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WRONG SIDE NEUROSURGERY

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Abstract: A very important problem of bioethics in surgery, in general and in neurosurgery, in particular, is wrong side surgery. This kind of mistake is more common in specialties where patients are operated immediately and in large departments with a big number of interventions. In order to address this problem, neurosurgical departments need guidelines to prevent wrong-side surgery. These guidelines should include having an open discussion between the surgical team about the case, verifying the surgical procedure to be performed, marking the surgical site in advance, adopting a series of neurosurgical checklists, using the latest technology in the field or keeping an error record. In wrong side surgery even an incision without the craniotomy represents a serious mistake and should be avoided.

Key words: wrong sided surgery, neurosurgery, medical error, bioethics.

INTRODUCTION

Ethics connotes a sense of self-respect that as a mere custom denies you the right to do anything wrong, even when not policed or monitored. It is an inner conviction about what is proper and philanthropic [1]. The critics of modern medicine claim that everywhere in the world has been registered a decline in medical and social ethics, neurosurgery included [1].

Fortunately, the past years have witnessed the development of a new branch of neurosciences called neuroethics. It works in two main directions: the ethics of neurosciences (seeks to develop an ethical framework for regulating the conduct of neuroscientific enquiry and the application of neuroscientific knowledge to human beings) and the neuroscience of ethics (the impact of neuroscientific knowledge upon our understanding of ethics itself) [2].

Apart from the ethical aspects, another discipline is yet to prove its usefulness by capturing and integrating the wealth of information in this fast-evolving specialty into better patient care decisions, improved outcomes, and better information for patients and their families – evidence based medicine (EBM), which emphasizes the use of a defined set of principles aimed to critically analyse and synthesize research findings and disseminate evidence into medical practice [3].

Medical errors in neurosurgery – actual concepts

Neurosurgery is far from being immune to medical errors. The complexity of neurosurgical patients and the interdisciplinary teams required to manage their conditions expose these patients to the same errors found in other medical and surgical specialties, along with errors unique to neurosurgery.

Medical errors have been defined in various ways, but at their core, they are acts of omission or commission that cause harm or have the potential to cause harm to patients. This definition was elaborated in the neurosurgical literature by Stone and Bernstein as any act of omission or commission resulting in deviation from a perfect course for the patient. A perfect course was defined as one in which nothing went wrong, from the smallest detail (such as dropping a sponge) to the most obvious example – wrong site neurosurgery (WSN) [4, 5].

The surgical procedure performed on the wrong

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side or body area – "WSN", is part of a broader concept – "wrong site surgery", which is often used as a general designation of several subtypes of incorrect site surgical events [6]: incorrect site surgery (in particular) - surgical procedure performed on an incorrect body part; wrong level surgery - surgical procedure performed at a wrong level but at the correct site; wrong level exposure - surgical exposure completed on a faulty level; wrong side surgery - surgical procedure performed on the wrong side of the body or on the erroneous extremity; incorrect procedure – the wrong surgical procedure performed on the right side and site; and incorrect patient - intervention performed on the incorrect patient.

Generating factors for wrong-sided neurosurgery

There are several main aspects responsible for most cases of WSN: incorrect positioning of the patient as well as the failure of the devices required for the procedure [7].

Positioning of neurosurgical patients is an important part of every procedure and paying attention to the physical and physiological consequences of incorrect positioning can prevent serious adverse events and complications. Ideal patient positioning involves balancing surgical comfort against the risks related to the patient position. Complications due to incorrect positioning of the patients for neurosurgical procedures include[8]: perioperative nerve injury - brachial plexus injury, ulnar, radial or median neuropathy; postoperative visual loss - most common causes of postoperative visual loss are ischemic optic neuropathy and central retinal artery occlusion.

Most of the neurosurgical procedures require devices for their completion, like high speed drills, operating microscopes, neuroendoscopes, ultrasounds, C-arms, neuronavigation, cavitron ultrasonic surgical aspirators, etc. In the case of malfunction of such devices, depending on the stage of the intervention, the surgery may not be performed at all, or could fail to be completed in the preoperatively planned manner and extent.

Another commonly identified upstream error is that of incorrect listing of the operation. In a 2014 review of wrong-site procedure data, 59 (11%) out of 541 cases of wrong-site procedures were related to incorrect information from the surgeons' office. These included 34 operations on the wrong side, 2 operations at the wrong spinal level, 8 procedures at the wrong site and 15 incorrect procedures [9]. Over 14% of neurosurgical patients, in particular, suffer one or more perioperative complications, many of which are preventable [10]. Wrong-side or wrong-patient procedures occur in approximately 1 case out of every 100,000 operations, and in 2.2 cases out of 10,000 craniotomies [11], the prevalence reaching up to 4.5 in 10,000 cases dependent on the procedure being performed [12, 13].

Only a couple of studies have analysed errors specifically in the field of neurosurgery. In one of them, the authors reported on the prospective collection of error data in neurosurgery [5] (between May 2000 and August 2006), on a total number of 1108 elective cases, comprising 76.1% cranial, 22.7% spinal, and 1.2% other procedures. There were 2684 errors in 87.1% of cases. The most common errors were technical (27.8%), contamination (25.3%), equipment failure or missing equipment (18.2%), or related to delay (12.5%). Of the errors, 22.6% were considered major and 77.4% were minor, with 2.7% of errors substantially impacting the clinical course of the patient. Of all errors, 78.5% were deemed preventable. Of the complications, 16.7% were related to errors, of which 80.6% were major errors.

Other authors have incorporated data from the prior study and reported their experience cataloguing errors from 2000 to 2013, where all errors were prospectively logged by the senior author for 2082 of his cases [4]. Intraoperative errors and their characteristics were prospectively recorded between May 2000 and May 2013. This period has been divided in two groups - Group A = error patterns observed between May 2000 and August 2006, Group B = error patterns observed between September 2006 – May 2013. A total of 1108 cases in Group A and 974 cases in Group B were surgically treated. A total of 2684 errors were recorded in Group A, while 1892 errors were recorded in Group B. The results showed a marked decrease in the proportion of cases with error (87% to 83%, $p < 0.006$), mean errors per case (2.4 to 1.9, $p < 0.0001$), proportion of error-related complications (16.7% to 5.5%, $p < 0.002$), and clinical impacts of error (2.7% to 1.0%, $p < 0.0001$) in Group B compared with Group A. Moreover, errors recorded in Group B had a more predictable nature than those in Group A (85.8% vs 78.5%, $p < 0.0001$) whereas a significant reduction was also noticed with most types of error. A descending trend in the mean errors per case was demonstrated from the years 2001 to 2012. On the other hand, the number of severe errors has increased in the Group B (22.6% to 29.5%, $p < 0.0001$) compared with Group A during this period.

Neurosurgery has records of wrong-sided operations performed both on the brain as well as in the spinal cord pathology. Jhawar *et al.* [14] discovered that 735 interventions have been performed, either wrong-

sided or entirely wrong. The same author conducted a study [17] on neurosurgeons who performed 4695 lumbar and 2649 cervical discectomies, as well as 10,203 craniotomies. Based on this self-reporting, the incidence of wrong-level lumbar surgery was estimated to be 4.5 per 10,000 operations, 6.8 for cervical discectomies and 2.2 for craniotomies respectively per 10,000 interventions.

In a study published in 2010 [15] the concept of deviation from an optimal course (DOC) was introduced in order to cover as many errors as possible. More than 1100 consecutive operative cases were studied, 756 cases could be evaluated, among them 529 elective and 227 emergency cases. A total of 190 DOC (25%) were found. The most common DOC was primarily due to (a) equipment failure or missing equipment, (b) pre-operatory mismanagement, and (c) non-optimal procedures. Unexpectedly, the error rate in emergency cases was lower than in elective cases (14% vs. 30%).

Risk factors of Wrong-sided procedures

Neurosurgery represents the third most amenable surgical area to wrong site surgery next to orthopaedics and general surgery [16]. The most frequent risk factors include: incorrect patient positioning or preparation of the operative site, erroneous information provided by the patient or their family, missing or improper patient consent, failure to use site markings, neurosurgeon exhaustion, several neurosurgeons involved in one case, multiple procedures on the same patient, unusual time limits, emergent procedures, unusual patient anatomy and overall poor operative team communication [17]. In a more clear and condensed approach, these factors may be classified as follows:

1. connected with service management: incorrect imagistic establishment of the part where the pathological process is located, unusual time pressure, urgent interventions, lack of data verification medical protocol, both in the clinic and the operating room (OR), the incomplete and improper documentation;

2. connected with team management: insufficient communication between doctors, between the member of the operatory team, uncertainty in pointing out an error (the intern or the nurse can feel intimidated about pointing this to the chief doctor);

3. connected with the human dimension: fatigue, distraction, priority conflicts, role conflicts, erroneous prioritization at the beginning of the surgery, ambiguities (emergencies that can occur at the same time);

4. connected with the doctor-patient relationship: lack of patient involvement (as well as family involvement) in understanding aspects of his diagnosis, lack of training in giving an informed consent, lack of surgical site in the operating room [17];

5. connected with the patient: as far as spine surgery is concerned, the problem of patient's particular anatomy has been evoked (correlated with the error of not checking the x-rays for the site to be operated [15].

Prevention

There are various strategies that could be implemented as precautionary measures. The most common of them focus on having an open discussion between the surgical team about the case, marking the site, adopting a series of neurosurgical checklists, using the latest technology in the field or simply keeping an error record.

Team discussion

Convergence and cooperation within the interdisciplinary medical team is essential. Doctors need to involve on a professional level and converge towards the patient's health. They should avoid personal disputes and vanities and share the responsibility for the patient. This practice should diminish, even cancel the factors that lead to medical errors, thus creating the conditions for the disappearance of the concept of "wrong-side neurosurgery" [17]. Moreover, a responsible and emphatic involvement is considered of an outmost importance as well [1].

Surgical site marking

As any other surgical department, site marking might be categorised as one of the biggest and handy error saving procedures. The importance of site marking was shown in an eight-case study on neurosurgical operations performed on the wrong side [16]. In seven cases site marking was not done although the surgeons felt that had it been done. In all but one case the surgeon's normal site check was omitted. In the one case where the check was carried out the mistake was made because the patient had been marked on the wrong site.

Checklists

Checklists represent a tool designed to collect information with the purpose of preventing the human error due to the inherent limitations of human attention and memory, as it guarantees the sequence and accomplishment of the planned assignment [17]. The World Health Organization created the Surgical Safety Checklist in 2007 to improve team communication and ensure key preoperative steps were conducted [18]. A multi-site pilot of the World Health Organisation

(WHO) checklist found a 4% reduction in complications and 0.7% reduction in mortality [17].

Up to date technology

Advanced technological systems can also be used in order to prevent wrong-side operations. In neurosurgery, each craniotomy could be performed with the help of a surgical navigation system. Thus, the occurrence of wrong-side craniotomy would be decreased from rare to almost never [11]. In addition, other technologies such as barcode-enabled medication administration should be taken into through account [19].

Error recording

Error recording proved useful not only from the point of gathering a science-based statistics, but also from the point of raising awareness among medical personnel [4]. This study has revealed significant improvement in most characteristics of errors. One explanation for this improvement may be the increased awareness of errors among team members as well as the accommodation of neurosurgery residents, nurses, and anaesthesia staff about the commonness and preventability of errors.

In conclusion, it seems that the type of procedure and patient's characteristics are important factors to consider when addressing surgical error. For individual surgeons to maintain quality control and contribute to the safety of the healthcare system, they must track and analyse errors to ensure that systems may be developed to prevent their occurrence [5][20].

Neurosurgical wrong sided interventions do occur, but are rare events. The literature data suggest that the prevention of such errors will require neurosurgeons to recognize risk factors and increase the use of intraoperative imaging [17].

Over the last few years important consideration has been pointed at marking the surgical site [21] and talking again to the patient before general anaesthesia. A brief review of the local anatomy must always be performed preoperatively as this is a frequent cause of wrong sided surgery. Modern neurosurgery needs to be very rational, have well established principles and strategies in order to eradicate major errors, such as wrong-side operations. Concern for the patient's life as well as excellency in treatments are provided not only by the intellectual power, but also by the neurosurgeon's personality and humanism.

Conflict of interest

The authors declare that they have no conflict of interest.

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