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Retrospective analysis of the patients undergoing neuroanaesthesia between the years 2015-2019

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Abstract

This study aimed to retrospectively evaluate the patients who underwent neuroanesthesia at Ondokuz Mayıs University Faculty of Medicine Hospital between 2015 and 2019. We included all patients who underwent neuroanesthesia between 01.01.2015 and 31.12.2019 and recorded demographic characteristics, comorbidities, type of surgery performed, anesthesia management and complications. We included a total of 5172 patients in the study. 52.9% of the patients were male and the mean age was 43.2%. We observed that the patients were operated most frequently for herniopathy (21.3%), shunt/external ventricular drainage (19.7%) and cranial mass (18.7%), and 77.3% of the cases were elective surgery. The average duration of anesthesia was 145.9 minutes. Thiopental (46.7%) and propofol (45.6%) were used most frequently as induction agents, while rocuronium (93.7%) was preferred as the neuromuscular blocking agent in almost all patients. Remifentanil (81.4%) was the most commonly used intraoperative analgesic. While inhalation anesthesia was preferred for maintenance in 3077 (59.5%) patients, total intravenous anesthesia was used in 1811 (35.1%) patients. Complications developed in 24.1% of the patients, and cardiovascular complications were observed in 71.9%. The study evinced that 1282 patients (24.8%) needed postoperative intensive care. This study revealed that the repetition of retrospective studies at regular intervals would contribute to the development of anesthesiology by enabling both the evaluation of the practices in the same clinic and the comparison between clinics.

Keywords: neuroanesthesia, neurosurgery, perioperative period, retrospective

1. Introduction

Anesthesia can be defined as neuroanesthesia in interventions performed due to self-induced or neurological injuries of the central nervous system (CNS) or peripheral nervous system (PSS). A good understanding of neuroanatomy and physiology, being familiar with the effects of drugs used on the brain and spinal cord, and protecting the brain and spinal cord constitute the basis of neuroanesthesia (1). Intracranial mass surgeries, ischemic cerebrovascular and neurological diseases, aneurysms and arteriovenous malformations, functional neurosurgery, interventional neuroradiology, spinal cord surgery, neurotrauma, pediatric neurosurgical procedures all constitute neurosurgical operations, and therefore neuroanesthesia (1-3).

Neuroanesthesia covers anesthesia applications in neurosurgical surgery. The objectives of neuroanesthesia are to provide the most suitable operating conditions for a neurosurgical operation, to maintain oxygenation with cerebral perfusion while providing optimum conditions, and to protect cerebrovascular autoregulation. The technique to be applied for the operation should protect intraoperative and postoperative hemodynamic stability under surgical stress, should not delay recovery and awakening, and should allow early neurological evaluation. Preventing the increase in intracranial pressure (ICP), suppressing the hypertensive response due to surgical stress and not impairing venous return are indispensable parts of neuroanesthesia (1-3).

We performed in this study a retrospective analysis of patients who underwent neuroanesthesia in the last five years at Ondokuz Mayıs University Faculty of Medicine Hospital and discussed the results in light of the literature. We also aimed to evaluate and develop neuroanesthesia applications positively.

2. Materials and Methods

We retrospectively analyzed patients who underwent neuroanesthesia between 2015 and 2019 in the neurosurgery operating room of Ondokuz Mayıs University Faculty of Medicine Hospital. The study was approved by the Local Ethics Committee (Date: 08.10.2020 Decision no: 2020/542). We obtained the study data from the online hospital information system and preoperative and intraoperative registration forms in the patient files and excluded patients whose surgeries were canceled for any reason or whose records were missing.

We recorded the patients' gender, age, American Society of Anesthesiologists (ASA) scores, comorbidities, type of

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surgery, duration of anesthesia, methods used in monitoring, agents used in anesthesia induction and maintenance, intraoperative fluid and blood management, analgesia management, complications, and postoperative intensive care need. We analyzed the data with IBM SPSS V23, evaluated conformity to normal distribution with the Kolmogorov-Smirnov test and used Chi-square, Kruskal Wallis and Mann-Whitney U tests to compare the variables. We expressed the data as arithmetic mean±SD (standard deviation), number and percentage and considered $P<0.05$ significant.

3. Results

We included 5172 patients in the study. 52.9% were male, and the mean age was 43.2 ± 24 years. The most frequently performed operations were 21.3% herniopathy, 19.7% shunt/EVD (external ventricular drainage) and 18.7% intracranial mass. 63.7% of the patients had at least one concomitant systemic disease. 48.6% had cardiovascular, 27.4% endocrine, and 25.1% neurological system diseases. Anesthesia times averaged 145.9 ± 75.5 minutes. Table 1 shows the patients' demographic data.

Table 1. Demographic data of the patients

Frequency n (%)		
Gender	Woman/Man	2435 (47.1)/2737 (52.9)
Age		43.2 ± 24.0
ASA Score	I	1205 (23.3)
	II	2652 (51.3)
	III	1050 (20.3)
	IV	222 (4.3)
	V	43 (0.8)
Comorbidities	Cardiovascular	1607 (48.6)
	Endocrine	904 (27.4)
	Neurological	829 (25.1)
	Pulmonary	314 (9.5)
	Trauma	307 (9.3)
Surgery Type	Herniopathy	1100 (21.3)
	Shunt/EVD	1018 (19.7)
	Cranial mass	966 (18.7)
	Spinal mass	239 (4.6)
	Others	1849 (35.7)
Duration of Anesthesia		145.9 ± 75.5

Table 2. Agents used in anesthesia management

Frequency n (%)		
Hypnotics	Thiopental/Propofol	2413 (46.7)/ 2358 (45.6)
Neuromuscular Blocker	Rocuronium	4832 (93.4)
Inhalation Agents	Sevoflurane	1508 (29.2)
	Desflurane	1565 (30.3)
	Propofol	1874 (36.2)
Early Postoperative Analgesics	Pethidine	900 (46.7)
	Tramadol	1125 (58.4)
	NSAID	91 (4.7)
Fluid Therapy	Saline/Colloid	4263 (82.4)/ 777 (15.0)
Blood Products		342 (6.6)
Reverse NMB	Neostigmine	2233 (43.2)
	Sugammadex	1310 (25.3)
	Unused	1572 (30.4)

Table 3. Complications and need for ICU admission

Frequency n (%)		
Complications	Cardiovascular	897 (71.9)
	Metabolic	145 (11.6)
	Allergic	139 (11.1)
	Pulmonary	120 (9.6)
	Others	19 (1.5)
ICU Need		1282 (24.8)

Thiopental (46.7%) and propofol (45.6%) were preferred most frequently as induction agents, and rocuronium (93.7%) was preferred as the neuromuscular blocking agent in almost all patients. Remifentanil (81.4%) was the most commonly used intraoperative analgesic. In maintenance, inhalation anesthesia was preferred in 59.5% of patients, while total intravenous anesthesia was preferred in 35.1%. The most commonly used postoperative analgesic was tramadol (54.8%), while the most commonly used maintenance fluid was 0.9% NaCl (82,4%). The use of colloid and blood products were 15.0% and 6.6%, respectively. The agent used to reverse neuromuscular blockade (NMB) was neostigmine (43.2%). In the early postoperative period, the need for analgesics in the recovery unit was 37.3%. Tramadol (58.4%) was the most widely used postoperative analgesic. Table II details the agents used in anesthesia management.

The most frequent surgery types which difficult intubation was encountered were Spinal fracture surgery, herniopathy surgery, and cranial mass and instrumentation surgery. The difficult intubation incidences for these surgeries were 21%,20%,11% respectively.

Complications developed in 24.1% of the patients where 71.9% were cardiovascular complications. The need for postoperative intensive care unit (ICU) admission was 24.8%. The greatest need for postoperative intensive care unit was in intraparenchymal bleeding surgeries (96.2%), decompression surgeries (91.7%) and aneurysm surgeries (87.6%). Table III shows complications and ICU need details.

4. Discussion

We evaluated 5172 patients who underwent neuroanesthesia for neurosurgery between 01.01.2015 and 31.12.2019 in Ondokuz Mayıs University Faculty of Medicine, Department of Anesthesiology and Reanimation. Neuroanesthesia covers anesthesia applications in neurosurgical surgery. We aimed to provide the most suitable operating conditions for a neurosurgical operation, maintain oxygenation with cerebral perfusion while providing optimum conditions, and preserve cerebrovascular autoregulation. The technique to be applied for the operation should protect intraoperative and postoperative hemodynamic stability under surgical stress, should not delay recovery and awakening, and should allow early neurological evaluation. Preventing the increase in ICP, suppressing the hypertensive response due to surgical stress and not impairing venous return are indispensable parts of neuroanesthesia. With this study, we aimed to evaluate the neuroanesthesia process and effectiveness at Ondokuz Mayıs University Faculty of

Medicine Hospital clinic and prepare a data source to guide neuroanesthesia applications.

Gokduman et al. (4) found that 52% of the patients who were operated for an intracranial mass were male. In accordance with the literature, 52.9% of the patients in our study were male, and the mean age of the patients was 43.2 ± 24 years. A comparison between the mean age and the type of surgery revealed that the highest mean age was 64.2 ± 9.6 in narrow canal surgery type, and the lowest mean age was 3.3 ± 11.3 in operations related to congenital/genetic diseases. The patients' ASA scores showed that 51.3% were ASA 2. These rates were also consistent with the results of similar studies in the literature. As in the study by Bozkurt et al. (5), the reason for the high number of ASA 2 patients may be possibly due to the average age of the patients who underwent surgery being in the middle age group and above, the rate of at least one systemic disease getting higher with increasing age, and smoking and alcohol use, which increases the ASA score at a high rate in those who do not have co-morbid systemic diseases

Neurosurgical cases are quite diverse and differ by age group. Herniopathy in elderly patients and hydrocephalus surgery in pediatric patients have been reported commonly (10,11). In accordance with the literature data, herniopathies (25.6%) constituted the majority of patients over the age of 18 in our study, while shunt/EVD surgery (57.6%) was dominant in patients under 18 years of age. Emergency cases revealed that the most common indications in our patients over the age of 18 were shunt/EVD and subdural hematoma and emergency pediatric patients under the age of 18 were mostly operated for shunt/EVD and cranial fractures. Isık et al. reported in two studies that emergency indications were subdural and epidural hematoma for adults, and epidural hematoma and cranial fracture for pediatric patients (6,7).

The duration of anesthesia depends on many factors such as the type of operation to be performed, the surgical techniques to be applied, the physical condition of the patient, and the skill of the anesthesiologist and surgeon. The average duration of anesthesia was 145.9 ± 75.5 minutes in our study. We found anesthesia times to be 176.2 ± 55.8 minutes in cranial surgical procedures and 129.8 ± 40.1 minutes in spinal surgical procedures.

Although the rate of intubation difficulty varies in studies, the incidence is reported between 1.8-8.2% (8). Yegin et al. (9) found the rate of intubation difficulty to be 3.3%, while Sabanci et al. (10) found it as 4.1% in their study of 603 patients. We also found intubation difficulties in 236 (4.6%) patients in our study. We found the causes of difficulty in intubation as 41.1% neck motion restriction, 18.2% high larynx and 11.9% short-muscular neck. In their research, Dimitriou et al. (11) found intubation difficulty to be more common in men than in women. We also found the same in our study, and that it was statistically significant ($p<0.05$). Considering the surgeries with intubation difficulties, the most common was spinal fracture with 21%, herniopathy with 20%, and spinal instrumentation with 11%. This is possibly due to fractures, hernias and masses restricting neck movements, preventing positioning, making it difficult to reach the trachea and making suitable conditions for intubation difficult, especially in the cervical region.

Thiopental has neuroprotective effects, propofol has a rapid recovery profile, and both are widely used for induction in neuroanesthesia (10). We found in our study that 72.4% thiopental was preferred in cranial surgical procedures in induction, and 91.1% propofol was preferred in spinal surgery procedures. We also observed that thiopental was preferred for cranial surgical operations due to its neuroprotective effects, and propofol was preferred in cases where rapid awakening and early neurological evaluation was required after spinal surgical operations.

The minimal effect of rocuronium on brain metabolism, rapid onset, short half-life, and rapid reversal with sugammadex have increased the use of neuromuscular blocking agents (NMB) for neuroanesthesia (1).

The total intravenous anesthesia (TIVA) technique and its component, propofol, are common in anesthesia maintenance due to hemodynamic stability, rapid neurological recovery, minimal effect on neuromonitoring, and negative cerebral effects of inhalation agents (12). We found in our study that the most commonly used maintenance agent was propofol with 36.2% and that it was preferred especially in cranial space-occupying surgeries with high ICP and in selected spinal neurosurgical surgeries with neuromonitoring. We also found that desflurane with 30.3% and sevoflurane with 29.2% were used in the second and third frequencies, respectively. We determined that 58.3% propofol, 30.1% sevoflurane and 11.5% desflurane were used as agents in the maintenance of anesthesia in cranial surgical procedures; while 61.8% desflurane, 30.1% sevoflurane and 8.0% propofol were used in the maintenance of anesthesia in spinal surgical procedures.

The rapid onset and disappearance of remifentanil's effect, its immediate onset after administration, and easy dose adjustment without worrying about the delay in awakening with deep analgesia have increased its use in balanced inhalation anesthesia (3,13). In our study, the most commonly used opioid analgesic was remifentanil with 81.4%.

Although TIVA has some advantages over inhalation anesthesia in the intraoperative and early postoperative period, comparing the medium and long-term results, the difference between them is considered to be insignificant (14). We observed in our study that 59.5% inhalation and 35.1% TIVA were preferred as the maintenance method.

It is safe to assume that the possibility of complications increases with age, prolongation of anesthesia duration and presence of comorbidity (15). Although complications in the intraoperative period are various, the most common one is

cardiovascular complications. In their study, Gercek et al. (16) found the rate of intraoperative complications as 25.6%. In our study, we similarly found the complication rate as 24.1%. In the study by Minami et al. (17) 63.2% of intraoperative complications were cardiac and 21.8% pulmonary complications. In our study, 71.9% of intraoperative complications were cardiovascular, 11.6% metabolic, 11.1% allergic and 9.6% pulmonary complications. The most common intraoperative complications were subarachnoid hemorrhage (SAH) with 64.4%, decompression surgery with 58.3%, and intraparenchymal hemorrhage surgery with 57%. The incidence of intraoperative complications was significantly higher in patients who were admitted to surgery urgently than those admitted to surgery electively, and similarly, the rate of intraoperative complications was higher in patients with concomitant systemic disease ($p<0.005$).

The need for intensive care after neurosurgical operation may be considered for close neurological follow-up and treatment. Yeğin et al. found the need for postoperative intensive care as 21.7% in patients who underwent neuroanesthesia (9). We found it similarly as 24.8%. We also found that the need for postoperative intensive care increased significantly between years ($p<0.005$). The need for postoperative intensive care existed mostly in intraparenchymal bleeding surgery with 96.2%, decompression surgery with 91.7% and aneurysm surgery with 87.6%. Furthermore, our study evinced that the need for postoperative intensive care was higher in patients admitted to emergency surgery than those who received elective surgery, and the duration of anesthesia was longer in patients who needed postoperative intensive care compared to patients who did not need postoperative intensive care ($p<0.005$).

From the anesthesia records kept in a regular and systematic way, many studies covering large patient series can be carried out in a healthy way. We concluded that the repetition of retrospective studies at regular intervals could allow both the continuous evaluation of the practices in the same clinic and the comparison between the clinics and thus, contribute to the development of anesthesiology.

Conflict of interest

There is no conflict of interest to declare.

Acknowledgments

None to declare.

Ethical Approval

The study was approved by the Ethics Committee of Ondokuz Mayıs University (Date: 08.10.2020 Decision no: 2020/542). The study was conducted in accordance with the principles of the Declaration of Helsinki.

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