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ORIGINAL ARTICLE / KLİNİK ÇALIŞMA

A Detailed Evaluation of Centers that Use Video-Electroencephalogram Monitorization and Epilepsy Surgery in Turkey

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Türkiye'de Video-EEG Monitorizasyonu ve Epilepsi Cerrahisi Uygulayan Merkezlerin Ayrıntılı İncelemesi

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Summary

Objectives: The aim of this study was to collect data through the Epilepsy Surgery Commission of the Turkish Epilepsy Society to obtain a comprehensive assessment of the status of epilepsy patients in Turkey, to identify the existing infrastructure-service potential of video-electroencephalogram (EEG) monitoring (VEM) centers and epilepsy surgery, to initiate standardization activities, to create awareness of the data, and to ensure that the necessary precautions are taken by the health authorities.

Methods: Two separate data collection forms were prepared, including VEM and surgical details. The forms were sent to all university hospitals, training and research hospitals, and adult neurology specialists in private centers, via e-mail, through the Turkish Epilepsy Society. This was a volunteer-based questionnaire, and centers were included in the study based on e-mail feedback. Data collected from June to November 2015 were included in the study.

Results: The study included 32 VEM centers (28 centers still active) and 14 epilepsy surgery centers (12 centers still active). In total, 20,000 patients in our country monitored in the VEM centers during the study period. Of those, 1833 patients underwent resective surgery (1606 scalp examinations, 227 invasive examinations), and 321 patients had vagal nerve stimulation treatment.

Conclusion: This study, which reveals the reality in our country, demonstrates that, optimistically, only 5% of the target audience for epilepsy surgery is reached. Raising awareness is necessary to identify patients with resistant epilepsy, and to promote referral to suitable centers and access to treatment, appropriate health care policies, and support for the necessary tools and working conditions at epilepsy centers.

Keywords: Epilepsy; epilepsy surgery; video-electroencephalogram.

Özet

Amaç: Türk Epilepsi ile Savaş Derneği Epilepsi Cerrahi Komisyonu tarafından epilepsi hastalarının kapsamlı değerlendirilmesini sağlayan Video-elektroensefalografi (EEG) monitorizasyon (VEM) merkezlerinin ve epilepsi cerrahisinin mevcut altyapısı-hizmet potansiyelini belirlemek, standardizasyonu hususunda çalışmaların başlatılmasını gündeme taşımak, veriler doğrultusunda farkındalık yaratarak bu konuda gerekli önlemlerin alınmasını resmi kurumlara net verilerle sunabilmek amacı ile veri toplama çalışması yapılmıştır.

Gereç ve Yöntem: Video-EEG monitorizasyon ve cerrahi detayları içeren iki ayrı veri toplama formu düzenlendi. Formlar Türk Epilepsi ile Savaş Derneği tarafından e-posta yoluyla tüm üniversite hastaneleri, eğitim araştırma hastaneleri ve özel merkezlerdeki erişkin nöroloji uzmanlarına ulaştırıldı. Gönüllülük esasına dayanan bu anket çalışmasında merkezler e-posta yoluyla geribildirimde bulunarak çalışmaya dahil oldu. Veriler Haziran-Kasım 2015 tarihleri arasında toplanarak incelendi.

Bulgular: Çalışmaya 32 VEM merkezi (28 merkez halen aktif) ve 14 epilepsi cerrahisi merkezi (12 merkez halen aktif) verilerini göndererek dahil oldu. Toplamda ülkemizde bugüne kadar 20.000 hastaya VEM uygulandığı görüldü. Toplamda 1833 hastaya rezektif cerrahi (1606 skalp inceleme, 227 invaziv inceleme sonrası) uygulanırken 321 hastaya vagal sinir stimülatörü takılmıştı.

Sonuç: Ülkemiz gerçeğini büyük ölçüde ortaya koyan bu çalışma, epilepsi cerrahisi için hedef kitlenin en iyimser rakamlarla sadece %5'ine ulaşılabildiğini göstermiştir. Dirençli epilepsi hastalarının belirlenmesi, uygun merkezlere refere edilmesi ve uygun tedavilere ulaşabilmeleri için farkındalığın artırılması, uygun sağlık politikaları ile epilepsi merkezlerinin çalışma koşullarının desteklenmesi gerekmektedir.

Anahtar sözcükler: Epilepsi; epilepsi cerrahisi; video-elektroensefalografi.

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Introduction

The main treatment goal for epilepsy is to provide seizure control as soon as possible without the drug side effects. Patient having epileptic seizure is often evaluated by the emergency department or family physician in the primary care setting, and is frequently directed to the neurologist in the secondary care setting. About one-third of patients with epilepsy are pharmacoresistant patients despite of the rapidly increasing number of antiepileptic drugs (AEDs) in recent years. Despite of at least two AEDs given alone or in combination, the patients, who cannot reach the long-term seizure freedom, are defined as pharmacoresistant according to the International League Against Epilepsy (ILAE-2010) criteria.[1] In the secondary care setting, if seizure control was not achieved for one year under the neurologist control, the patient should be referred to epilepsy centers without trying a different drug or combinations of drugs. Epilepsy centers are the units that can provide a multidisciplinary approach where extensive diagnosis and treatment of patients with uncontrolled seizures can be performed as well as the routine treatment of individuals with epilepsy. In epilepsy centers, multidisciplinary teams are employed: a neurologist specialized in epilepsy, specialist in clinical neurophysiology, brain surgeon, neuroradiologist, nuclear medicine specialist, neuropathologist, psychiatrist, psychologist, nurse, electroencephalography (EEG) technician, and social care specialist. Although patients are known to have a significant contribution to seizure control, unfortunately, only 1% of pharmacoresistant patients are referred to epilepsy centers.[2] A possible reason for this is the misconception that only epilepsy surgery is performed in epilepsy centers. However, many services are provided in epilepsy centers in addition to the surgery such as identification of epileptic or non-epileptic conditions, non-compliance with the treatment, non-epileptic psychogenic seizures, treatable underlying causes, identification of pseudo-resistant patients from medications due to improper dose and medication, and differentiation of epilepsy syndromes which can be misidentified.[2]

Approximately one third of patients with pharmacoresistant epilepsy are thought to be candidates for surgery. Contrary to common belief, surgery is not the last treatment option for focal-onset epilepsy, and the chance of success is significantly reduced due to delay in surgery. Indications including referral criteria for an internationally accepted epilepsy surgery are still not clearly defined, and maybe due to, epilepsy surgery remained idle despite class 1 evidences and clinical practices.[3]

Data collection study was performed by the Epilepsy Surgery Commission of the Turkish Epilepsy Society to identify the existing infrastructure-service potential of video-EEG monitoring (VEM) centers, where provide comprehensive assessment for the epilepsy patients in our country, and epilepsy surgery, to initiate standardization activities, to create awareness of the data, and to present the necessary precautions to be taken in this regard to the authorities clearly. In this article, we aimed to share the data.

Materials and Methods

The study with draft data collection forms, which was planned in March 2015, was opened up for discussion in the 3rd Epilepsy Symposium held in June 2015. In the direction of suggestions after the discussion, two separate data collection forms including VEM and surgical details were prepared.

Questions regarding VEM centers were determined as follows. Foundation year, academic and technical capacity of the center (number of neurologists, nurses, technicians and their educational background, placement of unit, number of beds), safety equipment of the center (bed equipment, emergency resuscitation conditions), patient admission and evaluation conditions of the center (patient's waiting duration, monitoring duration, reporting duration, cost), communication between other centers (rate of the patients being referred or to be referred to the advanced centers for surgery).

Questions for centers performing surgery were determined as starting date of performing surgery, technical equipment and academic staff of the center (number of surgeons, preoperative examinations, invasive monitoring, and multidisciplinary meeting), applicable surgical methods and the number of patients underwent surgery.

Both forms were sent by e-mail to neurologists in university hospitals in our country, educational research hospitals and in private centers by the Turkish Chapter of International League Against Epilepsy. Data collection work has been completed between June 2015 and November 2015, and a detailed documentation of the data has been made.

Table 1. Centers participating in video-electroencephalography monitoring data collection

Acıbadem University
Adana Başkent University
Adnan Menderes University
Ankara University*
Akdeniz University
Antalya Training and Research Hospital
Balıkesir University**
Bakırköy Training and Research Hospital
Cumhuriyet University
Çukurova University
Dicle University
Dokuz Eylül University
Erciyes University
Gazi University
GATA
İstanbul University Cerrahpaşa Faculty of Medicine***
İstanbul University İstanbul Faculty of Medicine
İnönü University
Karadeniz Technical University
Marmara University
Meram University
Mesa-Ankara*
Muğla University
Okmeydanı Training and Research Hospital
Osmangazi University
Pamukkale University
Süleyman Demirel University
Tepecik Training and Research Hospital
Trakya University
Uludağ University
Yeditepe University
Yüzüncüyıl University*

*Currently passive; **Newly established, has not accepted patients yet; ***The data belong to a neurologist.

Results

Video-EEG monitoring

Thirty two VEM centers (27 university hospitals, 4 education and research hospitals and 1 private center) were included in the study by sending their data (Table 1). This number can be said to represent 95% of the VEMs in Turkey. Therefore, the findings are suggested to be generalized for Turkey.

Of the centers, 28 were still active, three were passive for several reasons, one center was newly established and had not started to evaluate the patients. While a center was active more than 20 years of service, eight centers were active less than five years (Fig. 1).

Of the currently active 28 centers, only adult patients were evaluated in 15 whereas both adult and pediatric patients were evaluated in 13 centers. Pediatric Neurology Centers were wanted to be included in the study, but no sufficient communication was achieved. Only four centers had three beds, eight centers had two beds, and 16 centers had one bed. Two or more neurologists were employed in half of the centers, and half of the neurologists studied epilepsy and epilepsy surgery abroad, while the remaining half were trained domestically. Technicians currently working in active VEM units were trained through in-service training in the laboratory. Seven of these technicians graduated from the electrophysiology technician college and 19 of them were nurse in the past. More than half of the centers had no private nurses for the unit. Most of the centers were using beds reserved for VEM in the neurology service, seven centers had individual units, and seven centers had specially equipped beds. All and almost all security measures were stated to be implemented in the majority of centers in terms of ready to use ambu bag, laryngoscope, intubation tubes, defibrillator, ready vascular access, IV mailer, drugs such as adrenaline-atropine, oxygen equipment, experienced nurses in resuscitation and to localized close-range distance to emergency resuscitation team if necessary. VEM applications were performed on weekdays in half of the centers, in the whole week in other remaining half, and in the mornings in one center. Waiting period of the patients for the VEM was more than two months in half of

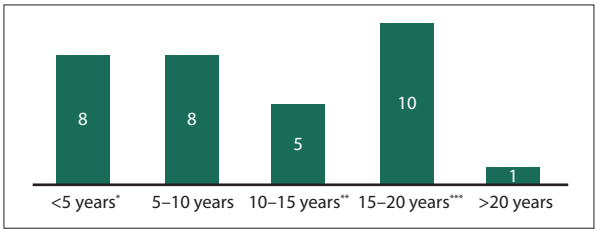

Fig. 1. Distribution of centers according to the service duration (n=32). *A center is newly established. **A center is passive, ***Two centers are passive.

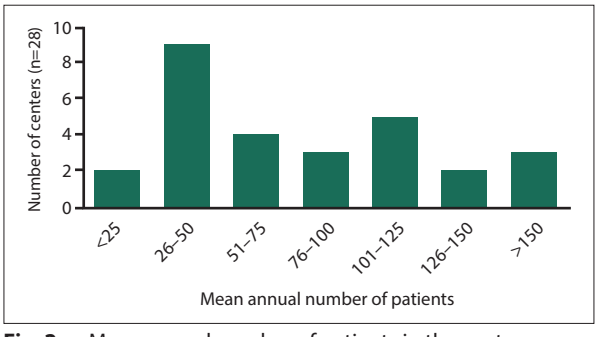

Fig. 2. Mean annual number of patients in the centers.

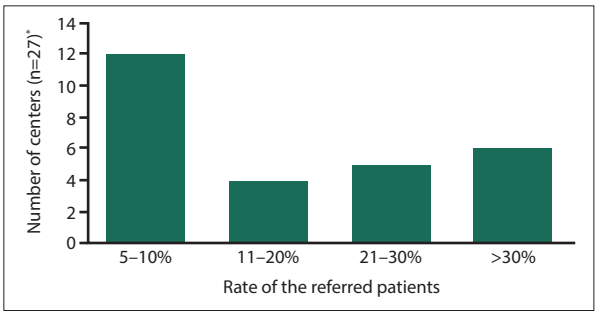

Fig. 3. Rates of the patients, who are referred to VEM centers. *No center was specified.

the centers, and more than four months in six centers. The maximum waiting period was nine months. The mean annual number of patients in the centers, which were currently active, was given in Fig. 2. As of the starting date of the study, estimated total number of patients, to whom VEM was applied, increased in direct proportion to the activation time and number of beds of the centers. The number of patients monitored by the centers from the establishment were between 56-6000 per center, and VEM was observed to be applied to about 20,000 patients in total. The mean annual patient number of the VEM centers were shown in Fig. 2.

Of the patients to be referred for the further examination, only 5–10% were monitored in 12 VEM centers and more than 30% of the patients in six centers (Fig. 3).

Neurologists stated that they spent two to four hours in one day for VEM evaluation in the half of the centers whereas this duration was reported to exceed four hours in four centers. Almost all of the neurologists thought that the time spent and effort were not an advantage in terms of performance. An additional admission fee between TRY 10.00/day and TRY 2,250.00/day were reported to be requested in 11 of the centers. For this reason, four out of five patients were reported to give up the hospitalization in some centers.

Epilepsy surgery

Active epilepsy surgery was performed in 14 of 28 centers where active VEM can be performed (Table 2). Two of these centers were previously facilitated, and the operation period was inactive, and one of them stated that they would be re-operated. A private center, which had been previously performing epilepsy surgery, was passive for a long time, and did not plan to perform the surgery again.

The ratios of the patients considered as surgical candidates in the video-EEG monitoring centers were shown in Fig. 4.

Table 2. Centers where epilepsy surgery is performed and participate in data collection

Akdeniz University*
Antalya Training and Research Hospital
Bakırköy Training and Research Hospital
Dokuz Eylül University
Erciyes University
Gazi University
GATA**
İstanbul University Cerrahpaşa Faculty of Medicine***
İstanbul University İstanbul Faculty of Medicine
İnönü University
Okmeydanı Training and Research Hospital
Pamukkale University
Uludağ University
Yeditepe University

*Passive, will continue; **Passive; ***Data belong to a neurologist.

Table 3. Centers where invasive video-electroencephalography monitoring is performed and participate in data collection

Erciyes University
Gazi University
GATA*
İstanbul University Cerrahpaşa Faculty of Medicine**
İstanbul University İstanbul Faculty of Medicine
Pamukkale University
Uludağ University
Yeditepe University

*Passive; **Data belong to a neurologist.

Surgical experiences of the centers performing surgery were presented in Fig. 5.

There was only one epilepsy surgeon in 12 of the centers whereas the remaining two centers had two or more epilepsy surgeons. In the half of the centers performing surgery, only adult patients were evaluated, and both adults and children were evaluated in the other remaining centers. The tests which can be performed in the pre-surgical evaluation by the centers within the bounds of possibility were given in Fig. 6.

Active invasive monitoring was performed in seven of the centers performing surgery (Table 3).

It was stated that patients were evaluated with a multidisciplinary meeting before the surgery in 12 of 14 centers performing surgery. Patient waiting time for the monitoring in

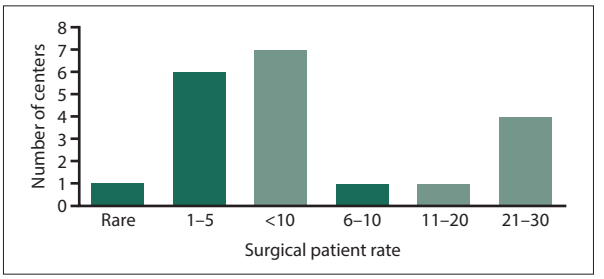

Fig. 4. Surgery candidates for patients who underwent video-EEG monitoring.

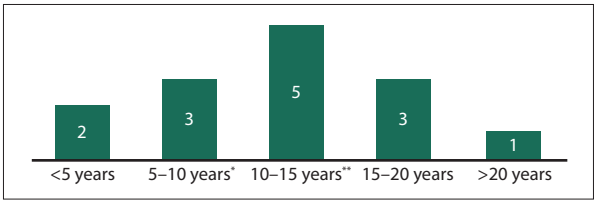

Fig 5. Distribution of centers, where surgical procedures are performed, according to their service duration (n=14).
*Passive, will resume; **A center is passive.

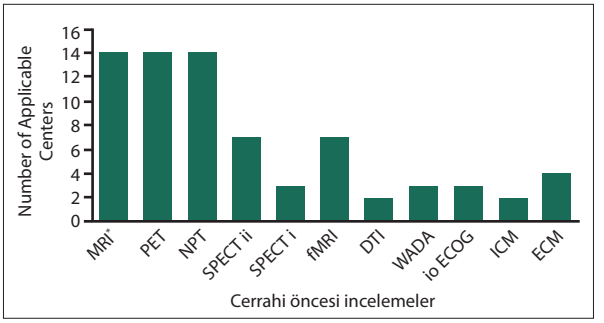

Fig. 6. Distribution of pre-surgical examinations according to centers.
MRI: Magnetic resonance imaging; PET: Positron emission tomography; NPT: Neuropsychological tests; SPECT ii: Interictal SPECT; SPECT i: Ictal SPECT; DTI: Diffusion tensor imaging; io ECOG: Intraoperative electrocorticography; ICM: Intraoperative cortical mapping; ECM: Extraoperative cortical mapping. *At least 1.5 Tesla.

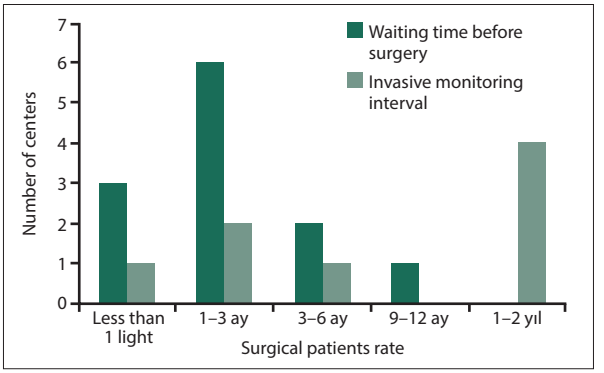

Fig. 7. Appointment duration of centers before the operation and for invasive monitoring

centers performing invasive monitoring, and for the surgical procedure in centers performing surgery were given in Fig. 7.

Lesionectomy, temporal lobectomy, vagal nerve stimulation (VNS) could be performed in almost all of the centers. Distribution of surgical modalities according to the centers where it can be applied was summarized in Fig. 8.

There was a significant variation between the centers in term of the annual number of patients underwent an operation by scalp and invasive monitoring. More than 20 patients were operated per year in a few centers, and this was remarkable (Fig. 9).

In all centers providing data, the number of patients underwent an operation was 1833, and the number of patient received VNS was 321. Of the operation decisions, 1606 were made by scalp monitoring, 227 were made by invasive monitoring. Distribution of the patients per center, who were operated by scalp and invasive examination, was given in Figs. 10 and 11.

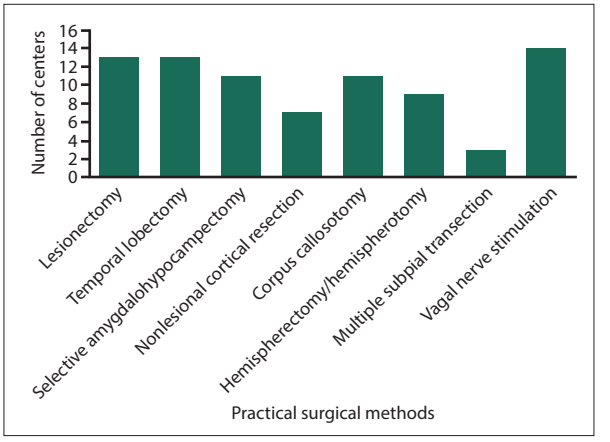

Fig. 8. The distribution of surgical methods according to the centers where they can be performed.

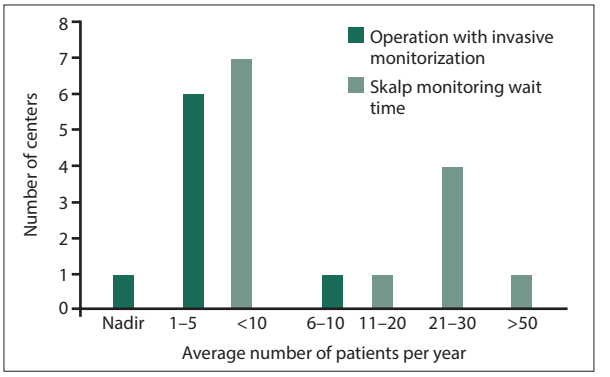

Fig. 9. Mean annual number of patients who were operated by scalp and invasive monitoring in centers.

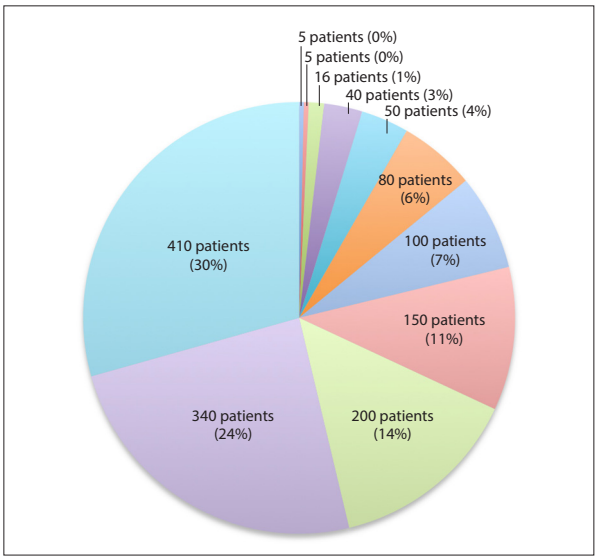

Fig. 10. Distribution of patients, who were operated by scalp monitoring, according to the centers.

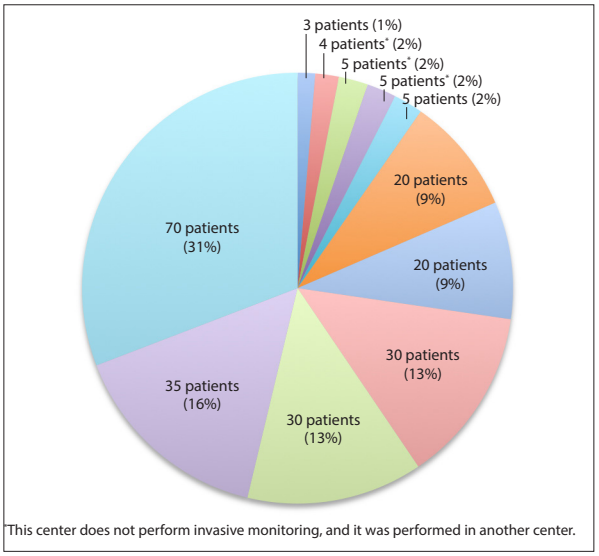

Fig. 11. Distribution of patients, who were operated by invasive monitoring, according to the centers.

Most of the centers not performing surgery stated that they reffered their patients to the the centers performing surgery through an official channel, whereas a few centers by the directly personal contacts.

Discussion

Although epilepsy is one of the most disabling neurological disorders, it is still not addressed as a public health problem. Pharmacoresistant epilepsy is not only a situation including resistant seizures but also a multifaceted clinical presentation associated with overdose medication, cognitive impairment, psychosocial dysfunction, addiction, limited lifestyle, poor quality of life, increased morbidity and mortality.[4] Epilepsy surgery is the most effective method in the control of seizures in pharmacoresistant focal epilepsy, and also provides improvement in cognition, behavior and quality of life.[5] Epilepsy surgery has been proven to be a cost-effective strategy for both adults and children.[6–8]Absolute Risk Reduction (ARR) for seizure recurrence is very significant when compared to AED. For instance, number needed to treat (NNT) is 10 for carotid endarterectomy for stroke prevention, and 2 for epilepsy surgery.[5]

The goal in epilepsy surgery is not only to stop the seizures but also to protect the patient from drug side effects, to protect the psychical and social status of the patient, to improve the quality of life, and to reduce mortality and morbidity of the disease. The sudden unexpected death in epilepsy (SUDEP) risk is 20 times higher than in normal population.[9] SUDEP is a cause of mortality of up to 1% per year in pharmacoresistant epilepsy patients.[10]

According to the studies, nearly 5,000 new possible epilepsy surgery patients are determined in the United States (USA) every year. However, less than 1/3 of these patients were reported to be able to be operated. It is estimated that there are about 800,000 epilepsy patients in our country of which population approaches to 80 million. It can be roughly predicted that there are about 80,000 candidates for epilepsy surgery in our country if 30% of the patients are thought to be pharmacoresistant and 30% of them are thought to be surgery candidates.[11] Even though it is thought that the number of operated patients, which was determined as 1,833 according to the data sent to us, might be doubled at most with the missing centers and data provided by pediatric neurologists (approximately 4000), only 5% of surgery candidates in our country could be reached. It is very clear that raising awareness for epilepsy surgery is required both in society and in the public.

The efficacy of the epilepsy surgery is related with the academic and technical capacity of the surgeon and VEM centers. In this data collection study, 28 active VEM units were included in total, and seven of them were located in the eastern and southeastern regions (Fig. 12).

The number of specific epilepsy centers registered on the official website of the National Association of Epilepsy Cen-

Fig. 12. Video-electroencephalography monitoring centers included in the study. Red: Active working centers; Green: Passive centers.

ters (NAEC) in the USA, which has a population of about 320 million, is stated as 233.[12] Of these centers, 52 are referred to as centers offering level 3 care. NAEC has defined level 3 care epilepsy centers as centers providing VEM, basic medical, neuropsychological and psychosocial services and basic neurodiagnostic evaluations.[13] In some centers offering level 3 care, epilepsy surgery, resective epilepsy surgery and vagus nerve stimulator implantation can be performed, however, invasive monitoring and complex epilepsy surgery are not performed. Of these centers, 181 were specified as level 4 care centers. NAEC has defined level 4 care centers as centers providing more comprehensive medical, neuropsychological and psychosocial treatment, advanced neurodiagnostic evaluations, invasive monitoring and an extensive surgical procedure for epilepsy.[13]

Only eight of the epilepsy centers in our country can meet the criteria for the level 4 care epilepsy center from the most optimistic point of view. While the population of our country is about ¼ of the USA, the number of our center offering level 4 care is unfortunately 1/22 of the USA.

VEM examination in our country can be done in about one third of provinces. This number is very insufficient and cannot be said to have a balanced distribution within the country. It was also remarkable that half of these centers had only one bed, and half of them had less than 10 years of experience. In a data collection study on epilepsy surgery published with the participation of 189 centers in the USA, mean number of beds in VEM centers was reported as eight.[14]

When the mean annual patient number of the centers included in our study are considered, monitoring of the existing pharmacoresistant patients can be completed in about 32 years if we think that 2,500 patients can be monitored in a year even calculated on the basis of the maximum number of patients and even there are no new patients. Patient's waiting time for VEM was less than a month in newly established few centers whereas it was between two and nine months in the majority of centers. Technicians graduated from electrophysiology technician college were employed only in seven centers, and there was no private nurses for the unit in more than half of the centers. Only in half of the centers, 7/24 evaluation was performed. More than half of the neurologists working at VEM centers spend time corresponding to third or half of their working hours, and almost all of them thought that it had no advantages in terms of performance. In some experienced private university centers offering VEM, it was stated that the patients could not meet the hospitalization fees and, therefore, they refused hospitalization. These conditions must be improved for VEM centers to work more effectively. Our fastest requests from the Ministry of Health are increasing the number of bed capacity in the centers, employment of technically equipped staff, improvement of the admission and evaluation performance, and also including these kind of demanding processes in the "special processes" list and subjecting these processes to payment in experienced private Universities. In addition, carrying out studies on the standardization and even the accreditation of VEM centers by appropriate commissions may contribute to the identification and completion of the equipment deficiencies of the centers.

VEM centers are reference centers for the evaluation of epilepsy patients in terms of diagnosis, differential diagnosis and, if appropriate, surgery. More than 25% of the patients were re-

Fig. 13. Epilepsy surgery centers included in the study. Red: Active working centers; Green: Passive centers.

ported to be candidates for epilepsy surgery only in five centers. Most of the VEM applications in other centers were observed to be differential diagnosis purposes. Additionally, in our study, it was stated that only 5–10% of the patients were referred to about half of the VEM centers for further evaluation. The rate of patients referred for further evaluation was expressed to be more than 30% in only six experienced centers. This may be due to the difficulty in recognizing pharmacoresistant epilepsy patients and lack of awareness about epilepsy surgery. In this study, we have shown the geographical distribution of the VEM centers in our country, and we hope that neurologists can give quicker decisions through this study in terms of referring patients to the advanced centers.

Active epilepsy surgery could be performed in 12 of 28 centers where active VEM can be performed. Most of the centers were located in the western provinces of our country (Fig. 13).

Pre-surgical evaluations are the most important factors affecting the success and risk of the surgery, and it was stated that the tools, except of magnetic resonance imaging (MRI), positron emission tomography (PET), and neuropsychological tests, could not be performed in more than half of the centers. The annual number of patients underwent surgery in centers with limited preoperative evaluation conditions was reported to be less than 10 whereas epilepsy surgery was performed in 20–30 patients in four centers, and more than 50 epilepsy surgeries were performed in one center in a year. Invasive monitoring was actively performed in seven centers, however, at most five patients could be evaluated per year in all centers, except of one. It is necessary to examine the reasons of this picture, particularly the organization and application difficulties of invasive monitoring and problems in electrode refill. Similarly, temporal lobectomy, lesionectomy, and VNS can be performed in almost every center depending on preoperative evaluation conditions whereas specific surgical procedures (such as non-lesional cortical resection, multiple subpial resection) could be performed in limited centers.

In conclusion, the number of epilepsy surgeries and centers performing invasive monitoring are not sufficient. Unfortunately, the number of surgical and invasive monitoring services does not meet the needs of the country except of several centers. Official referral chains of the centers, where surgery is not performed, can be created. Only senior centers has the wide range of surgical procedure, and surgeons and epileptologists with less experience may work interactively with these centers. In adult epilepsy centers, there are adult and pediatric patients, to whom VEM and surgery are performed, and a data collection study involving data on pediatric neurologists should be carried out.

This is an encouraging study with regard to the determination of data in our country and national multi-center studies with the participation of 32 centers. This study, which reveals the truth of our country to a great extent, has showed that epilepsy surgery is still the most cost-effective and most effective treatment for patients with pharmacoresistant epilepsy, and only 5% of the patients, who are thought to be surgery candidates, could be reached. It is necessary to raise awareness on the concept of pharmacoresistant epilepsy and epilepsy surgery as soon as possible, and the working conditions of epilepsy centers should be supported with appropriate health policies, and appropriate treatment options should be presented for patients with epilepsy.

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Conflict of interest

The authors declare that they have no conflict of interest.

Authorship Contributions

Concept: Y.B.G., N.D.; Design: Y.B.G., N.D., C.G.; Data collection &/or processing: Y.B.G., N.D., C.G., N.Y.; Analysis and/or interpretation: Y.B.G., N.D., N.Y.; Literature search: Y.B.G.; Writing: Y.B.G.

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