




Knowledge and attitudes of neurologists toward epilepsy surgery: an Italian survey

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Received: 11 December 2021 / Accepted: 18 March 2022 / Published online: 21 March 2022
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Abstract

The current study, conceived with the contribution of the Commission for Epilepsy Surgery of the Italian League Against Epilepsy (LICE) and the Epilepsy Study Group of the Italian Neurological Society (SIN), aimed to assess potential physician-related barriers to refer subjects for epilepsy surgery. All the members of SIN and LICE were invited by email to complete a 28-item online questionnaire. The survey items included: (1) individual and medical practice characteristics, (2) knowledge of current indications to select candidates for epilepsy surgery, (3) factors potentially affecting the attitude toward epilepsy surgery. Overall, 210 physicians completed the survey. More than half (63.3%) of the participants showed proper knowledge of the ILAE drug-resistance. Definition and almost two-thirds of them (71.9%) considered themselves adequately informed about indications, risks, and benefits of epilepsy surgery. Surgery was regarded as a valid option to be used as early as possible by 84.8% of the interviewees, and 71% of them estimated its complication rate to be low. However, more than half (63%) of the respondents reportedly referred patients for surgery only after the failure of 3–5 antiseizure medications. Overestimation of risks/complications of surgery and inadequate healthcare resources were identified as the main factor contrasting the patient referral for surgery by 43% and 40.5% of the participants, respectively. In conclusion, this survey confirms the existence of knowledge gap within both physicians and the healthcare system, as well as an educational need regarding epilepsy surgery. Further researches are warranted to define learning outcomes and optimize educational tools.

Keywords Survey · Physician · Seizure · Drug-resistant epilepsy · Surgery · Treatment

Introduction

The efficacy and safety of epilepsy surgery, especially for temporal lobe epilepsy (TLE), have been established through three randomized controlled clinical trials [1–3] and a large number of retrospective and prospective cohort studies [4]. Despite the well-known negative effects of refractory epilepsy on cognition [5, 6], psychosocial functions and quality

of life (QoL) [7], as well as the good outcomes reported after surgery, the literature agrees on considering it an underutilized treatment [8, 9]. Indeed, nowadays, adult people with drug-resistant epilepsy (PwDRE) are referred for surgical evaluation after an average of two decades after the disease onset [10]. Several reasons have been hypothesized, including (i) different levels of technology among centers resulting in different candidate selection strategies, (ii) confidence in new antiseizure medications (ASM), and the belief that epilepsy surgery is expensive, complex and a risky procedure, and that it should be considered only as the last resort [11].

Ten years ago, Erba and colleagues [11] investigated the barriers toward epilepsy surgery by means of an ad hoc questionnaire exploring physicians' willingness to refer PwDRE for surgery.

They surveyed 183 Italian adult and child neurologists compared with a group of academic and clinical leaders in the field, and found that the majority of Italian neurologists

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have highly variable attitudes toward epilepsy surgery, reflecting ambivalence, and uncertainty when approaching this type of treatment.

In the last years, a great emphasis on knowledge and dissemination of epilepsy surgery principles in Italy has been placed by the Italian League Against Epilepsy (Lega Italiana contro l'Epilessia, LICE) and the Commission for Epilepsy Surgery through focused scientific meetings and seminars, teaching courses, and published papers [12, 13]. Therefore, herein we aimed to evaluate knowledge and perception of epilepsy surgery among adult and pediatric neurologists in Italy.

Methods

The survey was conceived with the contribution of the Commission for Epilepsy Surgery of the LICE and the Epilepsy Study Group of the Italian Neurological Society (Società Italiana di Neurologia, SIN), and included relevant questions and topics based on current literature.

The questionnaire was developed as a 28-item self-administered form by a team composed of four trained epileptologists, then reviewed and approved by all members of the LICE Epilepsy Surgery Commission. The form was divided in 3 sections: the first (block A, 6 items) explored individual and medical practice characteristics, the second (block B, 13 items) examined the knowledge of existing guidelines to select candidates for epilepsy surgery evaluation, while the third (block C, 9 items) assessed the perception of surgical risks and benefits and the possible barriers affecting the attitude toward surgery. The questions were presented as inquiries with a number of answers ranging from 3 to 7 according to the question type.

The inclusion criteria required all participants to be medical doctors, to have completed the specialty in adult or pediatric neurology, clinical neurophysiology, neurosurgery, and to be actively practicing. There were no other restrictions and participation was voluntary.

An online survey was developed using the free open-access Google™ Forms (<https://www.google.com/forms/about/>) application. The survey included an informed consent verification, making possible for those who did not agree with its terms of use to end the survey without further questions. No personally identifiable information was collected, and data were treated according to the European regulation GDPR n. 2016/679. The questionnaire remained online for approximately 2 months (from September 15, 2020) on the homepage of the official website of both scientific societies. All the members of LICE and/or SIN were first contacted by email and invited to complete the survey. Reminders were mailed every 2 weeks. No incentives were offered in return for completing the questionnaire.

Data analysis

Statistical analysis was performed using IBM SPSS Statistics version 25 (Armonk, NY). Differences among responders were studied using the χ^2 test for population comparison. The comparison was performed among 4 groups based on the years of clinical experience: (i) 1–5 years; (ii) 5–10 years; (iii) 10–20 years; (iv) > 20 years. We also compared the differences according to the geographical distribution of the respondents (i.e., [i] Northern Italy, [ii] Central Italy and Sardinia, [iii] Southern Italy) and their workplace (i.e., [i] University Hospital; [ii] Community Hospitals, [iii] Outpatient services, [iv] Other). Significance level was set a $p < 0.05$. Correction for multiple comparisons using the Bonferroni method was used when needed. Questions that were found to be statistically significant among more than one group were further analyzed using a logistic regression model with associations assessed by odds ratios (OR) and their Wald CIs. Results are reported as frequency counts with percentages.

Results

Two-thousand twelve invites to survey participation were mailed to SIN members and 890 to LICE members (a number of physicians could be enrolled to both scientific societies, but privacy policy prevented us from having access to the total sample size). In total, 210 participants completed the survey and were considered for the analysis.

Table 1 presents the demographic and professional distribution of the participants to the survey in addition to their answers to block A questions. One-hundred twenty-eight (61%) out of 210 physicians reported working as neurologists, 63 (30%) as pediatric neurologists, 14 (6.6%) as clinical neurophysiologists, and 5 (2.4%) as neurosurgeons.

More than half (63.3%) of the respondents showed proper knowledge of the ILAE drug-resistance definition [14] and almost two-thirds of them (71.9%) considered themselves adequately informed about indications, risks, and benefits of epilepsy surgery. Surgery was regarded as a valid option to be used as early as possible by 84.8% of the interviewees, and 71% of them estimated its complication rates to be low. However, more than half (63%) of the survey participants reportedly referred patients for surgery only after the failure of 3–5 ASM. Overestimation of risks/complications of surgery and inadequate healthcare resources were identified as the main factor contrasting the patient referral for epilepsy surgery by 43% and 40.5% of the respondents, respectively.

Tables 2 and 3 summarize questions and answers of blocks B and C with frequency distribution.

Table 1 Block A questions: demographic characteristics of survey respondents

Total	<i>n</i> (%)
	210 (100)
1. Specialty	
Neurology	128 (61)
Neurophysiology	14 (6.7)
Neurosurgery	5 (2.4)
Child Neurology	63 (30)
2. Years of experience	
< 5	48 (22.9)
5–10	35 (16.7)
10–20	42 (20)
> 20	85 (40.5)
3. Work place	
University Hospital	118 (56.2)
Non-University Hospital	78 (37.1)
Outpatient services	12 (5.7)
Other	2 (1)
4. Geographical distribution	
Northern Italy	129 (61.4)
Centre Italy and Sardinia	47 (22.4)
Southern Italy	34 (16.2)
5. Monthly <i>N.</i> of patients with epilepsy	
< 10	46 (21.9)
10–50	105 (50)
> 50	59 (28.1)
6. Patients with focal epilepsy	
< 10%	16 (7.6)
10–30%	33 (15.7)
31–50%	69 (32.9)
> 50%	92 (43.8)

Differences according to years of experience

The respondents' answers to question 7 (“After the failure of how many drugs do you define drug-resistant epilepsy?”) revealed significant differences according to the years of experience: 50.6% of the participants with >20 years of experience (YOE) defined drug-resistant epilepsy after the failure of ≥ 3 ASM, whereas 75% of those with < 5 YOE answered “2” as the minimum number ($p=0.004$). Most physicians in all groups declared of caring for less than 20 patients that might be candidate for surgical therapy (see Table 1), and the majority of them recommended presurgical evaluation in less than 5 patients during the last year (question 9, $n=149$, 71%).

The age most commonly considered for epilepsy surgery was 30–50 years ($n=115$, 55.6%). When asked about their attitude toward patients with intellectual disabilities (question 16: “Would you recommend epilepsy surgery

to a patient with intellectual disability”), most physicians were “not sure,” regardless of YOE. The answer to question 15 (“What kind of patient is the most suitable for epilepsy surgery in your opinion”) revealed significant differences among groups: most participants with >20 years of clinical experience (57.6%) would not recommend epilepsy surgery for patients with extra-temporal lesional focal epilepsy as opposed to physicians with fewer YOE (<5 years YOE, 66.7%; 5–10 YOE, 62.9%; 10–20 YOE, 59.5; $p=0.02$). Answers to other questions showed no significant differences according to clinicians' experience.

As for block C, the answer to question 23 (“What do you think are the main complications/risks of epilepsy surgery?”) and 26 (“Which are the main factors affecting the neurologists' attitude towards surgery?”) revealed significant differences among groups: most physicians with <5 and 5–10 YOE considered neurological impairment caused by the resection of eloquent cortex as the main risk of epilepsy surgery ($n=23$, 47.9% and $n=14$, 40%), whereas participants with 10–20 YOE regarded “cerebrovascular complications” as the main surgical risk ($n=13$, 31%), and a significant proportion of those with >20 YOE did not identify specific complications ($n=25$, 29.4%; $p=0.03$).

Most physicians considered “overestimation of risks/complications” as the main factor that may discourage neurologists from recommending presurgical evaluation ($n=90$, 42.9%). Yet, a significant portion of respondents with >20 YOE also reported difficulty obtaining a valid consultation in a surgical center ($n=28$, 32.9%; $p=0.03$).

Differences according to geographical distribution

The answer to question 15 (“Which kind of patient is the most suitable for epilepsy surgery in your opinion”) revealed significant differences among groups: most physicians from Northern Italy and Southern Italy would recommend epilepsy surgery for all patients with drug-resistant epilepsy regardless of comorbidities, as opposed to participants from Central Italy and Sardinia (Northern Italy, 59.7%; Central Italy and Sardinia, 31.9%; Southern Italy, 67.6%; $p=0.001$). Question 17 (“Which evaluations do you consider necessary before referring patients to pre-surgical evaluation”) also received significantly different answers: most physicians from Northern Italy and Southern Italy would recommend neuropsychological evaluation before epilepsy surgery, contrary to those from Central Italy and Sardinia who showed more heterogeneous opinions (Northern Italy, 72.9%; Central Italy and Sardinia, 53.2%; Southern Italy, 79.4%; $p=0.02$). The answers to other questions revealed no significant differences among groups.

Table 2 Block B questions: respondents' knowledge of existing practice guidelines

Total	<i>n</i> (%)
	210 (100)
7. After the failure of how many ASM do you define drug-resistant epilepsy?	
1	1 (0.5)
2	133 (63.3)
> 3	76 (36.2)
8. How many of your patients meet drug-resistant epilepsy criteria and are potentially eligible for epilepsy surgery?	
< 20	147 (70)
20–50	45 (21.4)
51–100	11 (5.2)
> 100	7 (3.3)
9. <i>N.</i> of patients referred in the last year to an epilepsy surgery center	
1–5	149 (71)
6–10	38 (18.1)
11–20	16 (7.6)
> 20	7 (3.3)
10. <i>N.</i> of patients referred in the last year to a neurosurgeon not trained in epilepsy surgery	
1–5	196 (93.3)
6–10	5 (2.4)
11–20	7 (3.3)
> 20	2 (1)
11. After the failure of how many ASM do you consider presurgical evaluation?	
2	37 (17.6)
3–5	65 (63.1)
6–10	3 (1.4)
>10	105 (50)
Not considered for presurgical evaluation	0 (0)
12. What is the minimum seizure frequency to consider presurgical evaluation?	
Any debilitating seizure	10 (4.8)
Daily seizures	13 (6.2)
Weekly seizures	7 (3.3)
Monthly seizures	126 (60)
Regardless of seizures' frequency if a lesion is detectable	54 (25.7)
13. On average, how long after diagnosis do you refer a patient for surgery evaluation?	
No specific time length	26 (12.4)
< 5 years	4 (1.9)
5–10 years	0 (0)
> 10 years	180 (85.7)
14. What is the average age of people referred for epilepsy-surgery in your experience? *	
Children	82
Adults < 30 y.o.	109
Adults 30–50 y.o.	115
Adults > 50 y.o.	32
15. What type of patients do you think is more suitable for epilepsy surgery? *	
Temporal lobe epilepsy and hippocampal sclerosis	125
Extra-temporal, structural epilepsy with clear lesion on brain MRI	115
Temporal and extra-temporal non-lesional epilepsy	45
Every drug-resistant epilepsy	115
16. Do you think people with intellectual disability should be referred for epilepsy surgery?	
Yes	52 (24.8)
No	11 (5.2)

Table 2 (continued)

Total	n (%)
	210 (100)
Not sure	140 (66.7)
Depends on single case basis	7 (3.3)
17. Which evaluations do you consider necessary before referring patients to presurgical evaluation? *	
EEG	114
Video-EEG	177
Brain MRI	205
Functional Neuroimaging (fMRI/PET/SPECT)	106
Neuropsychological evaluation	146
18. Do you refer for presurgical evaluation also cases you consider poor surgical candidates?	
Yes	122 (58.1)
No	55 (26.2)
Not sure	33 (15.7)
19. By what means do patients obtain consultation in an epilepsy surgery center in your experience?	
Patients spontaneously go to an epilepsy surgery center	10 (4.8)
I recommend patients to ask for presurgical evaluation in a dedicated center	74 (35.2)
I personally send patients for presurgical evaluation in a dedicated center	126 (60)

*More than one answer admitted

ASM, antiseizure medications

Differences according to workplace

The majority of physicians working in university hospitals reported visiting more than 50 patients monthly, as opposed to clinicians working in other clinical institutes (81.4% of university hospitals vs. 18.6% of community hospitals; $p < 0.001$). The answer to question 7 (“After the failure of how many drugs do you define drug-resistant epilepsy?”) revealed that most physicians working in university hospitals or outpatient services reported “2” as the minimum number of therapeutic failures required for the definition of DRE (62.4 % of university hospitals, 91.7% of outpatient services), compared with participants working in non-university hospitals, the majority of whom defined DRE after the failure of ≥ 3 ASM (61.5%; $p = 0.003$). Most of those working in university and community hospitals recommended presurgical evaluation after an average of at least 10 years (87.3% of university hospitals and 88.5% of community hospitals), as opposed to physicians working in outpatient services (58.3%; $p = 0.003$).

Logistic regression

The answers to question 7 showed significant differences among physicians according to YOE and workplace. The multinomial logistic regression model considering both parameters (i.e., YOE and workplace) as covariates revealed that physicians with < 5 YOE were less likely to answer “3”

as the minimum number of drugs required for the definition of DRE (OR 0.4; 95% CI 0.2–0.9; $p = 0.04$).

Discussion

The present study represents an assessment of the general knowledge and attitudes of the pediatric and adult Italian epileptologists (pediatric and adult neurologists, neurophysiologists, and neurosurgeons) toward epilepsy surgery.

By considering the mailed invites, the total number of physicians who completed the survey is substantially low and we cannot exclude that this result may reflect a limited interest in the surgical treatment of epilepsy. Indeed, epilepsy surgery is one of the most underutilized evidence-based therapeutic options, with a limited number of surgical procedures performed out of million potential candidates worldwide [15]. In addition, surgical loads tend to decrease with time [16]. Possible explanations include, among others: (i) an increasing proportion of difficult cases, (ii) the growing number of non-lesional epilepsies, and (iii) the backlog of patients amenable for new treatment options.

In general, most of the participating physicians consider themselves adequately informed about indications, risks, and benefits of epilepsy surgery, which is acknowledged as a valid option, with a low incidence of surgical complications, and to be considered as early as possible. Indeed, most participants correctly identified the ILAE definition for DRE, which is the key condition to refer a case to surgical

Table 3 Block C: attitudes towards surgical risks and benefits and barriers

Total	<i>n</i> (%)
	210 (100)
20. Do you consider yourself to be adequately informed about indications, risks and benefits of epilepsy surgery?	
Yes	151 (71.9)
No	38 (18.1)
Not Sure	21 (10)
21. What is your attitude towards epilepsy surgery?	
I think it is a valid option which should be considered as early as possible	178 (84.8)
I think it is a valid option in terms of efficacy, but with many risks of serious complications	16 (7.6)
I consider it the last resort for people with drug-resistant epilepsy	16 (7.6)
I do not think it is a valid option	0 (0)
22. In your opinion, the complication rate of epilepsy surgery is about	
< 5%	149 (71)
5–10%	53 (25.2)
> 10%	8 (3.8)
23. In your opinion, what are the most frequent complications of epilepsy surgery?	
Post-surgical infections	48 (22.9)
Cerebrovascular complications (stroke/hemorrhage)	46 (21.9)
Permanent neurological deficits due to impairment of functional cortex	75 (35.7)
None of the above	41 (19.5)
24. Epilepsy surgery is underused. What are the main reasons, in your opinion?	
Patient's will	9 (4.3)
Missed/late indication by treating neurologist	103 (49)
Inadequate resources (i.e., few centers, long waiting-lists, high costs)	85 (40.5)
Other	14 (6.2)
25. In your opinion, what are the factors that impact the most on patients?	
Overestimation of surgery's risks compared to seizures' risks	153 (72.9)
Dissatisfaction with seizure freedom after surgery	14 (6.7)
Psychiatric and/or cognitive comorbidities	16 (7.6)
Organizational difficulties (in reaching surgical center, taking time off work, etc.)	20 (9.5)
Uncertainty about the possibility of ASM discontinuation after surgery	7 (3.3)
26. What are the factors that may discourage neurologists from referring patients for epilepsy surgery?	
Low expectation of seizure freedom	48 (23)
Overestimation of risks/complications	90 (43)
More trust in new pharmacological therapies (i.e., clinical trials of new drugs)	27 (13)
Expectations about the efficacy of new neuromodulation techniques	2 (1)
Difficulties in obtaining consultation from an epilepsy surgery center	43 (20)
27. Which tool do you consider more useful to help patients make an informed and conscious decision?	
Illustrative material available in the doctor's office	166 (79)
Dissemination material written by experts to be consulted online	14 (6.7)
Participation to educational congresses about risks and benefits of epilepsy surgery	12 (5.7)
Psychological consultations	17 (8.1)
Consultation with epileptologists expert in epilepsy surgery	1 (0.5)
28. Which tool do you consider more useful for neurologists?	
Participation to courses/ congresses about epilepsy surgery	35 (16.7)
International recommendations/guidelines	16 (7.6)
Educational courses to medical communication	3 (1.4)
Fast access to specialized consultation within a dedicated epilepsy surgery network	16 (7.6)

Table 3 (continued)

Total	<i>n</i> (%)
	210 (100)
All of the above	140 (66.7)

evaluation, and correctly acknowledged temporal lobe epilepsy due to hippocampal sclerosis as well as all focal epilepsies associated with a clear MRI-detected epileptogenic lesion as the best targets for epilepsy surgery. However, at the same time, this survey confirms literature data on the well-known epilepsy surgery treatment gap, as most physicians refer few PwDRE for surgery evaluation, generally after several years since disease onset and after many failed ASM trials (more than two-third of participants to our survey referred for surgical evaluation after at least 10 years since diagnosis) [11, 15].

There are various explanations for our findings: for instance, the overestimation of risks/complications of epilepsy surgery is considered as a primary barrier not only by PwDRE but also by physicians. Moreover, inadequate resources, including few specialized centers (which results in long waiting lists and, consequently, high direct and indirect healthcare costs), represent the main structural barriers [15, 17].

The availability of illustrative material in the doctor's office is regarded as a useful tool to improve an adequate information. As far as healthcare providers are concerned, a multimodal approach is expected, including participation to courses/congresses, provision of international scientific recommendations/guidelines, and quick access to specialized consultations within a dedicated epilepsy surgery network.

While the geographical distribution of the survey participants did not affect our findings, younger age was associated with better knowledge and attitudes, as well as an easier access to tertiary epilepsy surgery centers. In a recent systematic review on Healthcare professionals' knowledge, attitudes, and perception of epilepsy surgery, Samanta et al. [15] identified several key explanations for physician-related barriers to epilepsy surgery: inadequate knowledge of the role of epilepsy surgery in the management of PwDRE, poor identification and referral of surgical candidates, ambivalent attitudes and perceptions regarding epilepsy surgery, insufficient communication of the risk-benefit ratio of epilepsy surgery, and challenging issues related to the organization of surgical referral. Although neurologists might have greater awareness about epilepsy surgery than other healthcare providers, several studies found that from one-third to half of the neurologists do not know that epilepsy surgery is a therapeutic option [18, 19]. Other studies underscored the issue of inappropriate referral: a UK study showed that over half of the pediatric neurologists considered the failure of

ketogenic diet as a prerequisite before considering surgery [20]. Similarly, a Canadian study found that approximately half of neurologists correctly identify the need for prompt referral for PwDRE with ongoing seizures [9].

In our survey, the modalities of candidates' selection for epilepsy surgery appeared in line with published reports, since both seizure frequency and MRI detection of a presumed epileptogenic zone were indicated as important factors to refer PwDRE for surgery [9, 20]. By contrast, the coexistence of intellectual disability is considered a factor that negatively impacts epilepsy outcome [9].

The Italian study by Erba et al. [11] showed that two-thirds of the neurologists reported a lower score (i.e., a neutral attitude) compared with the panel of experts who had a more positive approach to epilepsy surgery. In our survey, the neurologists perceived themselves as favorably disposed towards and well-informed about epilepsy surgery, especially if younger, thus probably reflecting their increased awareness about recent randomized clinical trials on epilepsy surgery [1–3] and the access to these data early in their career [11]. Nevertheless, they still refer few subjects to epilepsy surgery centers, and usually do it late in the disease course. This might be explained by the insufficient communication of the risk/benefit ratio of epilepsy surgery that generates fear, insecurity and ultimately refusal. Therefore, treating physicians must be carefully counseled in order to guarantee that patients make the best-informed and most conscious decision.

Despite the accumulating evidence on excellent outcomes in well-selected cases [21], and on the very low rate of complications when surgery is performed by an experience and specialized team, physician communication approaches remain highly variable and often insufficient. In the Michigan study [22], less than half of the neurologists do not provide patients with information about the expected surgery outcome, especially in case of extra-temporal epilepsy. Moreover, when provided, outcomes appear to be less favorable than those reported in literature [4, 21]. Another identified barrier is related to the limited availability of specialized centers with consequent practical difficulties in referrals and timely access to dedicated facilities. Organization issues before and after referral have been previously reported, including subjects not being returned to the care of the referring physicians afterward [15, 23, 24].

Erba et al. [11] reported that neurologists do not reject surgery a priori as a viable option, but that most of them

are ambivalent, lacking the necessary motivation to initiate the process toward this potentially therapeutic option. The number of subjects treated for epilepsy and referred for surgery, the region where physicians attained their specialty, and the awareness of RCTs appeared to correlate with the neurologists' attitudes.

Possible solutions to the multifaceted problem of epilepsy surgery underutilization include strategies to address different issues: for instance, to disseminate the knowledge of drug-resistance definition and the associated risks, as opposed to the potential benefits of surgery; to encourage the adoption of epilepsy quality measures; and to promote the use of structured referral sheets that are suitable for local conditions and address local barriers [9, 11, 15]. Although the optimum educational method for physicians is still a matter of debate, interactive, web-based high-quality teaching, facilitated by the COVID-19 pandemic, has recently emerged as a method which might integrate a more traditional educational format, such as learning from specialists during routine clinical encounters, peer-reviewed journals, and specific epilepsy surgery clinical recommendations and viewpoints. In this perspective, LICE and SIN devoted great efforts and increased epilepsy surgery educational activities (e.g., realization of video- and podcasts, specialized clinical encounters, focused seminars, and writing of dedicated papers and reviews) [13].

Although our study has the merit to be directed to a large number of specialists potentially involved in epilepsy management, it has several limitations, the most important being the relatively low number of physicians completing the survey, which prevents us from generalizing our results. In addition, most participants were adult neurology specialists, thus configuring a selection bias which might affect the interpretability of specific questions' answers (i.e., "What is the average age of people referred for epilepsy surgery in your experience?"). Moreover, the questionnaire was explorative in nature, focusing on information, specific policies, and personal beliefs, while ignoring other topics of interest such as cultural and ethical issues. Finally, the majority of participants work in Northern Italy; however, a good coverage of the entire country was guaranteed.

In conclusion, this survey found some knowledge gap and educational need regarding epilepsy surgery. Further studies are warranted to improve knowledge and assess specific learning gaps among different health providers, in order to optimize educational formats and finally evaluate the impact of specific educational interventions on the various stakeholders.

Acknowledgments The authors thank all the participants for their contribution and all the new members of Commission for Epilepsy Surgery of Italian League Against Epilepsy: Lorenzo Ferri, Rita Garbelli, Matia Martucci, Claudia Passamonti, Michele Rizzi.

Author contribution Study conception and design: Sara Casciato, Alessandra Morano, Lorenzo Ricci, Giancarlo Di Gennaro, Ettore Beghi, Carlo Efsio Marras; data collection and analysis: Alessandra Morano, Lorenzo Ricci, Sara Casciato, Giancarlo Di Gennaro, Ettore Beghi; writing—original draft preparation: Lorenzo Ricci, Sara Casciato, Alessandra Morano, Giancarlo Di Gennaro, Ettore Beghi; writing—review and editing: Sofia Asioli, Carmen Barba, Massimo Caulo, Gabriella Colicchio, Massimo Cossu, Alessandro Consales, Luca de Palma, Flavio Villani, Nelia Zamponi, Laura Tassi, Carlo Efsio Marras.

Data availability On demand.

Code availability Not applicable.

Declarations

Ethical approval Ethics approval was not required for this study.

Consent to participate Not applicable.

Consent for publication Not applicable.

Conflict of interest The authors declare no competing interests.

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Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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