Original Article

Implementation and adherence to a speciality-specific checklist for neurosurgery and its influence on patient safety

Varun Suresh, P R Ushakumari, C Madhusoodanan Pillai, Raja Krishnan Kutty[1], Rajmohan Bhanu Prabhakar[1], Anilkumar Peethambaran[1]

Departments of Anaesthesiology and [1]Neurosurgery, Government Medical College, Thiruvananthapuram, Kerala, India

Address for correspondence: Dr. Varun Suresh, Department of Anaesthesiology, Government Medical College, Thiruvananthapuram - 695 011, Kerala, India. E-mail: varunsureshpgi@gmail.com

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ABSTRACT

Background and Aims: Neurosurgery involves a high level of expertise coupled with enduring and long duration of working hours. There is a paucity of published literature about the experience with a speciality-specific checklist in neurosurgery. We conducted a cross-sectional observational study to identify the adherence to various elements of the Modified World Health Organization Surgical Safety Checklist (WHO SSC) for neurosurgery by the operating room (OR) team. **Methods:** We implemented an intra-operative Modified WHO SSC consisting of 40 tools for neurosurgery, in 200 consecutive elective cases. Trained anaesthesiologists assumed the role of checklist co-ordinator. The checklist divided the surgery into 5 phases, each corresponding to a specific time-period. The adherence rates to various tools were evaluated and areas where the checklist prompted a corrective measure were analysed. **Results:** A total of 131 cases undergoing craniotomy and 69 cases undergoing spine surgery were studied. With the 40-point modified SSC applied in 200 cases, we analysed a total of 8000 observations. The modified checklist prompted the OR team to adhere to speciality-specific safety practices about application of compression stockings (9.5%); airway precautions in unstable cervical spine (2.5%); precautions for treatment of raised intracranial pressure (10.5%); and intraoperative neuro-monitoring (5%). **Conclusion:** The implementation of Modified WHO SSC for Neurosurgery, by a designated checklist co-ordinator, can rectify anaesthetic and surgical facets promptly, without increasing the OR time. The anaesthesiologist as SSC coordinator can effectively implement an intraoperative checklist ensuring excellent participation of operating room team members.

Key words: Checklist, neurosurgery, perioperative care

INTRODUCTION

Surgical procedures play an important role as a treatment modality for many common diseases alleviating the human suffering with millions of surgical procedures performed the world-over every year. After major surgery, there is a reported crude mortality rate in the range of 0.5–5%[1] with at least 50% of the total in-hospital adverse events attributed to surgical care.[2] Many of the surgical complications are due to preventable or modifiable causes.[3] Checklists are a common tool to prevent human errors and facilitate mandatory inspection of the equipment in complex and high-intensity work environments. 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.[4]

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The WHO SSC though comprehensive, is envisaged to cover all the surgical sub-specialities. Hence, WHO encourages that each speciality can use modified SSC specific to their requirements complying with certain mandatory protocols.[5]

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.[6] In this context, we conducted the present study implementing a Modified WHO SSC for neurosurgery in our centre. 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.

METHODS

After obtaining Institutional Ethics Committee approval, we conducted a cross-sectional observational study to evaluate the adherence to various elements of the Modified WHO SSC for neurosurgical procedures by our OR team. The study was conducted from January 2020 to April 2020. Informed written consent was obtained from participating patients. The study was registered with the Clinical Trial Registry of India vide CTRI/2020/01/022861. The study was conducted in the neurosurgical ORs of our institution. There are two dedicated neurosurgical theatres in our institution operating 2-4 elective cases a day on an average.

We selected a total of 200 consecutive patients undergoing nerosurgery 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]. The standard WHO SSC was implemented in our institution since 2015 and has been followed in all surgical cases.

The WHO SSC is a 19-item tool addressing issues pertinent to intraoperative care.[4] 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 [Table as Supplement to text]. 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 200 consecutive elective cases undergoing neurosurgery in the ORs of our hospital.

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 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

The patient and surgical case characteristics of the study population are described in Table 2. A total of 131 cases undergoing craniotomy and 69 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 200 cases, we analysed a total of 8000 observations.

Table 2: Patient and surgical case characteristics

Demographic variable	Values expressed as Mean±SD or as *n* (%)
Age (years)	47.3±14.1
Gender (Male)	121 (60.5)
Gender (Female)	79 (39.5)
Body mass index (kg/m^2)	23.2±5.2
ASA physical status I &II	153 (76.5)
ASA physical status III &IV	47 (23.5)
Elective surgery	200 (100)
Type of neurosurgery	
Craniotomy	131 (65.5)
Supratentorial	112 (56.5)
Intraaxial lesion	23 (11.5)
Extraaxial lesion	61 (30.5)
Aneurysm	19 (9.5)
Awake craniotomy	01 (0.5)
Cranioplasty	08 (4.0)
Infratentorial	19 (9.5)
Cerebellar lesion	12 (6.0)
CP angle lesion	07 (3.5)
Spine Surgery	69 (34.5)
Cervical spine instrumentation	24 (12.0)
Lumbar spine instrumentation	04 (2.0)
Lumbar discectomy	32 (16.0)
Spinal cord lesion	09 (4.5)
Duration of surgery (min)	289.4±152.5

SD: Standard deviation, ASA: American Society of Anesthesiologists, CP: Cerebellopontine

No major intraoperative errors were noted during the study period. The concordance to sign-in phase of the checklist and areas where the checklist prompted a corrective initiative are described in Table 3. Compression stockings were not present in 19 (9.5%) cases, wherein the checklist prompted application of stockings/pneumatic compression devices. Operative site was not marked in 9 cases. Out of these, 8 cases had a cranial bone defect and were scheduled for cranioplasty with evident operative site on inspection. Twenty-nine patients did not require two large bore intravenous cannulae or central venous cannula in view of lesser anticipated intraoperative blood loss. Nineteen patients (9.5%) of the 24 (12%) cases undergoing cervical spine instrumentation required advanced airway adjuncts due to unstable spine. The SSC prompted timely mobilisation of advanced airway carts with video-laryngoscope/bronchoscope for 5 of these cases. Patient allergy to phenytoin sodium in 4 (2%) cases was revealed to all team members after applying the checklist. The checklist prompted the

Table 3: 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?	200 (100)	0	-
2.	Is procedure and site mentioned on wrist band?	200 (100)	0	-
3.	Is local site preparation done?	200 (100)	0	-
4.	Are dental prostheses, if any, removed?	200 (100)	0	-
5.	Are Compression stockings/Pneumatic stockings in situ?	181 (90.5)	19 (9.5)	19
6.	Is preoperative medication administered? (Anti-convulsants, Steroids, proton-pump inhibitors)	200 (100)	0	-
7.	Has consent for surgery been obtained?	200 (100)	0	-
8.	Is the operative site marked, and is it appropriate? (involving left or right distinction)	191 (95.5)	9 (4.5)	9
9.	Are all necessary monitoring equipments checked, connected and ready?	200 (100)	0	-
10.	If patient's risk of blood loss is >500 ml in adults or >7 ml/kg in children, it is recommended to have at least 2 large bore intravenous lines or a central line before surgical incision and fluids/blood available. Has necessary precaution been taken?	171 (85.5)	0	-
11.	Has airway difficulty or aspiration risk been ascertained with Plan A, B and C for difficult airway?	200 (100)	0	-
12.	Is video-laryngoscope (VLS)/bronchoscope arranged for potential high risk airway due to primary neurologic condition?	19 (9.5)	5	5
13.	Have the patients allergies been ascertained and are all members of the team aware of it?	196 (98)	4 (2)	4
14.	Have all artificial implants been removed?	196 (98)	4 (2)	4
15.	Has the patient been diagnosed with raised intracranial pressure?	123 (61.5)	77 (38.5)	-
16.	If yes, adequate preparation for treatment of raised ICP and total intravenous anaesthesia is done?	102 (51)	21 (10.5)	21
17.	Are anaesthesia safety checks complete (equipment, medications, emergency medications, patient's anaesthetic risk)?	200	0	-
18.	Does the patient require intra-operative neuro-monitoring (Bispectral index/ Electromyography/Evoked potentials/Cranial nerve monitoring)?	76 (38)	0	-
19.	Has necessary preparation been done for intraoperative neuro-monitoring including modification in anaesthesia protocol?	66 (33)	10 (5)	10
20.	Are required surgical prostheses arranged - craniotomy drill, bone wax, CUSA, aneurysm clips, haemostatic agents, plate and screws?	179 (89.5)	21 (10.5)	21

OR: Operating room, ICP: Intracranial pressure, CUSA: Cavitron ultrasonic surgical aspirator

application of total intravenous anaesthesia (TIVA) for maintenance in 21 (10.5%) 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 10 (5%) of the 76 (38%) cases where neuro-monitoring was used. The checklist prompted timely procurement of ultrasonic dissectors/bone drills/ bone-wax/haemostatic agents in 21 (10.5%) cases.

The concordance to the time-out and sign-out phases of the checklist and areas where the checklist prompted a corrective initiative are as described in Table 4. Forced air warmer was applied after a checklist prompt in 17 (8.5%) cases. Intraoperative point of care investigations were prompted by the SSC for 19 (9.5%) cases which included an arterial blood gas analysis for 11 cases and serial blood sugar estimation for 8 cases. Twenty-nine (14.5%) study cases required postoperative mechanical ventilation. The SSC prompted early arrangement of required intensive care unit facilities for 7 (3.5%) of these cases.

The time required for completion of sign-in phase of the checklist was 132 ± 11 seconds. The time-out and sign-out phases of the checklist were completed in 91 ± 09 seconds and 62 ± 08 seconds, respectively. The team member's participation reported by checklist co-ordinators was as follows- Excellent 80.5%; good 17.5%; and poor 2%. Distraction levels during checklist conduct were as minimal in 85.5%; moderate in 13%; and maximum in 1.5% of the cases.

DISCUSSION

The implementation of a 40-tool modified checklist co-ordinated by the anaesthesiologist found the

Table 4: Time-out and Sign-out 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* (%)
	Time-out: - after induction and before surgical incision, entire team present			
21.	Each team member has introduced him/herself by name and role	162 (81)	38 (19)	38
22.	Pause to confirm correct operation for correct patient on correct site. (anaesthetist, nurse and surgeon should all individually confirm agreement)	193 (96.5)	7 (3.5%)	7
23.	Confirm prophylactic antibiotic was given within the 60 min prior to skin incision or else re-dosed?	200 (100)	0	-
24.	Essential imaging CT/MRI is displayed as appropriate?	200 (100)	0	-
25.	Are pressure points, eyes and genital area checked and padded?	188 (94)	12 (6)	12
26.	Reviewed anticipated critical events also surgical critical/unexpected steps	195 (97.5)	5 (2.5)	5
27.	Anticipated blood loss is discussed?	197 (98.5)	3 (1.5)	3
28.	Approximate operative duration is discussed?	200 (100)	0	-
29.	Are anaesthetic concerns, intention to use blood products discussed?	200 (100)	0	-
30.	Is the forced air warmer kept on and in-situ?	183 (91.5)	17 (8.5)	17
31.	Nurse confirmed sterility of instruments and discussed equipment issues/concerns	200 (100)	0	-
	Sign-out: - during or immediately after wound closure, before moving the patient out of the operating room, whilst surgeon still present			
32.	Has intraoperative point of care investigation been done?	181 (90.5)	19 (9.5)	19
33.	Does the patient require mechanical ventilation postoperatively?	29 (14.5)	0	-
34.	If yes, is the ICU ventilator arranged?	22 (11)	7 (3.5)	7
35.	Confirm if operation was performed and recorded?	200 (100)	0	-
36.	Check if instrument, sponge/swab and needle counts are complete?	200 (100)	0	-
37.	Check if surgical specimens are labelled correctly?	198 (99)	2 (1)	2
38.	Highlight equipment issues	197 (98.5)	3 (1.5)	3
39.	Verbalise plans or concerns for postoperative recovery	197 (98.5)	3 (1.5)	3
40.	Debriefing with all team members present	200 (0)	0	-

CT: Computed tomography, MRI: Magnetic resonance imaging, ICU: Intensive care unit

pragmatic challenges that underlie the meticulous conduct of neurosurgical procedures. Our Modified WHO SSC is unique with all tools linked to specific unambiguous action and it meets all the underlying intraoperative concerns of speciality-specific patient care that is pertinent to neurosurgery. To the best of our knowledge, ours is the first study from the developing world to evaluate the implementation of a modified speciality-specific checklist in lines with the time-tested WHO SSC. Our novel effort assures that specialty-specific checklists are feasible and can be completed in a short time frame with the OR team members not loosing attention. It further reiterates that focussed training and teamwork shall ensure conscientious implementation of a SSC, rather than this becoming a mere 'tick-box' exercise.

To date, the world neurosurgical experience with checklists is quite limited[7] compared to other areas of surgery.[8,9] The vast progress and increase in neurosurgical procedures in the last decade necessitates the need to initiate a speciality-specific SSC.[10] 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.[5]

In our study, we used a paper checklist for each case instead of a poster checklist. Poster placements are limited by free-wall space, fixed font-size and unavailability if placed on mobile machinery. Such situations can warrant reliance on the co-ordinators' memory to perform the checklist tools, which can easily lead to missed items that can jeopardise patient safety.

Jelacic *et al*.[11] 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*.[12] 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.[13] 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.

We found a complete concordance to many tools in our modified checklist that were simultaneously present also in the nursing personnel pre-operative checklist **[**Table 1**].** We infer that these 'double checks' in two different areas, the preoperative ward and OR, has unparalleled importance in ensuring perioperative patient safety in neurosurgery.

The implementation of the modified checklist in our study facilitated focussed actions pertinent to patient concerns specific for neurosurgery such as mechanical deep vein thrombosis prophylaxis; use of advanced airway aids for unstable cervical spine;[14] prevention of hypersensitivity/anaphylaxis to phenytoin;[15] use of osmotherapy and/or total intravenous anaesthesia (TIVA) for raised ICP; targeted anaesthetic titration for intraoperative neuromonitoring;[16,17] and point-of-care blood-gas analysis [Tables 3 and 4]. This attains further relevance in the context when neurosurgical cases are done by non-neuroanaesthesiologists.

The rather low concordance to self-introduction of all team members in our study needs to be viewed with compassion. Unfamiliarity with OR workflow and embarrassment of trainee resident doctors/nurses could have contributed to this. Implementing the modified checklist facilitated self-introductions among all the team members thereby inculcating greater communication and work involvement of all team members.

Till date, very few studies have examined the role of a safety checklist in neurosurgery.[6,7] Westman M *et al*.[18] in their systematic review on SSC use and its impact on patient safety analysed 29,717 neurosurgical patients across 13 observational studies and 1 randomised controlled trial. However, majority of these studies were protocol driven 'bundles-of-care' wherein multiple interventions in the treatment protocol had influenced outcome rather than the SSC alone. It was observed that practice of such 'bundles-of-care' can reduce infection rates, postoperative complications and unforeseen reoperations/readmissions in posterior spinal-fusion surgeries,[19,20] paediatric and adult ventriculo-peritoneal shunts,[21,22] external ventricular drain procedures,[23,24] and ventriculostomy.[25]

Earliest experience with a checklist in neurosurgery is an 8-item simple checklist introduced by Lyons *et al*.[26] Lepanluoma *et al*.[27] 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*.[28] found no error in operative-site in a series of 3595 neurosurgical procedures in their institution after implementation of WHO SSC. Fargen *et al*.[29] observed that use of WHO SSC in neuro-interventions improves team communications. Using the WHO SCC, Haugen *et al*.[30] 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.

Our study has a few limitations. We did not perform a pre-post evaluation on measurable outcome variables like mortality, surgical site infections, unplanned reoperations and length of hospital stay. Our checklist may not be applicable for certain neurosurgical procedures like deep brain stimulator placements, robotic neurosurgery and neuro-radiologic interventions.

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. The anaesthesiologist as SSC coordinator can ensure excellent participation of OR team members during the checklist implementation. The modified SSC also improves communication among the team members and results in a smooth workflow in the neurosurgical OR.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Table as Supplement to Text: World Health Organisation Modified Surgical Safety Checklist for Neurosurgery Date

	Patient Name	ID No		Diagnosis			Surgery	
	Sign in - (before any medication is administered inside OR, with surgeon present) Verbally verify, review with the patient when possible	✓ ✘ !	15	Has the patient been diagnosed with raised Intracranial Pressure?		29	Are anaesthetic concerns, intention to use blood products discussed?	
1	Is Patient identity wrist band present?		16	If yes, adequate preparation for treatment of raised ICP and total intravenous anaesthesia is done?		30	Is the forced air warmer kept on and *in-situ*?	
2	Is the procedure and site mentioned on wrist band?		17	Are anaesthesia safety checks complete (equipment, medications, emergency medications, patient's anaesthetic risk)?		31	Nurse confirmed sterility of instruments and discussed equipment issues/ concerns	
3	Is local site preparation done?		18	Does the patient require intra-operative Neuro-monitoring (Bispectral index/ Electromyography/Evoked potentials/Cranial nerve monitoring)?			Sign-out: - during or immediately after wound closure, before moving the patient out of the operating room, whilst surgeon still present	✓ ✘ !
4	Are dental prostheses removed, if any?		19	Has necessary preparation been done for Intraoperative Neuro-monitoring including modification in anaesthesia protocol?		32	Has intraoperative point of care investigation been done?	
5	Are Compression stockings/Pneumatic stockings in situ?		20	Are required surgical prostheses arranged - Craniotomy drill, Bone wax, CUSA, Aneurysm clips, Haemostatic agents, Plate and screws?		33	Does the patient require mechanical ventilation postoperatively?	
6	Is preoperative medication administered? (Anti-convulsants, Steroids, Proton-pump inhibitors)			Time-out: - after induction and before surgical incision, entire team present	✓ ✘ !	34	If yes, is the ICU ventilator arranged?	
7	Has consent for surgery been obtained?		21	Each team member has introduced him/ herself by name and role		35	Confirm operation performed and recorded?	
8	Is Operative site marked, if appropriate (involving left or right distinction)		22	Pause to confirm correct operation for correct patient on correct site. (Anaesthetist, nurse and surgeon should all individually confirm agreement)		36	Check instrument, sponge/swab and needle counts are complete?	
9	Are all necessary monitoring equipments checked, connected and ready?		23	Confirm prophylactic antibiotic was given within the 60 minutes prior to skin incision or else re-dosed?		37	Check surgical specimens are labelled correctly?	
10	Has preparation for 2 large bore intravenous lines or a central line been made?		24	Essential imaging CT/MRI is displayed as appropriate?		38	Highlight equipment issues	
11	Has airway difficulty or aspiration risk been ascertained with Plan A, B and C for difficult airway?		25	Are pressure points, eyes and genital area checked and padded?		39	Verbalize plans or concerns for postoperative recovery	
12	Is Video-laryngoscope (VLS)/ Bronchoscope arranged for potential high risk airway due to primary neurologic condition?		26	Reviewed anticipated critical events also Surgical critical/unexpected steps		40	Debriefing with all team members present	
13	Have the patient's allergies been ascertained and are all members of team aware of it?		27	Anticipated blood loss is discussed?			Remarks of the checklist co-ordinator:-	
14	Have all artificial implants been removed?		28	Approximate operative duration is discussed?				

✓ Concordant ✘ Discordant ! Corrective initiative done

OR=Operation room; ICP=Intracranial pressure; CUSA=Cavitron ultrasonic surgical aspirator; CT=Computed tomography; MRI=Magnetic resonance imaging; ICU=Intensive care unit