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Proposed Simple, Efficient Free Hand Technique for Frontal External Ventricular Drain (EVD) in Case of Small Ventricle: A Report of New Technique

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Abstract

Background: EVD is a common procedure done in neurosurgery and the residents should master it and this is what exactly means that it should be simple, safe, fast and accurate. EVD can be done through many entry points to the different part of the lateral ventricle but the famous site is the anterior horn of the lateral ventricle which is commonly approached through Kocher's point which is a famous point for all neurosurgeon by its measurements of allocation. The commonest problem with EVD insertion into the anterior horn is the navigation of the ventricular cavity with the right trajectory and so the location of the catheter tip in the right place near the foramen of monro to ensure CSF draining. Size of the ventricle plays significant role in the success of the procedure especially free hand technique. The more dilated ventricle, the more chance to hit the ventricular cavity especially from the first trial and vice versa. In case of small ventricle, the procedure with free hand technique seems more complicated and the chance to hit the ventricle from the first trial may reduce especially with non-expert surgeon but may succeed in the following trials with increased risk of complications with more trials. Purpose: Most EVD's are placed with freehand technique which depends on the operator skills to navigate the ventricle with right trajectory and hit the ventricle from the first trial, because many trials may complicate the procedure and produce undesirable side effects. So the key in this free hand technique is how to ensure the success from the first trial. In case of small anterior horn of the lateral ventricle, the procedure is even more difficult with the free hand technique and the classic Kocher point needs an expert to get the right trajectory to navigate such small ventricle. Our point idea came from this prospective and aimed at raising the success of the procedure especially in the

first attempt with simple technique. Method: It is a new entry point for EVD insertion through frontal burr hole gained by the intersection of two lines: the first is running vertically from the ipsilateral medial canthus downward and the second is running horizontal along the coronal suture which is usually palpable as ridge on the scalp extended lateral from the bregma. Burr hole is done just anterior to this intersection and catheter is placed in a perpendicular trajectory toward the ventricular cavity. Result: It has been used in about (n = 50 cases) fulfilling the criteria of radiological small ventricle as defined and they were candidates for EVD insertion by free hand technique. Only 3 cases (6%) out of the 50 cases failed in the first attempt but succeeded in the following trial. So high rate of success in first trial is seen in the most of cases using this technique during a period of one year of our practice without significant side effects seen. Conclusion: Our study is not conclusive and needs further studies for more evaluation. It was a suggested point other than the classic Kocher point in case of free hand EVD insertion in small ventricle. We recommend to try it and report any advantages or disadvantages to the literature.

Keywords

Frontal Ventriculostomy, Freehand EVD, Small Ventricle EVD, Frontal Horn EVD

1. Introduction

External ventricular drain (EVD) is one of the commonest procedures done in the daily neurosurgery practice and it is considered as lifesaving procedure in many emergency cases and so sometimes it is a bedside procedure. Despite being simple and less invasive in comparison to the other neurosurgical interventions, still it has a significant technical problem which may cause failure of the procedure and loss of the surgical benefit which can be offered to the patient by such simple procedure. One of the most problems with EVD placement especially in the frontal horn is the efficacy of placing the ventricular catheter tip near the foramen of monro from the first trial in the free hand technique which is considered the most commonly used for EVD insertion globally and it is the main way in our country. This can be explained by the urgency of the procedure and restricted availability of modern navigation techniques. Placement of the catheter efficiently from the first trial reduces the complications that might occur with multiple subsequent trials. Such problem of right insertion is commonly seen in case of small frontal horn. Such small frontal horn may be difficult to be navigated by freehand technique of the classical Kocher's point and may need skilled resident or surgeon to catch the ventricle from the first trial. And because many urgent cases of small ventricle EVD are faced by the young residents who may not be expert enough to navigate such small ventricle with the classic Kocher point; We report a simple point for frontal EVD with high efficacy of first trial success which is used a lot in our cases of EVD insertion during a period of one

year especially for cases with small ventricle. We recommend to consider this new proposed point as an alternative option that can be used for frontal EVD insertion in case of small ventricle.

2. Technique

2.1. What We Mean by Small Ventricle

The average anterior horn width of the ventricle in non-hydrocephalic patients is approximately 17 mm (left to right horn width of 31 - 37 mm). The average position of the ipsilateral medial can thus (IMC) is approximately 15 mm lateral to the mid-line (normal intercanthal distance of approximately 30 - 31 mm), and a line connecting the (IMC) and the lateral border of the anterior horn of the ventricle meets the level of the skull around 20 mm lateral to the midline, indicating that the entry point should be medial to this line to hit the non-hydrocephalic ventricle or small ventricle (**Figure 1**). So small ventricle is defined as nonhydrocehalic ventricle to slightly dilated ventricle not beyond the (IMC) line and not reaching the ipsilateral midpupillary line IMPP (**Figure 2**). This is what our new proposed point of entry and measurement based on. small ventricle is seen a lot in many cases candidate for EVD especially those presented early and their initial images show only the early features of hydrocephalus which is the initial temporal horn dilatation while the anterior horn is not yet dilated with characteristic mickey mouse appearance which indicates frank hydrocephalus and most likely the lateral border of the anterior horn is beyond the imaginary line from the ipsilateral medial can thus IMC reaching the midpupillary line where Kocher point is usually placed and can easily hit the ventricle. So our measurement from the image is a rough rapid evaluation of the anterior horn either into dilated or small ventricle and based on that we can decide either to use our proposed point or the classic Kocher point.

From the preoperative imaging either CT or MRI the selected side of entry is identified first, then simple crude measurement by drawing vertical line by a sheet of paper or by a ruler (**Figure 1**) from the ipsilateral medial can thus passing down through the ipsilateral anterior horn either to be passing through its lateral border if it is small as we mentioned or through its mid cavity if it is frankly dilated Such rapid measurement from the image identify the defined small ventricle and so the proposed entry point. The second step is drawing this line on the scalp to intersect with the coronal suture which is usually palpable as ridge extending laterally from the bregma. Skin incision is done over the intersection point as linear incision with 3 cm length with 2 cm anterior to the coronal suture and 1 cm posterior to it. Burr hole is done immediately anterior to the coronal suture; then dura is coagulated with forceps arching diathermy resulting in small durotomy with coagulation of the underlying cortical pia. Last step is ventricular catheter insertion which is done perpendicular downward toward the floor of the anterior horn with depth of 5 cm at least.

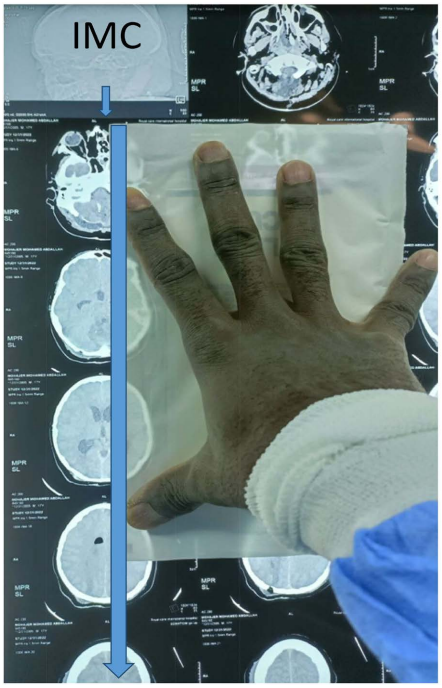

Figure 1. Showing the vertical line (blue line) when drawn from the ipsilateral medial canthus (IMC) point and how the anterior horn in the below cut is near this line (medially which is considered small ventricle in this case) and can be easily navigated with high accuracy by perpendicular insertion.

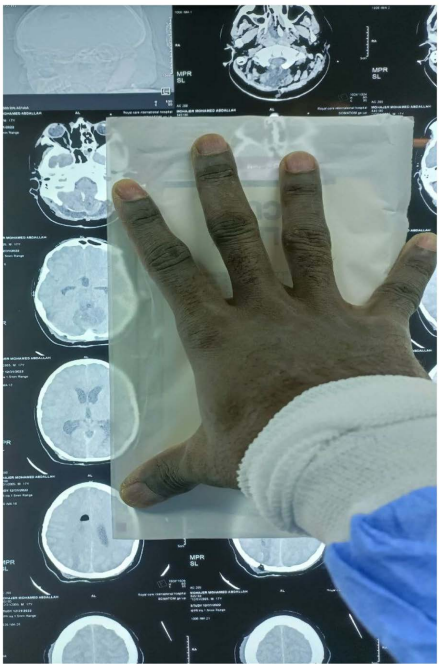

Figure 2. Same CT brain with the same anterior horn in relation to the line (blue arrow) if drawn from the midpupillary point (MPP) and how the anterior horn is away medially from this line which cannot be hit by perpendicular trajectory and needs specific trajectory (*i.e.* Kocher point).

2.2. Indications and Precautions

This technique Is mainly considered in case where EVD insertion either for therapeutic use or monitoring of ICP is indicated as free hand technique and the ventricular size is considered small as defined and so the possibility of ventricular hit from the first attempt is low by other entry points which need expert with certain trajectory to navigated the ventricle correctly and raise the chance of first hit.

Important precaution for this entry point is the well study of the superior sagittal sinus location from the image and exclude any eccentric position which may complicate the procedure and if so; the contralateral side should be used if possible or use the same side but with more lateral entry point from the midline (classical Kocher's point entry) or placement of the EVD in other horn rather than the anterior horn.

3. Discussion

in the literature The recommendations for entry points for the frontal horn of the lateral ventricle in the coronal plane range from 1.5 to 2.5 cm [1], 1.5 to 3.5 cm [2], 2 cm, 2.5 cm, 2 to 3 cm [3] [4], 2.5 to 3 cm [5] [6], and 3 cm [7] [8] [9] [10] [11] [12] up to 3 - 4 cm lateral to the midline [13] [14] or in the midpupillary line which usually ranges from 2.8 - 3.5 cm from the midline. The recommendations for entry points in the sagittal plane range from just anterior to the coronal suture orbregma [15] [16] 3 cm, 10 - 11 cm, 11 - 12 cm, or 12 - 12.5 cm posterior to the nasion [17] or 10 cm above the supraorbital ridge. According to these recommended measurements our proposed point is included within the allowed measures. The recommendations overlap, as the bregma is located on average 13 cm (12.2 - 13.8 cm) behind the nasion, and the coronal suture runs anterior in the lateral direction [3] [18]. Thus, for an entry site located 3 - 4 cmlateral to the midline, a sagittal entry point 2 cm anterior to the coronal suture corresponds to an entry point about 10cm instead of 11 cm posterior to the nasion. In summary, the entry points recommended in the literature vary from 1.5 cm to 4 cm lateral to the midline, and from 10 to 12.5 cm behind the nasion. It is clear that this include the classic Kocher point and again our new point. The most often-reported trajectories are either a perpendicular (90˚) puncture [11] or toward the ipsilateral medial canthus (IMC), nasion, or the contralateral medial canthus (CMC) [19] in the coronal plane. In the sagittal plane, the recommended trajectories are down- and backward through the external acoustic meatus [20], tragus, 1 cm anterior to the tragus, or 1.5 cm anterior to the tragus [21]. Our new point trajectory is the simplest mentioned one which is the perpendicular. It is not always easy to identify these landmarks reliably during surgery when sterile drapes are covering the patient, so such measurement should be done first and correctly before draping. The new proposed point will not be so confusing if these measures are not done before draping because it does not need to specific trajectory in comparison to others, just perpendicular. For a trajectory toward the nasion and tragus, it was found that 90% of the catheters reviewed

were placed within a 30˚ cone around the foramen of Monro, indicating a high variability when using anatomical landmarks. The average position of the IMC is approximately 15 mm lateral to the mid-line (normal intercanthal distance of approximately 30 - 31 mm) [2]. The average anterior horn width of the ventricle in nonhydrocephalic patients is approximately 17 mm (left to right horn width of 31 - 37 mm [22].

In a study about the high hit rate among the Entry points to the anterior horn, 1 or 2 cm lateral to the midline had the highest rate only in combination with a trajectory toward the nasion and this is almost near to match our entry point and trajectory [23].

4. Ethical Consideration

No significant ethical considerations are required because all EVD procedures conducted using this entry point are done under informed consent as being done for the classical Kocher point explaining the procedure and any possible side effects as any medical procedure or surgical intervention and it is not considered as totally new invented procedure because in the literature all the possible points from which anterior horn can be navigated including our point measurement are mentioned but the new was the indication and the trajectory especially in case of small ventricle free hand EVD aiming to raise the accuracy of first hit which is noted to be a problem when navigating small ventricle using other point (such as classical Kocher) in free hand EVD.

5. Conclusion

We propose easy point to do from technical view with high accuracy to navigate small ventricle by free hand technique and on the first trial specifically; with preoperative prediction for that by the measurement done from the images. We recommend to use it especially in case of small frontal horn EVD freehand procedure and to comment and report on the accuracy of hitting the ventricle from the first trial to the literature.

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Conflicts of Interest

We declare a conflict of interest regarding this proposed point which is that it is not a conclusive report about its efficacy of hitting small ventricle from the first attempt because we used small sample size (n = 50) and it is not used by many other surgeons to report on its efficiency and it needs further evaluation by further study from others.

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