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Research Article

YouTube as a neurosurgical training tool for the insertion of external ventricular drain

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ABSTRACT

Objectives: YouTube is the largest open-access media website and an increasingly recognised resource in Medical Education, with much content related to Neurosurgery. External Ventricular Drain (EVD) insertion is frequently undertaken by neurosurgical trainees. Online and distant learning have gained popularity during this COVID-19 pandemic more than ever. We evaluated content on YouTube as to its use as an effective open-access learning resource for EVD insertion as a key neurosurgical procedure.

Methods: A keyword search identified videos related to EVD insertion on 01/06/2020. Inclusion criteria was created to focus on content aimed at describing the technique of EVD insertion. An educational scoring system was devised related to the procedure of EVD insertion. Each video was scored on our educational score, JAMA Benchmark Criteria and Global Quality Score (GQS). They were subsequently categorised as effective or ineffective.

Results: A total of 12/700 videos met inclusion criteria. Dates posted ranged from 01/07/2012 – 24/04/2019, with views range 359 – 166,388, and mean of 30,531 (SD 49,570). Four videos (33%) were considered an effective learning resource. The cohort had a mean educational score of 6.91 (SD 3.86), with median JAMA score and GQS 2/4 (SD 0.62) and 2/5 (SD 1.6) respectively. A strong correlation was found between viewership and score (R 0.85, $p < 0.005$)

Conclusion: The majority of YouTube content on EVD insertion is an ineffective resource. Neurosurgeons and Institutions could harness YouTubes broad access by posting high-quality educational content. This is more important than ever with increasing emphasis on online training resources, YouTube included.

1. Introduction

Rapid advances in technology over the last few decades have transformed teaching methods across all disciplines. In particular, mounting evidence demonstrates that video-based education is an effective adjunct to traditional teaching approaches in the technical training of surgeons [1]. In particular, in light of the current COVID-19 pandemic and significant disruptions to surgical training, trainees are forced to search for effective alternatives to achieve learning objectives. YouTube is the largest global open access media sharing site, and possesses an enormous collection of medical education videos and channels [2], and has been utilised frequently by doctors during the pandemic for the purposes of public information and education [3].A recent study [4] demonstrated an increasing volume of media related to Neurosurgery on YouTube, with neurosurgeons and institutions utilizing the platform for education and promotional purposes. Of these videos, up to 20% may be directly related to surgical procedures. Therefore, harnessing the educational potential of YouTube may provide significant benefit in training neurosurgical trainees in the UK, with access to lectures, tutorials and procedures from sources across the world.

However, the use of YouTube as a learning resource is accompanied by the caveat that it is not peer-reviewed, introducing the risk of

Abbreviations: AANS, American Association of Neurological Surgeons; EVD, External Ventricular Drain; GQS, Global Quality Score; JAMA, Journal of the American Medical Association; ICP, Intracranial Pressure; NREF, Neurosurgery Research and Education Foundation; TBI, Traumatic Brain Injury; UK, United Kingdom.

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dissemination of false or outdated information [5]. In the context of Neurosurgery, this has the potential to result in disastrous consequences and, therefore, it is imperative that educational material is evaluated rigorously. The insertion of an External Ventricular Drain (EVD) is a common, lifesaving neurosurgical procedure which is frequently undertaken by neurosurgical trainees in the treatment of raised intracranial pressure and acute hydrocephalus [6]. Its use as a gold standard for ICP monitoring has also led to some centres routinely advocating its use in management of severe TBI [7].

Despite its frequent undertaking, the procedure has a risk of significant complications such as infection and intra-cerebral haemorrhage [8]. The procedure involves the insertion of a catheter using anatomical landmarks into the lateral ventricle of the brain, permitting cerebrospinal fluid drainage and relief of raised intracranial pressure. Recent literature has suggested that the use of neuronavigation significantly improves accuracy when inserting an EVD [9], as compared with the traditional landmark approach. Neurosurgery is a hands-on specialty, and therefore required educational content that is clear, annotated and illustrated for the benefit of the trainee. Given that EVD insertion is amongst the earliest procedures taught to junior neurosurgical trainees, we chose to evaluate existing educational videos on YouTube for: (i) their efficacy as a teaching method; and (ii) the validity of the information provided.

2. Methods

2.1. Search strategy

A YouTube search was performed using the following search terms: "EVD", "EVD Insertion" "External Ventricular Drain", "External Ventricular Drain Insertion", "Ventriculostomy", "Treatment of Raised Intracranial Pressure", and "Treatment of Hydrocephalus" (Fig. 1). The first 100 videos of each keyword were included to ensure a comprehensive search. Videos were sorted in order of relevance, which is the default search method of YouTube, in order to effectively simulate a typical user's experience. De-duplication was performed, and inclusion criteria were then applied to filter search results. The following data was extracted: author, title, upload date, and views.

2.2. Evaluation of educational material

The following features of educational videos were assessed: educational value, reliability, and accessibility. Given that there are no evidence-based guidelines on how to safely perform the insertion of an EVD, a scoring system was developed by a Consultant Neurosurgeon (PL) and Senior Neurosurgical trainee (MZ) to critically evaluate the educational value of selected videos (Fig. 2). The scoring system examined ten key steps, as well as nuances, techniques and safety considerations with a score range of 0–20. Two independent reviewers (IM and SM) then scored each video separately, and discrepancies of two points or greater were settled following discussion with the senior author. The mean score was then calculated, and videos were dichotomised into 'effective' and 'ineffective' groups based on a cut-off score of 10. Features of videos in both subgroups were then further analysed. In order to assess reliability, we used the previously validated *Journal of Medical Association* (JAMA) Benchmark score [10], which evaluates media across four separate domains: Authorship, Attribution, Disclosure and Currency [11]. Accessibility and general utility for trainees was evaluated using the five-point *Global Quality Score* (GQS) [12], which categorises online educational material from 1 to 5 as very poor, poor, satisfactory, good and excellent respectively, based on the overall flow and accessibility of internet based medical education content [13]. Ethical approval was not sought for this project as all content was found in the public domain.

2.3. Statistical methods

A Pearsons Correlation Coefficient was used the observe the relationship between viewership and educational score. The Kolmogorov-Smirnov Test of Normality confirmed that views showed a normal distribution, therefore an unpaired T-test was used for comparing the number of views between the Effective and Ineffective groups.

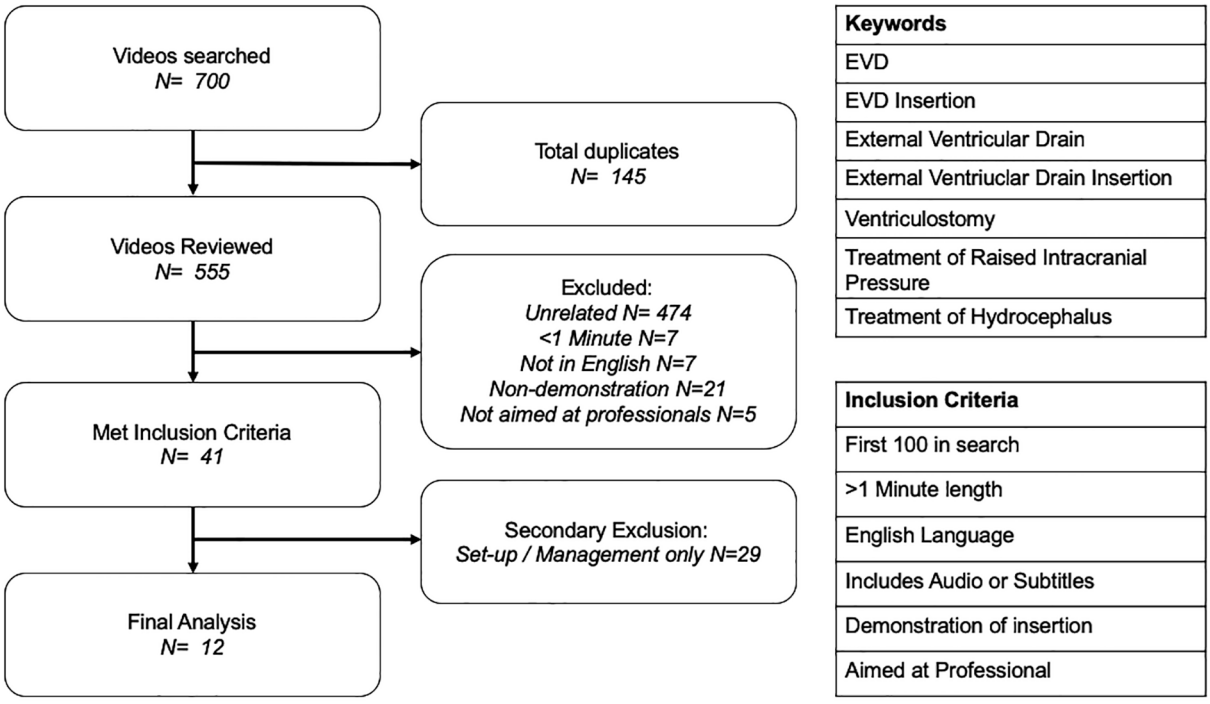

Fig. 1. Summary of search strategy with keywords used, inclusion criteria and flow diagram of results.

Video Evaluation	
Assessment Criteria: *2 points – Fully explained and demonstrated* *1 points – Partially explained or just demonstrated* *0 points – No explanation or demonstrated*	
Key step related to EVD Procedure:	**Assessment: Score 2, 1 or 0**
YouTube source mentioned?	
Aseptic technique of staff? • Hand washing, surgical mask etc..	
Kocher's Point explained? • 11cm posterior to nasion • 2.5cm from midline ipsilaterally	
Catheter Trajectory explained? • Coronal plane that passes through external auditory meatus? • Towards medial canthum of ipsilateral eye?	
Catheter advanced slowly with stylette in-situ through the burr-hole with correct trajectory?	
How to determine if catheter is in the ventricle, with safe withdrawal of stylette. • Characteristic "pop" before CSF fluid begins to drain	
Main drainage system has been levelled with reference to the tragus?	
Aseptic technique regarding sterile field? • Full sterile draping of the patient • Chlorexidine/Iodine/Antiseptic skin preparation applied? • Adherent transparent dressing film is applied, with borders secured with sterile adhesive strips?	
Catheter Secured?	
Dural edges and underlying Pia mater coagulated?	
Total Score:	**/20**

Fig. 2. A video evaluation scoring sheet created for the purpose of this study.

3. Results

A total of 700 videos were reviewed from the initial search. Following de-duplication and application of inclusion criteria, a total of 12 videos (2.15%) were shortlisted for final analysis (***Appendix 1***). One third of included videos (N = 4) were uploaded by verified sources. This included a neurosurgical education initiative launched by a National Health Service (NHS) trust (N = 1), while the remainder (N = 3) were from a medical device company (IRRAS). Of the remaining eight videos, sources included specialist interest channels (N = 3), private users that were self-depicted as neurosurgeons (N = 2), private users with no identifiable background characteristics (N = 2), and a 3-D printing company (N = 1). Four videos originated from the same source but had been edited independently to varying lengths; this was accounted for in final analysis. Three videos were produced by the same medical device company explaining the insertion of three different EVD devices.

The final sample had average views of 30,531 (SD 49,570; range 359 – 166,388) (Fig. 3***)*** and was normally distributed (*D = 0.3367, p = 0.1081*) The total views for all videos were 366,382. Videos were uploaded over a range of 7 years, with dates spanning 01/07/2012 – 24/04/2019. The mean score for the sample was 6.91 (SD 3.86; range 3–16). A strong correlation was found between viewership and score (R 0.85, $p < 0.005$) (Fig. 4). The median JAMA score was 2/4 (SD 0.62; range 1–3). The median GQS was 2/5 (SD 1.60; range 1–5).

Videos were dichotomised into 'effective' (Group 1; score >/= 10) and 'ineffective' (Group 2; score < 10) groups. Four videos (33.3%) were assigned to Group 1, with average views of 79,908 (SD 60,330; range 359 – 166,388) and mean score 11.75 (SD 2.49). The remaining 8 videos (66.7%) were assigned to Group 2, with average views of 5,844 (SD 6,113; range 409 – 20,058) and a mean score of 4.50 (SD 1.32). Group 1 had a significantly higher mean viewership in comparison to Group 2, with a difference of 74,064 views *t(10) = 3.13p = 0.011. (*Fig. 5*).*

4. Discussion

The potential advantages of open access online platforms for surgical training are evident, including: (i) global accessibility, allowing trainees to access a wealth of resources from around the world; (ii) individualisation of learning, by allowing learners to engage with content at their own pace; and (iii) independence from logistical constraints, which are becoming increasingly apparent in light of the current global pandemic. Whilst it is too early to assess the full impact of COVID-19 on neurosurgical training, there are already early indications of a detrimental effect in several centres across the US [14].

Given the reductions in elective operative workload, and cancellation of conferences and training courses, learning adjuncts such as YouTube are becoming increasingly important as a tool for self-directed learning for surgical trainees [15]. This is reflected by a vast majority of Neurosurgical trainees reporting they had used online videos as part of their learning in a national survey [16]. There are neurosurgical institutions such as the American Association of Neurological Surgeons (AANS) and the Neurosurgery Research and Education Foundation (NREF) provide online educational resources designed for trainees and medical students [17]. The demand for high quality neurosurgical educational videos for trainees is recognised in the success of The Neurosurgical Atlas, which is an online multimedia website offering learning material on the safe practice and techniques of many neurosurgical procedures, which has reported a large number of page visits and views on its content [18].

However, the increased use of open access learning material mandates an equally rigorous approach to evaluating its quality and validity. Indeed, a recent study evaluating patient educational videos for neurosurgical conditions concluded that content was heavily biased by advertisements disguised as patient education videos, with limited referencing and sourcing of material [19]. With respect to learning material for neurosurgical trainees, however, there have been no attempts to evaluate YouTube as an educational resource for specific procedures to date.

The identified sources of uploaded videos highlight the importance for evaluation, as only one third were from verified sources. Of note, the three videos uploaded by a medical device company were categorised as ineffective for learning purposes. A further finding was the presence of four videos from the same source but edited to different lengths and posted by different users. Interestingly, only two of the videos were categorised as effective, and there was a large variation in viewership of the four videos despite their similarities. This is a key illustration of the potential danger of users posting inappropriately edited content under the pretence of an original and trusted source. The median JAMA score, which may be interpreted as a measure of reliability [11], scored only 2/4 overall, suggesting poor reliability and accuracy of the sources. This was due to the majority of resources not clearly demonstrating the authorship or source of the video, as well as a lack of referencing.

Despite the large number of videos assessed initially, only a small number were eligible for final inclusion (12 out of 700 videos), and only one third of these videos were considered effective for learning. Indeed, the vast majority of results were based on medical and non-medical topics unrelated to EVD, and other resources detailing the set-up and management of EVD systems aimed at nursing professionals. When compared with similar studies in other surgical subspecialties [20–22], the volume and viewership of neurosurgical educational videos are considerably lower. Whilst this has not been formally assessed, this could represent an area for improvement for neurosurgical academia. Only 4 of the 12 videos in the final analysis were considered to be a useful educational resource with regards to the insertion of an EVD. In

	Full sample (n=12)	Effective (n=4)	Ineffective (n=8)
Total Views	366382	319633	46749
Mean Views (SD)	30532 (49570)	79908 (60331)	5844 (6113)
Mean Score (SD)	6.91 (3.86)	11.75 (2.49)	4.5 (1.32)
Median JAMA Score (SD)	2 (0.62)	2 (0.71)	1 (0.48)
Median GQS (SD)	2 (1.6)	4 (0.43)	2 (0.5)

Fig. 3. A table comparing the full sample of videos, and the effective / ineffective subgroups by views, mean views and scores on the three independent scoring systems.

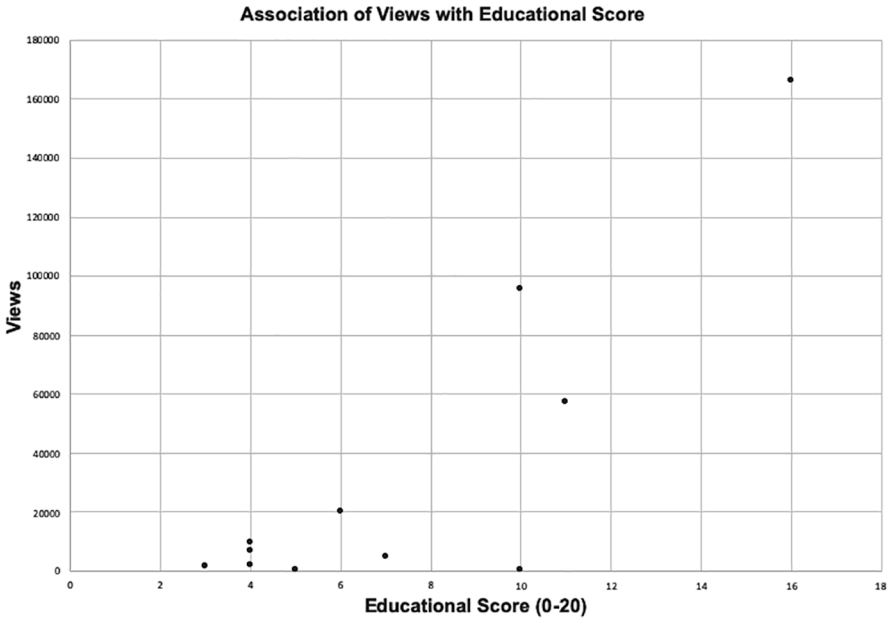

Fig. 4. Graph demonstrating the positive relationship *($R^2 = 0.72$, $p = < 0.001$)* between EVD educational score (X and total views (Y).

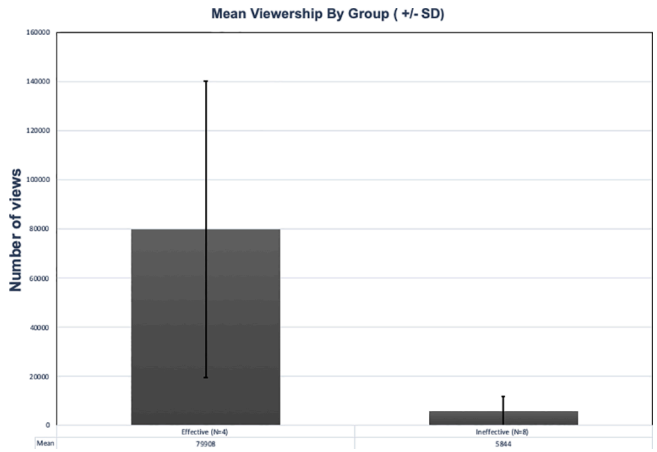

Fig. 5. Chart demonstrating the difference of mean views in the Effective and Ineffective group.

this regard, our study's findings draw similar conclusions to other studies of surgical procedures deeming the majority of online content to be neither useful nor safe [21,23]. Overall usefulness of the content, suggested by the median GQS score of 2/5 [11] was poor (mean 2.75/5, SD 0.43), indicating that there is significant scope for further improvement. However, our results demonstrate that videos that we scored as effective also had significantly higher views than videos considered ineffective. The three highest scoring videos had the highest number of views, suggesting that viewers will gravitate towards more useful resources. Also, the video accounting for the highest number of views also scored the highest for educational value, JAMA Benchmark Score, and GQS. This highlights that high quality educational content from reliable sources still has the potential to positively impact the global neurosurgical audience.

The most useful and reliable video 'How to place an external ventricular drain by Dr Michael Horowitz' *(appendix 1)* based on both the Educational Score *(16/20)* and JAMA Benchmark Score *(3/4)* may be of use to the neurosurgical trainee when learning or revising this procedure. In comparison, the 'External Ventricular Drain' [24] content on the recognised educational resource The Neurosurgical Atlas scored 17/20.

5. Limitations

A limitation to the findings of our study is the use of an Educational Score to evaluate the effectiveness of the EVD videos. While this was created with an experienced Consultant Neurosurgeon and Senior Registrar, it is not a validated method. However, given that there are currently no specific validated methods of evaluating online educational material on neurosurgical procedures, the creation of our own scoring system specific to the EVD procedure was mandatory.

Another limitation is that we are unable to determine if the views from each video were from neurosurgical trainees or other persons, or the actual number of users who viewed the content compared to the number of actual views.

6. Conclusion

YouTube has the potential to be a useful learning adjunct for the performance of basic neurosurgical procedures such as insertion of an EVD. In the current COVID-19 pandemic, the importance of educational media has never been more important to neurosurgical trainees. Despite the volume of media available, only a limited number are effective in terms of educational value, accessibility, and reliability. Trainees should use caution when using YouTube for training purposes, and instead use more established resources in Neurosurgical education. However, given that useful videos gain significant viewership, there is scope for the global neurosurgical community to use existing platforms to offer easily accessible learning material during challenging times for training. In either case, rigorous evaluation of educational videos with validated metrics are essential to promote acceptable standards.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix 1:. Table Summary of all videos included in the study including source

Video Demographics				Scores		
Name	Source	Year	Views (n)	Educational Score (X/20)	JAMA (X/4)	GQS (X/5)
EDITED-How to place an external ventricular drain aka ventriculostomy Sequence	Joshua Beck https://www.youtube.com/watch?v=x3br6tZRak4	2017	4758	7	1	3
EVD Infection Control Protocol - Placement	TheStrokeChanel https://www.youtube.com/watch?v=kmBh_6wSxI0	2013	20,058	6	1	2
External Ventricular Drain Insertion	Brainbook https://www.youtube.com/watch?v=XaL8AElw79o	2017	57,361	11	2	4
External Ventricular Drain Placement by Dr. Michael Horowitz	Michael Horowitz https://www.youtube.com/watch?v=AcgMf3CEWQ4	2013	166,388	16	3	5
How to place an external ventricular drain (aka: ventriculostomy)	Virtualmedstudent https://www.youtube.com/watch?v=x49rY0tZpVI	2012	95,525	10	2	4
Hummingbird Synergy Ventricular bolt placement for multimodal monitoring	Hummingbird Neuromonitoring https://www.youtube.com/watch?v=Th-C1R5aRg8	2012	1985	4	2	2
Hummingbird SynergyDuo Ventricular bolt placement for multimodal monitoring	Hummingbird Neuromonitoring https://www.youtube.com/watch?v=kg8brkJirXY	2012	409	5	2	2
Hummingbird Ventricular Bolt Based ICP Monitoring and Ventricular Drainage	Hummingbird Neuromonitoring https://www.youtube.com/watch?v=zD6HMmc0QmA	2012	6848	4	2	2
Intracranial Pressure Monitoring with Ventricular Catheter	neurosurgerynimhans Nimhans https://www.youtube.com/watch?v=d0i9M5xCOUo	2017	1469	3	2	2
Simulated Ventriculostomy (EVD) ON 3D printed models	3D LifePrints https://www.youtube.com/watch?v=OzRvWzttudM	2017	1670	3	1	2
Ventriculostomy Procedure	Aaron Silva https://www.youtube.com/watch?v=iKseXaRwJ8o	2014	9552	4	1	1

References

[1] A. Ahmet, K. Gamze, M. Rustem, K.A. Sezen, Is video-based education an effective method in surgical education? A Systematic Review, J. Surg. Educ. 75 (5) (2018) 1150–1158, https://doi.org/10.1016/j.jsurg.2018.01.014.

[2] S. Tackett, K. Slinn, T. Marshall, S. Gaglani, V. Waldman, R. Desai, Medical Education Videos for the World: An Analysis of Viewing Patterns for a YouTube Channel, Acad. Med. 93 (8) (2018) 1150–1156, https://doi.org/10.1097/acm.0000000000002118.

[3] C. Stokel-Walker, Covid-19: The doctors turned YouTubers, BMJ 369 (2020), m1563, https://doi.org/10.1136/bmj.m1563.

[4] N. Samuel, N.M. Alotaibi, A.M. Lozano, YouTube as a Source of Information on Neurosurgery, World Neurosurg. 105 (2017) 394–398, https://doi.org/10.1016/j.wneu.2017.05.111.

[5] K. Toolabi, R. Parsaei, F. Elyasinia, A. Zamanian, Reliability and Educational Value of Laparoscopic Sleeve Gastrectomy Surgery Videos on YouTube, Obes Surg. 29 (9) (2019) 2806–2813, https://doi.org/10.1007/s11695-019-03907-3.

[6] N.R. Ellens, D.L. Fischer, J.E. Meldau, B.A. Schroeder, S.E. Patra, External Ventricular Drain Placement Accuracy and Safety When Done by Midlevel Practitioners, Neurosurgery. 84 (1) (2019) 235–241, https://doi.org/10.1093/neuros/nyy090.

[7] C.Y.C. Chau, C.L. Craven, A.M. Rubiano, H. Adams, S. Tülü, M. Czosnyka, F. Servadei, A. Ercole, P.J. Hutchinson, A.G. Kolias, The Evolution of the Role of External Ventricular Drainage in Traumatic Brain Injury, J. Clin. Med. 8 (9) (2019) 1422, https://doi.org/10.3390/jcm8091422.

[8] J. Yuen, W. Selbi, S. Muquit, T. Berei, Complication rates of external ventricular drain insertion by surgeons of different experience, Ann. R Coll. Surg. Engl. 100 (3) (2018) 221–225, https://doi.org/10.1308/rcsann.2017.0221.

[9] A. AlAzri, K. Mok, J. Chankowsky, M. Mullah, J. Marcoux, Placement accuracy of external ventricular drain when comparing freehand insertion to neuronavigation guidance in severe traumatic brain injury, Acta Neurochir. (Wien). 159 (8) (2017) 1399–1411, https://doi.org/10.1007/s00701-017-3201-5.

[10] W.M. Silberg, G.D. Lundberg, R.A. Musacchio, Assessing, Controlling, and Assuring the Quality of Medical Information on the Internet: Caveant Lector et Viewor—Let the Reader and Viewer Beware, JAMA 277 (15) (1997) 1244–1245, https://doi.org/10.1001/jama.1997.03540390074039.

[11] M.N. Erdem, S. Karaca. Evaluating the Accuracy and Quality of the Information in Kyphosis Videos Shared on YouTube. Spine (Phila Pa 1976). 43 (22) (2018) E1334-e1339. https://doi.org/10.1097/brs.0000000000002691.

[12] A.G. Singh, S. Singh, P.P. Singh. YouTube for information on rheumatoid arthritis–a wakeup call? J. Rheumatol. 39 (5) (2012) 899. https://doi.org/10.3899/jrheum.111114.

[13] J. Van den Eynde, A. Crauwels, P.G. Demaerel, et al., YouTube Videos as a Source of Information About Immunology for Medical Students: Cross-Sectional Study, JMIR Med. Educ. 5 (1) (2019), e12605, https://doi.org/10.2196/12605.

[14] S.W. Guadix, G.M. Winston, J.K. Chae, et al., Medical Student Concerns Relating to Neurosurgery Education During COVID-19, World Neurosurg. (2020), https://doi.org/10.1016/j.wneu.2020.05.090.

[15] M. Farag, D. Bolton, N. Lawrentschuk, Use of YouTube as a Resource for Surgical Education-Clarity or Confusion, Eur. Urol. Focus. 6 (3) (2020) 445–449, https://doi.org/10.1016/j.euf.2019.09.017.

[16] P.K. Kumar, B. Bhadran, G. Harrison, Neurosurgery videos on online video sharing sites: The next best teacher? Neurol. India. 67 (2) (2019) 505–509, https://doi.org/10.4103/0028-3886.258028.

[17] S. Abdul Salim, W. Cheungpasitporn, V. Echols, et al., Forty-five years on home hemodialysis, a case of exceptional longevity, Hemodial. Int. 23 (4) (2019) E120–E124.

[18] B. Davidson, N.M. Alotaibi, B.K. Hendricks, A.A. Cohen-Gadol, Popularity of Online Multimedia Educational Resources in Neurosurgery: Insights from The Neurosurgical Atlas Project, J. Surg. Educ. 75 (6) (2018) 1615–1623, https://doi.org/10.1016/j.jsurg.2018.05.001.

[19] M. Ward, B. Ward, M. Abraham, et al., The Educational Quality of Neurosurgical Resources on YouTube, World Neurosurg. 130 (2019) e660–e665, https://doi.org/10.1016/j.wneu.2019.06.184.

[20] J.S. Lee, H.S. Seo, T.H. Hong, YouTube as a potential training method for laparoscopic cholecystectomy, Ann. Surg. Treat Res. 89 (2) (2015) 92–97, https://doi.org/10.4174/astr.2015.89.2.92.

[21] M.F. Ferhatoglu, A. Kartal, A. Filiz, A. Kebudi, Comparison of New Era's Education Platforms, YouTube® and WebSurg® Sleeve Gastrectomy, Obes Surg. 29 (11) (2019) 3472–3477, https://doi.org/10.1007/s11695-019-04008-x.

[22] E. Karabay, N. Karsiyakali, K. Kayar, H. Koseoglu, Hypospadias surgery on YouTube: is it valid? Minerva Pediatr. (2019). https://doi.org/10.23736/s0026-4946.19.05555-5.

[23] H.A. Rodriguez, M.T. Young, H.T. Jackson, B.K. Oelschlager, A.S. Wright, Viewer discretion advised: is YouTube a friend or foe in surgical education? Surg. Endosc. 32 (4) (2018) 1724–1728, https://doi.org/10.1007/s00464-017-5853-x.

[24] External Ventricular Drain; 2020. https://www.neurosurgicalatlas.com/volumes/principles-of-cranial-surgery/external-ventricular-drain (accessed 21/12/20).