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Original Research Article

A Cross-Sectional Observational Identification of the Adherence to Various Elements of the Modified WHO SSC for Neurosurgery

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Abstract

Aim: The primary aim of this study was to identify the adherence to various elements of the Modified WHO SSC for neurosurgery by the perioperative care team. The secondary aims were to evaluate how a mandatory speciality-specific checklist implementation practice can help in early identification of those therapeutic aspects that are pertinent and specific to neurosurgery.

Methodology: A cross-sectional observational study was conducted to evaluate the adherence to various elements of the Modified WHO SSC for neurosurgical procedures. The study was conducted in IGIMS Patna for 1 year . Informed written consent was obtained from participating patients. The study was conducted in the neurosurgical ORs of our institution. We selected a total of 100 consecutive patients undergoing neurosurgery for the study. The observed cases formed a sample of patients undergoing cranial or spinal surgery for their primary disease. The nursing personnel follow a written pre-operative checklist in our institution.

Results: A total of 63 cases undergoing craniotomy and 37 cases undergoing spine surgery were studied. The performance of the modified SSC was 100% among the checklist co-ordinators. With the 40-point modified SSC applied in 100 cases, we analysed a total of 4000 observations. The team member's participation reported by checklist co-ordinators was as follows- Excellent 78%; good 21%; and poor 1%. Distraction levels during checklist conduct were as minimal in 83%; moderate in 15%; and maximum in 2% of the cases.

Conclusion: The implementation of a speciality-specific neurosurgical checklist by a designated checklist co-ordinator can rectify in time anaesthetic and surgical facets without increasing the OR time. It also improves communication among the team members and results in a smooth workflow in the neurosurgical OR.

Keywords: anaesthesia, surgery, neurosurgery.

Introduction

As a highly specialized branch of the surgical sciences, neurologic surgery is a high-risk specialty prone to human errors in all the patients' in-hospital course: preoperative, intraoperative, and postoperative periods [1-3]. The intraoperative phase of this care is probably the most error prone, naturally. Operative neurosurgery (in general and the subspecialties) deploys in the course of each surgical dissection diverse range and number of man-made precision tools, in man-made work systems that incorporate several other multidisciplinary players like anesthetists, operative room nurses, neurophysiologists, operative room assistants, and biomedical engineers [3]. Some of the tools are fine, some bulky; some are simple manual tools, others comprise complex powered equipment. Most involve several small working parts. Also brought into the surgical fields during operative neurosurgery are a vast array of consumable/ disposable materials including standard surgical ones like sutures, needles, gauze sponges, and swabs, as well as neurosurgically specific consumables like neuropatties, cotton balls, bone wax, probes, and catheters/tubes.

With such staggering breadth of possibilities of the human errors that each operative neurosurgical patient gets exposed to, it is actually a mighty wonder that these errors are indeed an infrequently documented occurrence in contemporary operative surgery. Unless they are being underreported,3 the data on this problem show it to occur rather infrequently in the literature. Nevertheless, even the few documented ones exact such a high price on life, as well as the well-being of the affected, that they call for unrelenting efforts to prevent them [4].

The ‘Safe Surgery Saves Lives’ global campaigns in 2007 by the World Health Organization (WHO) lead to the demonstration of WHO Surgical Safety Checklist (SSC) in the operating room (OR), in significantly reducing mortality and adverse events [5]. The 19- item checklist, deployed in diverse global surgical populations, was associated with marked improvement in surgical outcomes. The enthusiasm fostered by this salutary effect of the SSC appears to have caused a great surge in the academic corpus relating to OR safety, especially regarding such metrics as iatrogenic intraoperative injuries and mishaps including surgery on the wrong-patient/side/anatomic level; surgical site infections; perioperative venous thromboembolism, and, in particular, retention of surgical instruments [6-9].

Neurosurgical practice requires a high expertise, enduring and long working hours, with no scope for inadvertent errors. Ever since the implementation of the WHO SSC, vast progress has been made in surgical neurosciences that mandates specific intra-operative essentials not required in other surgical sub-specialities. The global experience with a speciality-specific checklist in neurosurgery is limited [10]. The primary aim of this study was to identify the adherence to various elements of the Modified WHO SSC for neurosurgery by the perioperative care team. The secondary aims were to evaluate how a mandatory speciality-specific checklist implementation practice can help in early identification of those therapeutic aspects that are pertinent and specific to neurosurgery, which can otherwise be missed.

Methodology:

A cross-sectional observational study was conducted to evaluate the adherence to various elements of the Modified WHO SSC for neurosurgical procedures. The study was conducted in IGIMS Patna for 1 year. Informed written consent was obtained from participating patients. The study was conducted in the neurosurgical ORs of our institution. We selected a total of 100 consecutive patients undergoing neurosurgery for the study. The observed cases formed a sample of patients undergoing cranial or spinal surgery for their primary disease. The nursing personnel follow a written pre-operative checklist in our institution [Table 1].

Table 1: Preoperative preparation checklist for the Neurosurgical patient (To be filled by the nursing personnel in patient care ward before transferring the patient to operating room)

Checklist item (Mark Yes/No)
Informed Consent Local site preparation. Remove implants, dentures, ornaments Intravenous cannula in-situ. Patient identification tag present. Diagnosis and side of surgery marked on tag Nil per oral appropriate for age of the patient. Preoperative medications administered. Radiology images and medical record to accompany the patient on transfer. Blood products arranged at blood bank.

The WHO SSC is a 19-item tool addressing issues pertinent to intraoperative care [5]. We retained all the 19 items of WHO SSC and with further additions to suit the requirements for neurosurgical procedures, developed a modified 40-item SSC. Appraisals and inputs from neurosurgeons, anaesthesiologists and nursing personnel of the neurosurgical OR were carefully considered to develop the modified SSC. This modified WHO SSC was implemented in 100 consecutive elective cases undergoing neurosurgery in the ORs of our hospital. The anaesthesiologist attending the patient assumed the role of checklist co-ordinator in our study.

The co-ordinators were provided with a printed checklist for each patient. The checklist coordinators were trained about the revised checklist and its implementation before initiation of the study by the investigators. Education on the exact timing of implementation of sub-components of the checklist was also part of this training module. Before starting data collection in the OR, consistent inter-rater reliability between checklist coordinators and study investigators was ensured through multiple pre-planned training sessions. Discrepancies during the training period were discussed in detail and standard interpretation of checklist definitions was explained to the coordinators. The checklist divides the surgical procedure into 5 phases, each corresponding to a specific time-period in the normal flow of a procedure.

The list started with a briefing followed by the period, prior to induction of anaesthesia - Sign In. 'Sign in' domain was completed prior to any drug injection/intervention inside the OR. 'Time Out' was the period after induction and before surgical incision; 'Sign Out' corresponded to the period during or immediately after wound closure, with the senior operating surgeon still present in the OR. This was followed by a debriefing which constituted the fifth and final step of checklist implementation.

The respective operative team recapitulated pertinent intraoperative information of the patient and communicated necessary postoperative plans during the debriefing phase. The study investigators kept thorough overall surveillance daily of the new checklist performance. The checklist co-ordinator orally confirmed the completion of the basic steps for ensuring effective teamwork, safe anaesthesia, antibiotic prophylaxis against infection and other inherent routines in surgery. In each phase, the checklist coordinator confirmed that the surgical team had completed the tasks in the SSC as the surgery proceeds onwards. Each task in our printed checklist was to be marked either concordant or discordant by the co-ordinator. Tasks where the checklist prompted a corrective initiative were marked discordant and corrective initiative was initiated as required.

A major goal of checklist implementation is to ensure reasonable communication among OR team members. For this, the checklist co-ordinators recorded participation level of team members as excellent, good and poor (Excellent – all team members participated, good – one team member did not participate and poor when ≥2 team members did not participate). Further distraction levels during checklist conduct was recorded as minimal (non-team member was entering the OR); moderate (non-team member was entering the OR and any team member not attending to checklist questions); and maximum (non-team member was entering the OR, any team member not attending to checklist questions and any team member answering a phone call during checklist implementation). The time required to complete each phase of the modified WHO SSC was also recorded.

Data collected in a prescribed proforma was entered into a Microsoft Excel spreadsheet and analysed. The adherence rates to various components were evaluated as percentages. Areas where the checklist prompted a corrective measure were considered as scope for further improvement in the OR work pattern. The distraction levels and participation levels were also evaluated as percentages. A descriptive analysis of various challenges faced during checklist administration was also done.

Results:

A total of 63 cases undergoing craniotomy and 37 cases undergoing spine surgery were studied. The performance of the modified SSC was 100% among the checklist co-ordinators. With the 40-point modified SSC applied in 100 cases, we analysed a total of 4000 observations.

Table 2: Demographic details

Variables		**Values expressed as Mean±SD or as *n* (%)**
Age(years)		42.73 ± 18.2
Gender	Male	56
	Female	44
Body mass index(kg/m^2)		30.5 ± 8.3
ASA physical status	1 and 2	74
	3 and 4	26
Elective surgery		100

Table 3: Type of neurosurgery

Craniotomy	63
Supratentorial	54
Intraaxiallesion	09
Extraaxiallesion	27
Aneurysm	08
Awakecraniotomy	01
Cranioplasty	03
Infratentorial	08
Cerebellar lesion	07
CPanglelesion	03
Spine surgery	37
Cervical spine instrumentation	14
Lumbar spine instrumentation	01
Lumbar discectomy	17
Spinal cord lesion	05

Compression stockings were not present in 12%cases, wherein the checklist prompted application of stockings/ pneumatic compression devices. Operative site was not marked in 7% cases. 7% patients of the 14% cases undergoing cervical spine instrumentation required advanced airway adjuncts due to unstable spine. The SSC prompted timely mobilization of advanced airway carts with video-laryngoscope/ bronchoscope for 7 of these cases. Patient allergy to phenytoin sodium in 3% cases was revealed to all team members after applying the checklist. The checklist prompted the application of total intravenous anaesthesia (TIVA) for maintenance in 13% cases with raised intracranial pressure. The checklist prompted modifying anaesthesia protocol by avoiding skeletal muscle relaxants, using low alveolar concentration of inhaled anaesthetics and/or preparation for burst suppression in 6% of the 42% cases where neuro-monitoring was used. The checklist prompted timely procurement of ultrasonic dissectors/bone drills/bone-wax/haemostatic agents in 13% cases.

Table4: Sign-in tools of the Modified WHO SSC for Neurosurgery (Total *n*=200)

Tool. no	**Modified Surgical Safety Checklist Entries**	**Concordant *(n)***	**Discordant (n)**	**Corrective initiative done(n)**
	Sign in-(before any medication is administered inside OR, with surgeon present) Verbally verify, review with the patient when possible:			
1.	Is patient identity wrist band present?	100	0	-
2.	Is procedure and site mentioned on wrist band?	100	0	-
3.	Is local site preparation done?	100	0	-
4.	Are dental prostheses, if any, removed?	100	0	-
5.	Are Compression stockings /Pneumatic stocking sinsitu?	88	12	12
6.	Is preoperative medication administered? (Anti-convulsants, Steroids, proton-pumpinhibitors)	100	0	-
7.	Has consent for surgery been obtained?	100	0	-
8.	Is the operative site marked, and is it appropriate? (involving left or right distinction)	93	7	7
9.	Are all necessary monitoring equipments checked, connected and ready?	100	0	-
10.	If patient's risk of blood loss is>500mlinadultsor>7ml/kg in children, it is recommended to have at least 2 large bore intravenous lines or Acentralline before surgical incision and fluids/blood available. Has Necessary precaution been taken?	83	0	-
11.	Has airway difficulty or aspiration risk been as certained with Plan A, B and Cfor difficult airway?	100	0	-
12.	Is video-laryngo scope (VLS)/broncho scope arranged for potential high risk airway due to primary neurologic condition?	11	7	7

13.	Have the patients allergies been as certained and are all member soft the team aware of it?	97	3	3
14.	Have all artificial implants been removed?	96	4	4
15.	Has the patient been diagnosed with raised intracranial pressure?	59	41	-
16.	If yes, adequate preparation for treatment of raised ICP and total intravenous anaesthesia is done?	48	13	13
17.	Are anaesthesia safety checks complete (equipment, medications, emergency medications, patient's anaesthetic risk)?	100	0	-
18.	Does the patient require intra-operative neuro-monitoring (Bispectralindex/Electromyography/Evokedpotentials/Cranialnervemonitoring)?	42	0	-
19.	Has necessary preparation been done for intra operative neuro-monitoring Including modification in anaesthesia protocol?	34	6	6
20.	Are required surgical prostheses arranged-craniotomydrill, bonewax, CUSA, aneurysmclips, haemostaticagents, plate and screws?	87	13	13

The time required for completion of sign-in phase of the checklist was 174± 32 seconds. The time-out and sign-out phases of the check list were completed in89± 12 seconds and 68± 09 seconds, respectively. The team member's participation reported by checklist co-ordinators was as follows- Excellent 78%; good21%; and poor 1%. Distraction levels during checklist conduct were as minimal in 83%; moderate in 15%; and maximum in 2% of the cases.

Discussion:

Earliest experience with a checklist in neurosurgery is an 8-item simple checklist introduced by Lyons et al. [11] Lepanluoma et al. [12] found in their retrospective study that the implementation of standard WHO SSC in neurosurgery was associated with a decrease in complication-related neurosurgical reoperations from 3.3% to 2.0%. Oszvald et al. [13] found no error in operative-site in a series of 3595 neurosurgical procedures in their institution after implementation of WHO SSC. Fargen et al. [14] observed that use of WHO SSC in neuro-interventions improves team communications. Using the WHO SCC, Haugen et al. [15] found that complication rates decreased from 19.9% to 11.5%; mean length of stay decreased by 0.8 days; and in-hospital mortality decreased from 1.9% to 0.2% ($P < 0.001$) in their series of patients undergoing cardiovascular / neurologic/ urologic/orthopaedic/general surgery.

Westmann et al [1] found only 1 randomized controlled trial and 13 original, observational studies covering altogether 58,877 subjects, of which only 29,717 were neurosurgical patients. Many of these studies showed the use of SSC causing improvement in the rates of overall complications, surgical site infections, and reoperations and unplanned readmissions. The SSC also enhanced communication and perception of safety in the OR among the personnel [1]. There are various forms of SSC in use by different surgical specialties. These include either the original one by the WHO or its modifications or subspecialty-specific ones in neurosurgery like for deep brain stimulation or vascular neurosurgery [16, 17]. The checklists range in complexity from the 19-item one by WHO [18] to more extensive ones or a much simpler one like the 8-item intraoperative checklist of Lyons' [11]. In all, it appears, naturally, that the less complex the tool, the higher the level of compliance to be expected in its use.

The vast progress and increase in neurosurgical procedures in the last decade necessitates the need to initiate a speciality-specific SSC [19]. Moreover, the aim of the original WHO SSC is not to prescribe a single universal approach, but to ensure that essential safety elements are incorporated into the OR routine [20]. In our study, we used a paper checklist for each case instead of a poster checklist. Jelacic et al. [21] evaluated the effect of an aviation-style computerised SSC on checklist performance in general surgery and gynaecologic procedures. The authors found that total checklist completion rates with the computerised version were 86.3% compared to 2.1% for a poster version. The authors observed that there is a dramatic difference between observed checklist completion rates and documented checklist completion rates in real-life practice as also inferred by Mahmood et al. [22] and suggested the computerised SSC as an option in attaining better checklist completion rates.

However, implementing a computerised SSC is resource intense, expensive and requires appropriate training to apply in low-income countries. The trained OR anaesthesiologist assumed the role of checklist co-ordinator in our study. Evidence from previous studies indicates that such migrated leadership can improve team engagement and compliance with administering the checklist [23]. Personnel attitudes like denial, lack of engagement, hierarchy in the OR discouraging an open communication and embarrassment about introductions are barriers to implementing a checklist in the OR. Trained checklist co-ordinators who run the checklist at appropriate time frames considerably reduce this ambiguity. [24]

Conclusion:

The implementation of a speciality-specific neurosurgical checklist by a designated checklist co-ordinator can rectify in time anaesthetic and surgical facets without increasing the OR time. It also improves communication among the team members and results in a smooth workflow in the neurosurgical OR.

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