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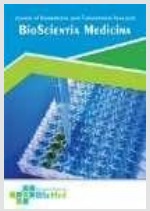

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Selective Amygdalohippocampectomy versus Anterior Temporal Lobectomy in Mesial Temporal Lobe Epilepsy: A Meta-Analysis of Seizure Control and Cognitive Outcomes

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A B S T R A C T

Background: Mesial temporal lobe epilepsy (MTLE) is a common form of drug-resistant epilepsy often necessitating surgical intervention. The choice between selective amygdalohippocampectomy (SelAH) and anterior temporal lobectomy (ATL) remains a subject of debate, with each procedure offering potential advantages and disadvantages in terms of seizure control and cognitive outcomes. **Methods:** A comprehensive literature search was conducted across PubMed, Scopus, and Springer databases to identify studies published between 2013 and September 2024 that compared SELAH and ATL in patients with MTLE. The primary outcomes of interest were seizure freedom rates and changes in cognitive function, particularly IQ scores. A meta-analysis was performed using a random-effects model to pool the results of included studies. **Results:** The meta-analysis encompassed 5 studies involving 218 patients with MTLE (105 underwent SelAH, 113 underwent ATL). The pooled results demonstrated a statistically significant reduction in the odds of achieving seizure freedom following ATL compared to SelAH (odds ratio [OR] 0.38, 95% confidence interval [CI] 0.24-0.81, p = 0.008). Regarding cognitive outcomes, no significant difference was observed in Performance IQ (PIQ) between the two groups. However, a trend towards improved Verbal IQ (VIQ) was noted in the SelAH group, although this did not reach statistical significance. **Conclusion:** The findings suggest that SelAH may offer superior seizure control compared to ATL in patients with MTLE. While both procedures appear to have comparable effects on PIQ, SelAH may be associated with a trend towards better preservation or even improvement in VIQ. The choice between SelAH and ATL should be individualized based on patient-specific factors, including preoperative cognitive profile and the relative importance of seizure control versus cognitive preservation.

1. Introduction

Temporal lobe epilepsy (TLE) is a type of epilepsy that often causes focal seizures and is difficult to treat with medication. Surgical therapy is considered an effective solution for TLE that does not respond to medication.[1] For many years, anterior temporal lobectomy (ATL) has been the primary surgical procedure, involving the removal of most of the lateral cortex, the amygdala, and the hippocampal formation, with seizure freedom rates ranging from 62% to 83%, depending on the length of follow-up.[2] However, to maintain nerve function and improve quality of life, minimal surgical approaches such as selective amygdalohippocampectomy (SelAH) using Transylvanian and transcortical methods are increasingly being considered. SelAH aims to preserve the functional temporal neocortex and reduce postoperative complications. Generally, there is no significant difference in seizure control between SelAH and ATL.[3–7] However, some studies suggest that SelAH

may provide better neuropsychological outcomes and reduce the risk of visual field deficits (VFD) compared to ATL.[8,9] Although previous meta-analyses are insightful, the existing data is outdated and needs to be updated. Some studies suggest that ATL may offer better seizure freedom than SelAH, but this might differ in the context of cognitive abilities or intelligence.[10] In this context, it should be considered that although ATL may offer a higher level of seizure freedom, this approach could carry additional risks to cognitive function or thinking abilities.[11] Conversely, SelAH, with its more selective approach, aims to minimize the impact on cognitive function while maintaining seizure control. Therefore, the decision regarding which surgical procedure to use should consider the balance between effectiveness in controlling seizures and its impact on the patient's quality of life and cognitive function.[12,13] Further research that updates the data and evaluates the long-term outcomes of various surgical methods is still needed to provide clearer guidance in selecting the most appropriate approach for patients with TLE.

Comparing two types of surgeries used in the management of mesial temporal lobe epilepsy (MTLE) due to hippocampal sclerosis (HS): selective amygdalohippocampectomy (SelAH) and anterior temporal lobectomy (ATL). This study is a meta-analysis aimed at: assessing whether SelAH has similar or better seizure control outcomes compared to ATL, and evaluating whether SelAH provides better neuropsychological outcomes than ATL, particularly in terms of changes in IQ scores (intellectual ability).

2. Methods

A comprehensive literature search was conducted across three major databases: PubMed, Scopus, and Springer. The search focused on studies published between 2013 and September 2024. Keywords used in the search included terms such as 'temporal lobe epilepsy,' 'mesial temporal sclerosis,' 'amygdalohippocampectomy,' and 'anterior temporal lobectomy.' The results were as follows: PubMed 21, ScienceDirect 115, Springer 23.

Inclusion criteria: Articles comparing seizure outcomes in patients after Selective Amygdalohippocampectomy (SelAH) or anterior temporal lobectomy (ATL); Studies with a mean or median follow-up period of 6 months or longer; Use of the Engel classification or similar schemes to assess postoperative seizure outcomes; Articles comparing IQ scores/cognitive function and levels of intelligence measured using the Wechsler Adult Intelligence Scale-Revised in patients undergoing SelAH or ATL; The mean and standard deviation of IQ scores or cognitive function must be obtainable from the papers; A clear definition of language dominance for all patients. Exclusion criteria: Overlap in Patient Populations: Studies with overlapping patient populations from the same center were excluded. The most recent or comprehensive articles were used when the same population was included in multiple articles; Short Follow-up Duration: Studies with a follow-up duration of less than 6 months were excluded from the analysis of seizure outcomes; Unclear Neuropsychological Data: For neuropsychological analysis, studies were excluded if they did not clearly define language dominance for all patients or if the mean and standard deviation of cognitive function assessments could not be obtained from the papers; Only articles published between 2013 and 2024 were included.

The extracted data included the first author's name, publication year, country, research institution, sample size, follow-up duration, seizure freedom rates, as well as the mean and standard deviation of Verbal IQ (VIQ), Performance IQ (PIQ), and Full Scale IQ (FIQ) before and after surgery. This data was collected independently by two authors. All studies were assessed for evidence level using the evidence classification scheme developed by the Centre for Evidence-Based Medicine in Oxford, UK. Since no randomized trials were included in our analysis, the methodological quality of these studies was evaluated using the modified Newcastle-Ottawa Scale. This scale uses a star rating system to assess 3 categories, including patient selection, study group comparability, and outcome assessment; studies that

achieve 7 stars or more are considered high quality.

Sintesis dan Analisis Data

Changes in VIQ, PIQ, and FIQ scores were calculated as the difference between the mean values before and after surgery. Studies were treated as the unit of analysis. To compare the proportion of seizure freedom between the SelAH and ATL groups, odds ratios with 95% confidence intervals were used. Changes in VIQ, PIQ, and FIQ scores between the two groups were compared using standardized mean differences with 95% confidence intervals. Heterogeneity of surgical effects across studies was evaluated using Q statistics, with $I^2 \geq 50\%$ indicating significant heterogeneity. Subgroup analysis was conducted to compare seizure control between SelAH with transcortical and transsylvian approaches and ATL. Sensitivity analysis was used to assess the stability of the meta-analysis results, including only studies with 7 stars or more. Publication bias was visually assessed using funnel plots. All meta-analyses were performed using Review Manager (version 5.3, Revman; The Cochrane Collaboration) with random or fixed effects models, depending on the presence of heterogeneity. Statistical significance was set at $p \leq 0.05$.

3. Results

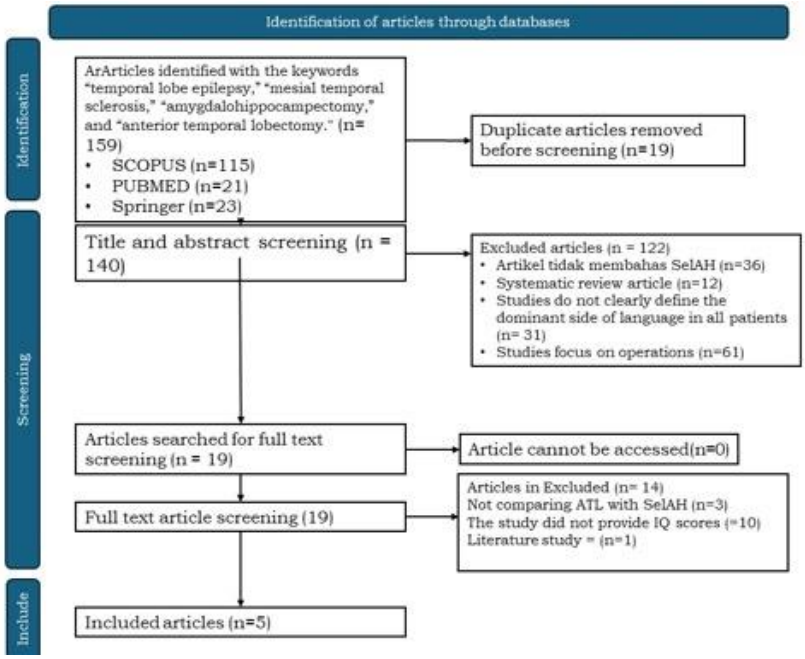

Figure 1. PRISMA flow diagram.

Based on initial data and manual searches, 159 journals were found. After screening to remove duplicates, 140 potentially eligible papers were identified, and of these, 19 papers were considered after reviewing titles and abstracts. Among these 19 papers, five articles involving cases (patients undergoing SelAH and ATL) met the specified inclusion criteria and were included in the final analysis after full-text review (see Figure 1). Among these articles, some focused on seizures and IQ. The characteristics of the included studies are summarized in Table 1. Out of the 6 studies, 3 were prospective cohort studies (with a level of evidence of 2b), while the remaining 3 studies were retrospective, with 3 studies performing contemporary comparisons (level of evidence 2b) and 2 studies using historical series as controls. Overall, the quality of the included studies was generally low. Of the 19 selected, only 1 met the criteria for

discussing Wechsler Adult Intelligence. Among the 5 studies that were prospective and retrospective, only 3 developed appropriate protocols for comparing SelAH and ATL in the treatment of TLE, which achieved 8 stars on the modified Newcastle-Ottawa Scale. Seizure-related outcomes included 5 studies with 218 patients suffering from MTLE (105 undergoing SelAH and 113 undergoing ATL) included in the seizure outcome analysis. Meta-analysis showed a statistically significant reduction in the likelihood of seizure freedom in patients undergoing ATL compared to those undergoing SelAH.

Table 1. Studies included in the meta-analysis.

Study	Level of evidence	Design	Analysis	SelAH	ATL	Approach for SelAH	Matching	Follow up	Newcastle-Ottawa Scale quality score
Fábio A. Nascimento	2b	Retrospective	seizure	34	33	TC dan TS	1,2,3,6,7	6	8 stars
Wang	2b	Retrospective	Seizure, IQ	39	33	TC dan TS	1,2,3,7,8	12	8 stars
Alonso	2b	Pro	seizure	15	14	TS dan TC	1,2,3,4,6,7,8	24	9 stars
Yingying Tang	2b	Pro	seizure	7	7	TC	1,2,3,4,6,7	45	8 stars
Boucher	4b	Retrospective	Seizure	13	26	TC and TS	1,2,5,6,7,8	54	8 stars

Matching: 1 = age; 2 = sex; 3 = duration of epilepsy; 4 = history of febrile convulsion; 5 = developmental delay; 6 = handedness; 7 = side of surgery; 8 = single surgeon.

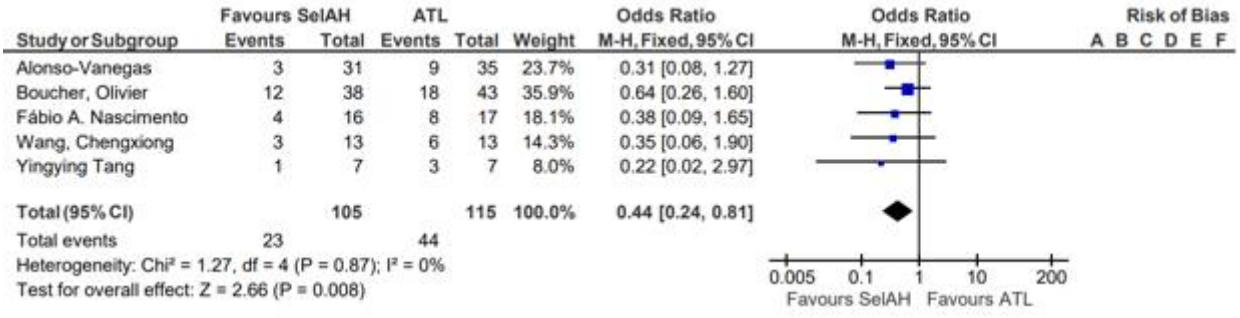

Figure 2. Forest plot and meta-analysis of postoperative seizure-free rate.

From the figure, the meta-analysis results from several studies comparing two intervention methods for the treatment of mesial temporal lobe epilepsy caused by hippocampal sclerosis (mTLE-HS), Selective Amygdalohippocampectomy (SelAH) and anterior temporal lobectomy (ATL). The odds ratio (OR) was used to assess the effectiveness of the two methods; an OR value of less than 1 indicates that ATL is more effective. The graph shows that the rate of seizure freedom after surgery tends to be higher in patients undergoing SelAH compared to ATL, although these results may vary depending on the studies analyzed. Although both ATL and SelAH are used to control seizures in patients with mTLE-HS, the data suggest that SelAH tends to yield better results than ATL according to the studies reviewed, as reflected by the low heterogeneity. Therefore, while SelAH may be superior in terms of seizure control, the decision to use ATL or SelAH should consider the individual patient's condition, preferences, and desired outcomes. The analysis also indicates a relatively low heterogeneity among studies ($Chi^2 = 1.27$, $I^2 = 0\%$), suggesting that the results from various studies are entirely consistent.

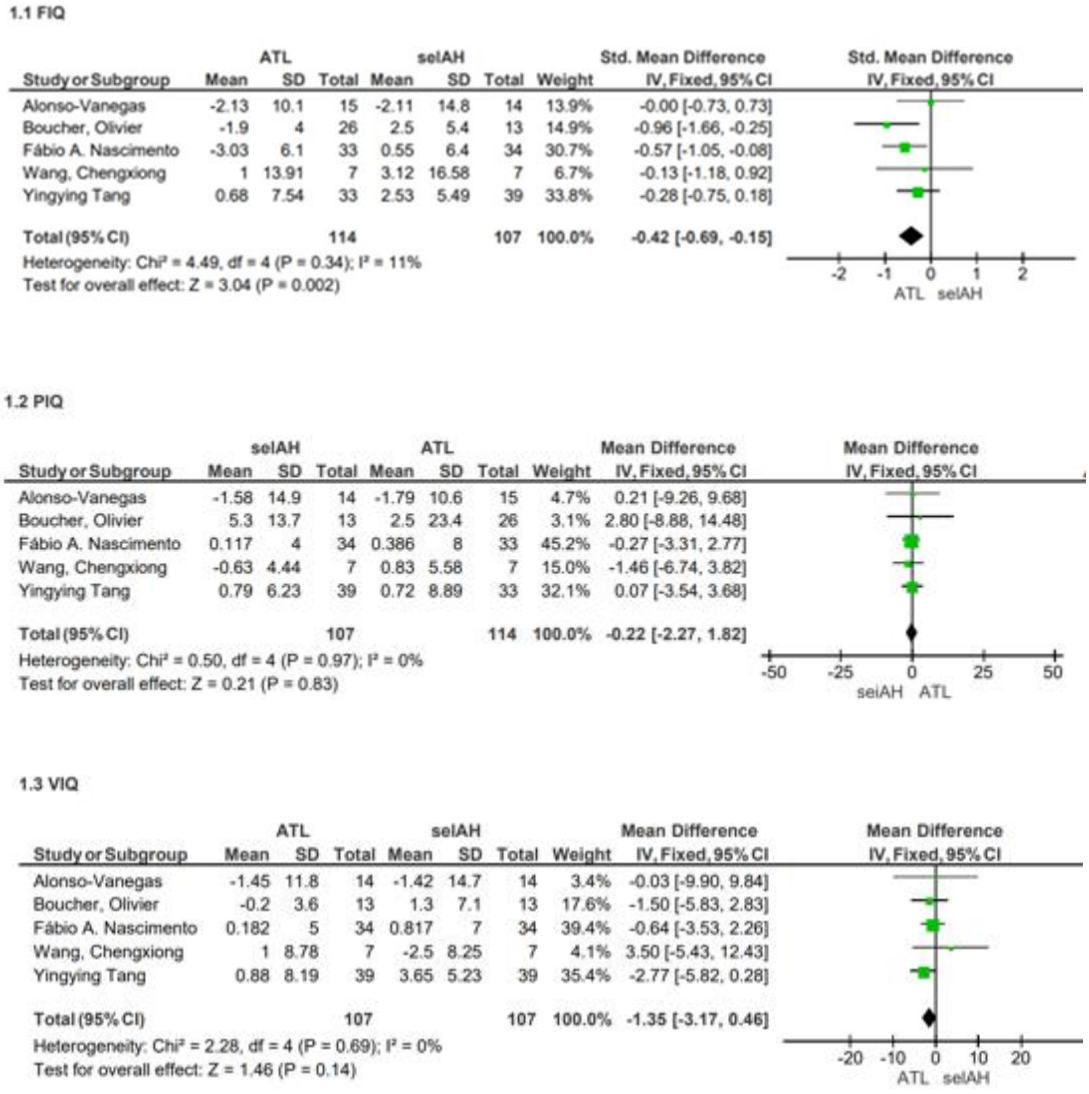

Figure 3. Forest plot and meta-analysis of changes in VIQ, PIQ, and FIQ scores.

In terms of Performance IQ (PIQ), there is no significant difference between the SelAH and ATL groups, with the standardized mean difference (SMD) indicating a small and statistically non-significant difference. Regarding Verbal IQ (VIQ), although not statistically significant, the SelAH group tends to have an advantage over ATL, with a positive SMD suggesting a trend towards improved verbal function.

4. Discussion

The SelAH technique, or Selective Amygdalohippocampectomy, represents a surgical approach that has gained significant traction in the management of mesial temporal lobe epilepsy (MTLE). The defining characteristic of SelAH lies in its targeted and selective resection of key structures within the mesial temporal lobe that are implicated in the generation and propagation of epileptic seizures. The primary targets of this procedure include the amygdala, uncus, hippocampus, and parahippocampal gyrus. These structures, while critical in various cognitive and emotional processes, can also serve as the epicenter of epileptic activity in MTLE, particularly when associated with hippocampal sclerosis. The surgical execution of SelAH is typically achieved through one of two principal approaches: the

transsylvian approach or the transcortical approach. The transsylvian approach involves accessing the mesial temporal structures by navigating through the Sylvian fissure, a natural cleft that separates the temporal lobe from the frontal and parietal lobes. This approach offers the advantage of minimizing disruption to the overlying neocortex, thereby potentially reducing the risk of postoperative cognitive deficits. The transcortical approach, on the other hand, involves making a cortical incision to gain access to the mesial temporal structures. While this approach may offer a more direct visualization of the surgical targets, it necessitates traversing the temporal neocortex, which could carry a slightly higher risk of impacting cognitive function.[11,12]

The hallmark of SelAH is its meticulous preservation of the lateral temporal neocortex. This region of the brain is involved in a myriad of higher-order cognitive functions, including language comprehension, auditory processing, and visual recognition. By sparing the neocortex, SelAH aims to minimize the potential for postoperative neurological deficits that could compromise the patient's quality of life. This stands in stark contrast to the more extensive resection performed in anterior temporal lobectomy (ATL), which typically involves removing a significant portion of the lateral temporal neocortex in addition to the mesial temporal structures. The rationale behind the selective nature of SelAH is rooted in the understanding that the epileptogenic zone in MTLE is often confined to the mesial temporal structures. By precisely targeting these structures while leaving the neocortex intact, SelAH seeks to achieve a delicate balance between effective seizure control and preservation of neurological function. This approach is particularly appealing in cases where the patient exhibits a well-defined epileptogenic focus within the mesial temporal lobe and a relatively preserved cognitive profile.[12,13]

The benefits of SelAH extend beyond its potential for seizure control. Studies have shown that SelAH may be associated with a lower risk of postoperative visual field deficits compared to ATL. This is attributed to the preservation of the optic radiations, which course through the lateral temporal lobe and are responsible for transmitting visual information from the eyes to the visual cortex. Additionally, SelAH has been shown to have a favorable impact on certain aspects of cognitive function, particularly verbal memory and language skills. This is likely due to the sparing of critical language and memory centers within the temporal neocortex. However, it is important to acknowledge that SelAH is not without its limitations. Some studies have suggested that SelAH may be associated with a slightly lower rate of long-term seizure freedom compared to ATL. This may be due to the fact that ATL, with its more extensive resection, may be more effective in eradicating all potential epileptogenic foci within the temporal lobe. Furthermore, SelAH may be technically more challenging to perform than ATL, requiring a high degree of surgical expertise and precision. The decision to pursue SelAH or ATL in the management of MTLE is a complex one that requires careful consideration of various factors, including the patient's seizure characteristics, imaging findings, neuropsychological profile, and individual preferences. In general, SelAH may be a more suitable option for patients with a well-defined epileptogenic focus within the mesial temporal lobe, a relatively preserved cognitive profile, and a strong desire to minimize the risk of postoperative neurological deficits. ATL, on the other hand, may be a more appropriate choice for patients with a more extensive epileptogenic zone or those who prioritize achieving the highest possible rate of seizure freedom, even at the potential cost of some cognitive impairment. SelAH represents a valuable addition to the armamentarium of surgical techniques for the treatment of MTLE. Its selective approach, aimed at preserving the lateral temporal neocortex, offers the potential for effective seizure control while minimizing the risk of postoperative neurological deficits. As our understanding of the pathophysiology of MTLE continues to evolve, and as surgical techniques continue to advance, SelAH is likely to play an

increasingly important role in the quest to improve the lives of individuals living with this challenging condition.[14,15]

ATL, as the statement indicates, is characterized by a more extensive resection of brain tissue. It not only targets the mesial temporal structures implicated in MTLE, such as the amygdala and hippocampus, but also extends to include portions of the lateral temporal neocortex. This neocortical resection is where the potential for greater cognitive impact arises. The temporal neocortex is known to subserve a range of cognitive functions, including auditory processing, language comprehension, and certain aspects of memory. The removal of parts of this neocortex, even when deemed necessary for seizure control, can disrupt these established neural networks and lead to postoperative cognitive deficits. These studies have demonstrated that patients undergoing ATL, with its inclusion of neocortical resection, are at a higher risk of experiencing postoperative cognitive decline compared to those undergoing the more selective SelAH procedure. The specific cognitive domains affected can vary depending on the extent and laterality of the resection, but often include deficits in verbal memory, language comprehension, and auditory processing.[14,15]

In contrast to ATL, SelAH is designed to be a more selective surgical approach. The primary targets of resection in SelAH are the amygdala, hippocampus, and parahippocampal gyrus - structures deeply embedded within the mesial temporal lobe and known to be central to the generation of seizures in MTLE. By meticulously sparing the lateral temporal neocortex, SelAH aims to minimize disruption to the cognitive networks housed within this region. The statement's reference to SelAH being "better at preserving certain cognitive functions related to the temporal cortex" underscores this advantage. Studies have shown that patients undergoing SelAH tend to experience fewer postoperative cognitive deficits compared to those undergoing ATL. This preservation of cognitive function is particularly notable in domains such as verbal memory and language comprehension, which are closely linked to the integrity of the temporal neocortex.[15,16]

While the cognitive benefits of SelAH are apparent, it is crucial to acknowledge that the extent of resection in ATL can sometimes confer an advantage in terms of seizure control, at least in the short term. The more extensive removal of potentially epileptogenic tissue in ATL may lead to a higher rate of seizure freedom in the initial postoperative period, particularly within the first year. However, this potential benefit needs to be weighed against the increased risk of cognitive deficits associated with the procedure. The statement also mentions that ATL is "more likely to cause postoperative visual field deficits." This is another potential drawback of the procedure, stemming from the proximity of the resection to the optic radiations, which carry visual information from the eyes to the visual cortex in the occipital lobe. Damage to these fibers can result in visual field defects, impacting a patient's visual perception and potentially affecting their quality of life.[14,16]

The choice between ATL and SelAH is not a one-size-fits-all decision. It requires a careful and individualized assessment of each patient's unique circumstances, including the specific characteristics of their epilepsy, their preoperative cognitive profile, and their individual priorities and values. For patients with well-defined mesial temporal lobe epilepsy and a strong desire to preserve cognitive function, SelAH may be the preferred option. Its selective approach minimizes the risk of postoperative cognitive deficits while still offering a good chance of seizure freedom. On the other hand, for patients with more extensive or poorly localized epileptogenic zones, or for those who prioritize complete seizure freedom above all else, ATL may be considered, despite its potential cognitive and visual consequences.[15]

A thorough preoperative evaluation, including detailed neuroimaging and neuropsychological testing, is essential in guiding the decision-making process. Neuroimaging helps to delineate the extent of the epileptogenic zone and identify any potential involvement of the temporal neocortex.

Neuropsychological assessment provides a baseline measure of cognitive function, allowing for a more accurate prediction of potential postoperative changes and aiding in the selection of the most appropriate surgical approach for each individual. The statement highlights a fundamental difference between ATL and SelAH in the surgical treatment of MTLE. ATL, with its more extensive resection, carries a higher risk of postoperative cognitive deficits and visual field defects but may offer a slight advantage in short-term seizure control. SelAH, on the other hand, prioritizes the preservation of cognitive function and visual fields but may be associated with a slightly lower rate of seizure freedom in the long term. The optimal choice between these two procedures necessitates a careful and individualized approach, taking into account the specific needs and priorities of each patient[16]. Conversely, SelAH tends to be better at preserving visual function.[15,17,18]

The temporal lobe plays a critical role in various cognitive functions, including memory, language, and visual processing. The anterolateral temporal neocortex, in particular, is involved in higher-order cognitive processes such as semantic memory, object recognition, and social cognition. Resection of this region, as is often performed in ATL, can disrupt these neural networks and lead to postoperative cognitive deficits. The extent of these deficits can vary depending on the specific areas resected, the patient's preoperative cognitive profile, and the presence of any compensatory mechanisms in the contralateral hemisphere. In contrast, SelAH aims to selectively remove the epileptogenic zone within the mesial temporal structures, including the amygdala, hippocampus, and parahippocampal gyrus, while sparing the surrounding neocortex. This more conservative approach minimizes the disruption of functional brain tissue and, consequently, reduces the risk of postoperative cognitive deficits. Studies have shown that SelAH is associated with better preservation of certain cognitive functions, particularly those related to language and verbal memory, compared to ATL.[15,16]

The choice between ATL and SelAH involves a careful weighing of the potential benefits and risks of each procedure. ATL, with its broader resection, may offer a higher likelihood of achieving seizure freedom, especially in the short term. This is particularly relevant for patients with extensive or poorly defined epileptogenic zones, where a more aggressive resection may be necessary to achieve complete seizure control. However, this increased efficacy comes at the cost of a higher risk of postoperative cognitive deficits. On the other hand, SelAH, with its more selective approach, prioritizes the preservation of cognitive function. This is particularly important for patients with well-defined epileptogenic zones and good preoperative cognitive function, where a less extensive resection may be sufficient to achieve seizure control without compromising cognitive abilities. However, the more conservative nature of SelAH may be associated with a slightly lower rate of seizure freedom in the long term, particularly in patients with more widespread or complex epileptogenic networks.[16]

Preoperative cognitive function, as assessed by IQ scores, has been identified as a significant predictor of postoperative cognitive outcomes in MTLE surgery. Patients with higher preoperative IQ scores tend to experience better cognitive outcomes following surgery, regardless of the specific procedure performed. This may be attributed to several factors, including greater cognitive reserve, better preoperative language lateralization, and more efficient compensatory mechanisms in the contralateral hemisphere. However, the relationship between preoperative IQ and seizure control is less clear-cut. While some studies have suggested that patients with higher IQ scores may have better seizure outcomes following surgery, others have found no significant association. This variability may be due to the complex interplay of factors influencing seizure control, including the extent of the epileptogenic zone, the presence of comorbidities, and the individual's response to anti-seizure medications.[16,17]

The choice between ATL and SelAH should be individualized based on a comprehensive assessment

of the patient's clinical presentation, imaging findings, and neuropsychological profile. Factors to consider include the extent and location of the epileptogenic zone, the patient's preoperative cognitive function, language dominance, and the relative importance of seizure control versus cognitive preservation. For patients with well-defined epileptogenic zones and good preoperative cognitive function, SelAH may be the preferred approach, as it offers a good chance of achieving seizure freedom while minimizing the risk of cognitive deficits. In contrast, for patients with extensive or poorly defined epileptogenic zones, or those with lower preoperative cognitive function, ATL may be a more suitable option, as it provides a broader resection and a higher likelihood of achieving complete seizure control, even though it carries a higher risk of cognitive impairment. A thorough preoperative neuropsychological assessment is crucial for identifying patients at risk of postoperative cognitive deficits and for guiding surgical decision-making. This assessment should include a comprehensive evaluation of memory, language, executive function, and other relevant cognitive domains. It should also assess language lateralization, which is critical for determining the optimal surgical approach and minimizing the risk of language impairment. Ongoing research is focused on refining surgical techniques and developing new approaches to further improve seizure outcomes and minimize cognitive morbidity in MTLE surgery. Advances in neuroimaging, intraoperative monitoring, and neuropsychological assessment are helping to identify the epileptogenic zone with greater precision and to tailor surgical interventions to the individual patient's needs. Additionally, the development of novel neuromodulatory techniques, such as responsive neurostimulation and deep brain stimulation, may offer alternative treatment options for patients with MTLE who are not suitable candidates for resective surgery. The choice between ATL and SelAH in the surgical management of MTLE is a complex one, involving a careful balance of seizure control and cognitive preservation. While ATL may offer a higher likelihood of achieving seizure freedom, particularly in the short term, it carries a higher risk of postoperative cognitive deficits. SelAH, on the other hand, prioritizes the preservation of cognitive function but may be associated with a slightly lower rate of seizure freedom in the long term. The optimal surgical approach should be individualized based on a comprehensive assessment of the patient's clinical, imaging, and neuropsychological profile. Preoperative neuropsychological assessment plays a crucial role in identifying patients at risk of postoperative cognitive deficits and in guiding surgical decision-making. Continued research is needed to refine surgical techniques and develop new approaches to further improve outcomes for patients with MTLE.[14,17]

The term "cognitive reserve" refers to the brain's capacity to cope with damage or insult while maintaining function. It's a multifaceted concept influenced by factors like education, intellectual pursuits, and overall brain health. Individuals with higher IQs are often considered to have greater cognitive reserve, implying a more robust neural network capable of adapting to disruptions caused by surgery. Selective Amygdalohippocampectomy (SelAH) is designed to be a more targeted surgical approach compared to Anterior Temporal Lobectomy (ATL). By meticulously resecting only the epileptogenic structures within the mesial temporal lobe, SelAH aims to minimize collateral damage to surrounding brain regions. This preservation of healthy tissue is particularly crucial in areas responsible for language, memory, and other higher-order cognitive functions.[17,18]

In patients with higher preoperative IQs, the brain's inherent resilience and adaptability may synergize with the tissue-sparing nature of SelAH. The preserved neural networks can potentially compensate for the loss of the resected structures, leading to better cognitive outcomes. The brain's ability to reorganize and rewire itself, especially in individuals with greater cognitive reserve, may facilitate a smoother recovery and minimize the risk of postoperative cognitive decline. In contrast, Anterior

Temporal Lobectomy (ATL) involves a more extensive resection, often encompassing parts of the lateral temporal neocortex in addition to the mesial structures. While this broader resection may offer advantages in terms of seizure control, it also carries a higher risk of disrupting neural networks critical for cognitive function. Patients with lower preoperative IQs, potentially indicative of lower cognitive reserve, may be more vulnerable to the cognitive impact of ATL. The brain's capacity to compensate for the loss of tissue may be limited, increasing the likelihood of postoperative cognitive deficits. This vulnerability is particularly pronounced when the surgery involves the dominant hemisphere, which houses crucial language centers. Verbal memory, the ability to encode, store, and retrieve verbal information, is intricately linked to the dominant hemisphere. In most individuals, the left hemisphere is dominant for language. Resection of tissue in the dominant temporal lobe, as is often the case in ATL, can disrupt the neural pathways involved in verbal memory processing.[16,17]

Patients with lower cognitive reserve may struggle to adapt to these disruptions, leading to difficulties in remembering and recalling verbal information. This impairment can significantly impact daily life, affecting communication, learning, and overall quality of life. The preoperative IQ, as a proxy for cognitive reserve, can serve as a valuable tool in surgical decision-making. In patients with higher IQs, the potential benefits of SelAH in terms of cognitive preservation may outweigh the potential risks of slightly lower seizure freedom rates compared to ATL. Conversely, in patients with lower IQs, the priority may shift towards maximizing seizure control, even if it entails a higher risk of cognitive decline. However, it's crucial to emphasize that preoperative IQ is just one piece of the puzzle. A comprehensive neuropsychological assessment is essential to evaluate the patient's cognitive strengths and weaknesses, identify potential vulnerabilities, and tailor the surgical approach accordingly. Another study further underscores the importance of preoperative cognitive evaluation. The findings suggest that patients with higher preoperative VIQ, PIQ, and FIQ scores tend to experience better cognitive outcomes after SelAH compared to ATL, particularly in surgeries involving the dominant hemisphere. This observation reinforces the notion that cognitive reserve plays a role in modulating the impact of surgery on cognitive function.[17,18]

Routine neuropsychological assessment allows for a more nuanced understanding of the patient's cognitive profile. It helps identify individuals who may be at higher risk for specific cognitive deficits, such as verbal memory impairment following dominant hemisphere surgery. This information empowers neurosurgeons to make informed decisions, weighing the risks and benefits of each surgical approach in the context of the individual patient's cognitive reserve and functional needs. The relationship between preoperative IQ and surgical outcomes in MTLE is a complex and evolving field of study. While higher IQs may generally favor more selective surgical techniques like SelAH, a personalized approach is paramount. Routine neuropsychological assessment, coupled with a thorough understanding of the patient's cognitive profile and functional goals, is crucial for optimizing surgical outcomes and preserving quality of life. In the era of precision medicine, the integration of cognitive reserve considerations into surgical decision-making represents a significant step towards tailoring treatment plans to the individual patient. By harnessing the brain's inherent resilience and adaptability, neurosurgeons can strive to achieve the delicate balance between seizure control and cognitive preservation, ultimately improving the lives of individuals with MTLE.[16,18]

5. Conclusion

ATL has a higher success rate in short-term seizure control, although it is at risk of causing postoperative visual field deficits. SelAH tends to be better at preserving visual function. There is no significant difference in Performance IQ (PIQ) between the two groups, but SelAH shows a trend toward improved Verbal IQ (VIQ), although this is not statistically

significant. SelAH, being more selective, generally preserves cognitive function better compared to ATL, which involves broader temporal neocortex resection and is at higher risk of cognitive deficits, particularly in verbal memory if the dominant hemisphere is involved. Higher preoperative IQ is often associated with better cognitive outcomes postoperatively, with high-IQ patients being more suited for SelAH, while those with lower IQs may be at greater risk for cognitive decline if ATL is chosen. Therefore, SelAH is generally preferable over ATL, but routine neuropsychological assessment is necessary to determine the optimal surgical approach.

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