nerve signs*

And at least one of the following:
   a. increased white cells, elevated protein, and decreased glucose in CSF (per reporting laboratory’s reference range)
   b. organisms seen on Gram stain of CSF
   c. organisms identified from blood by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment (e.g., not Active Surveillance Culture/Testing (ASC/AST))
   d. diagnostic single antibody titer (IgM) or 4-fold increase in paired sera (IgG) for organism

* With no other recognized cause
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<tr>
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Protocol

q5 day CSF surveillance - attendings surveyed

Version 1.7
External Ventricular Drain Neurosurgical Protocol

- Bed in position (head away from door, IV/vent on one side, clear path to operative side)
- Nurse to open and complete electronic tracking form (www.tinyurl.com/ventric) (https://redcap.ahc.umn.edu/surveys/?s=ktZBZLUGtE)
- Antibiotics administered no more than 60 minutes before incision
  - Ancef 2g OR
  - Clindamycin 900mg OR
  - Vancomycin 1g
- Sedation medications administered
- Hair clipped widely, anatomical sites marked
- Sterile glove prep/scrub
- Hand washing
- Don gown, hat, mask, double glove
- Everybody in room with hat and mask
- Full body surgical drape (1, 2, 6)
- Chloraprep again (1)
- Proceed with placement
  - Remove outer gloves before touching catheter
  - Use antibiotic impregnated catheter (9, 11)
  - Tunnel > 5 cm (3, 7)
- Secure catheter in place
- Chloraprep
- Biogel placed (4)
- Dermabond (optional) (5) + barrier primapore dressing
- Q 5 day csf cultures and prior to removal
Comprehensive Program

- Established REDCap **Database**
  - accessible placement survey: [www.tinyurl.com](http://www.tinyurl.com)
- **Nursing support** -
  - training on protocol and database
- EVD Cart
- Protocol posters
- Standardized EVD Note (EMR)
- Order Set in EPIC (EMR)
Neurosurgery Ventriculostomy Procedure Note

Pre procedure Diagnosis: ***
Post procedure Diagnosis: ***
Consent: Obtained
Anesthesia: Local
Time Out Performed
Procedure: *** sided External ventricular drain Placement.
Nursing staff entered this procedure into the EVD Quality Improvement Database

Details of the Procedure:
- Bed was positioned for unencumbered access for sterile procedure
- Patient was supine with head in the neutral position. *** side of the head was widely shaved using clippers.
- All staff wore face masks and hats.
- *** mL of Versed was administered.
- *** mL of Fentanyl was administered.
- Antibiotics were given pre-procedure.
- Anatomical landmarks were used for defining the trajectory and entry point for the ventriculostomy.

Followed by
- midazolam (VERSED) injection 0.5 mg

Caution: when used with opioids, may need lower doses
- Midazolam (VERSED) 0.1-0.5 mg
- 0.5-1 mg, Intravenous, for 1 Minutes. Once Within 24 HRS. Today at 2:30, for 1 dose
- Caution: when used with opioids, may need lower doses. If inadequate response may repeat 0.5 mg

Followed by
- midazolam (VERSED) injection 0.5 mg

Caution: may have synergistic effect when used with midazolam
- Midazolam (VERSED) 0.1 mg
- 0.5-1 mg, Intravenous, for 1 Minutes. Once Within 24 HRS. Today at 2:30, for 1 dose
- Caution: may have synergistic effect when used with midazolam. If inadequate response, may repeat up to 1.0 mg

Followed by
- fentanyl (SUBLIMAZE) injection 25-50 mcg

Caution: when used with midazolam
- Fentanyl (SUBLIMAZE) 25 mcg
- 50 mcg, Intravenous, for 2 Minutes. Once Within 24 HRS. Today at 2:30, for 1 dose
- Caution: may have synergistic effect when used with midazolam. If inadequate response, may repeat up to 1.0 mg

Naloxone
- Naloxone (NARCAN) injection 0.1-0.4 mg

Caution: when used with opioids
- Naloxone (NARCAN) 0.1 mg
- 0.4 mg, Intravenous, for 2 Minutes. Once Within 24 HRS. Today at 2:30, for 1 dose
- Caution: may have synergistic effect when used with midazolam. If inadequate response, may repeat up to 1.0 mg

Opening Pressure was ***

- Incision was closed using 3-0 Nylon or staples.
- The drain was secured at the exit site using 3-0 nylon suture.
- Drain was secured using staples.
- Bioprosthetic disk was placed at the exit site of the catheter.
- The site was covered with sterile gauze packing.
- The patient tolerated the procedure well.
- The drain was elevated and set at ***.

Monitoring of CSF will continue with samples collected every 5 days.
Training

• Establish resident training package
  • Protocol
  • Video
  • Proficiency test
• Nurse Education
  • Nurse Director led dissemination
  • Resident directed during each EVD
  • Ownership through observation
Sustainability

• Establishment of EVD committee
• Biannual report - REDCap
  • Infection rate
  • Compliance report
• Incoming residents
Data
Retrospective

- Retrospective patients - 5/2015 - 10/2013
  - Avg age: 53yrs - M:F 54.8yrs:51.7yrs
  - Deceased – 38% - M:F 14:22 (36% : 40%)
- Length of Stay - avg: 14d
  - M:F 16d:12 d
EVD data

- Average EVD duration - 7.6 days
- Pre-procedure Antibiotics – 70% given
- Opening pressure - avg 14.4mmHg (1-63)
- Max ICP - avg 26.6mmHg (11-64)
- Replaced 11%, biventricular 7%
- Steroids – 22%
- Shunted – 19%
Antibiotics

- Antibiotics given prior to procedure
  - HCMC: 65%
  - UMMC: 79%
Prospective
### Diagnosis and Associated Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Total Count</th>
<th>Missing</th>
<th>Unique</th>
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<tbody>
<tr>
<td>Subarachnoid hemorrhage</td>
<td>33 (27.3%)</td>
<td></td>
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<tr>
<td>Intracerebral hemorrhage</td>
<td>30 (24.8%)</td>
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<tr>
<td>Trauma</td>
<td>47 (38.8%)</td>
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<tr>
<td>Shunt infection</td>
<td>3 (2.5%)</td>
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<tr>
<td>Communicating hydrocephalus</td>
<td>5 (4.1%)</td>
<td></td>
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<tr>
<td>Non-communicating hydrocephalus</td>
<td>6 (5.0%)</td>
<td></td>
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<tr>
<td>Pseudotumor</td>
<td>1 (0.8%)</td>
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<tr>
<td>Other</td>
<td>15 (12.4%)</td>
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Counts/frequencies:
- Subarachnoid hemorrhage (33, 27.3%), Intracerebral hemorrhage (30, 24.8%), Trauma (47, 38.8%), Shunt infection (3, 2.5%), Communicating hydrocephalus (5, 4.1%), Non-communicating hydrocephalus (6, 5.0%), Pseudotumor (1, 0.8%), Other (15, 12.4%)
UMMC: Diagnosis

Number of Patients

- SAH: 12
- Trauma: 4
- ICH: 9
- Shunt Infection: 1
- Non-Communicating HCP: 1
- Pseudotumor: 1
- Other*: 1

*SDH, Tumor (2), arachnoid cyst, anoxic injury (2),

Hennepin County Medical Center

HCMC: Diagnosis

Number of Patients

- SAH: 10
- Trauma: 35
- ICH: 15
- Shunt Infection: 10
- Communication HCP: 5
- Non-Communicating HCP: 5
- Pseudotumor: 5
- Other*: 5

*Infection (2), subdural hygroma, septic emboli, tumor
• 48% patients with EVD treated for infection
• CSF drawn at any point - 57% retro 75% prospective
• Retro: 6 patients had positive CSF growth: 1 real, 2 prior, 3 contaminants
• Prospective: 1 prior, 2 contaminants
Retrospective: 1 infection in 712 EVD-days  
Infections per EVD day: 0.0014  
Antibiotics for CNS infection – 21% of patients with EVD

Prospective: 0 infection in 500 EVD-days  
Infections per EVD day: 0
Prospective

• 78% in ICU  22% in OR
• Average number of EVD-days per patient: 7.5
• 73% R, 27% L

• 12% replacements
• 30% patients received shunts
• 6% patients with hemorrhage
Antibiotics

- 82% abx before incision
- 10% abx for CNS
- 30% on steroids
Passes
Compliance
### Compliance

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<tr>
<th>Resident</th>
<th>Completed</th>
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**Total**

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**Compliance**: 0.75
National EVD Consortium
National EVD Consortium

Goal: Improve and study EVD placement and care

Initial Tasks
1. Guidelines for physicians and nurses
2. EVD Database
3. Comprehensive EVD program
4. National EVD training initiative
National EVD Consortium - Pending
Guidelines

No current guidelines

Plan
• Systematic Review of the literature
• Create template protocol based on guidelines
EVD Database

- Each institution has individual protocol
  - Database just captures variation
  - Forms are nearly identical between institutions
- Comparative Effectiveness Research
  - Can pose research questions
  - Potential for randomized experiments
  - Epidemiologic studies built-in
Comprehensive EVD Program

Complete “roll-out” package
• Template Protocol
• Standardized notes, equipment lists
• Nursing effort prepared for inter-institutional comm
• Training modules
National EVD Training

Goal: in-depth, intuitive, and effective training

- Checklists, video series, and tests
  - Nurses
  - APP
  - Residents
  - Staff

- Cheat sheets to be quickly available on website
- Available online for unrestricted viewing
Website

Motivation
• Centralizes information and fosters collaboration
• Already deployed but under construction
  • Easy to remember URL
• Allows for expansion
  • Future Direction (already underway): accuracy