International Journal of Women's Health

Dovepress
Taylor & Francis Group

Open Access Full Text Article

CASE SERIES

Early Ovarian Teratoma Resection Improves Outcomes in Anti–N-Methyl-D-Aspartate Receptor Encephalitis: A Dual-Case Series

Xi Lan[1,2,*], JiaYu Chen[1,*], Yang Yang[1], Hua Zhong[1], ChangYi Chen[1], YanChun Liang[1,2]

[1]Department of Obstetrics and Gynecology, Guangxi Hospital Division of The First Affiliated Hospital, Sun Yat-sen University, Nanning, Guangxi, 530022, People's Republic of China; [2]Department of Obstetrics and Gynecology, The First Affiliated Hospital of Sun Yat-sen University, Guangzhou, Guangdong, 510080, People's Republic of China

*These authors contributed equally to this work

Correspondence: YanChun Liang, Department of Obstetrics and Gynecology, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou, Guangdong, 510080, People's Republic of China, Tel +86 13751722697, Email lyanchun@mail.sysu.edu.cn

Objective: Anti–N-methyl-D-aspartate receptor (NMDAR) encephalitis is a neuroimmune disorder closely associated with ovarian teratomas, yet the prognostic impact of early surgical intervention requires further exploration. This dual-case analysis highlights the critical role of timely teratoma resection in improving clinical outcomes.

Case Presentation: Case 1 involved a 34-year-old female presenting with psychiatric-dominant symptoms. A right salpingo-oophorectomy (pathology: immature teratoma) was performed 18 days post-onset, followed by rituximab therapy, resulting in full recovery with a modified Rankin Scale (mRS) score of 0. Case 2, a 16-year-old adolescent, underwent an initial laparoscopic ovarian teratoma resection (pathology: mature teratoma) 28 days post-onset. Residual tumor necessitated a second surgery (on day 95), leaving mild quadriparesis and ataxia with a mRS score of 2. Both cases remained recurrence-free during follow-up (17 and 14 months, respectively).

Conclusion: Early surgical resection of ovarian teratomas is critical for favorable prognosis in anti-NMDAR encephalitis, halting antibody production and preventing irreversible neurological damage.

Keywords: anti-NMDAR encephalitis, ovarian teratoma, early surgery, prognosis, case Series

Introduction

Anti-N-methyl-D-aspartate receptor (NMDAR) encephalitis is a neuroautoimmune disease characterized by heterogeneous neuropsychiatric manifestations, including seizures, dyskinesias, and psychiatric disturbances.[1] It predominantly affects young women, and emerging evidence highlights age-stratified clinical phenotypes: adolescents often experience rapid onset neuroinflammatory crises (such as status epilepticus and coma), whereas adults may present with subtle prodromal symptoms (such as depression and anxiety).[2] Previous studies have uncovered an association between anti-NMDAR encephalitis and ovarian teratomas. These teratomas have the capacity to express neuronal antigens, which in turn trigger the production of pathogenic anti-NMDAR antibodies.1 Early diagnosis and prompt treatment are crucial for improving outcomes, as delays can lead to significant morbidity and mortality.[3]

The management of anti-NMDAR encephalitis typically involves a multidisciplinary approach, including immunotherapy, surgical intervention for teratomas, and supportive care.[2,4] However, due to the rarity of the disease, data on treatment efficacy and prognostic evaluation remain relatively scant. In this case series, we present two patients with anti-NMDAR encephalitis associated with ovarian teratomas, highlighting the importance of early diagnosis, Early Surgical Intervention,multidisciplinary management, and tailored treatment approaches. We discuss the clinical presentation, diagnostic challenges, and therapeutic outcomes in these cases, providing insights into the management of this complex autoimmune disorder.

https://doi.org/10.2147/IJWH.S573051
Received: 20 October 2025
Accepted: 14 January 2026
Published: 4 February 2026

Case Report

Case 1

A 34-year-old Chinese woman, who is unmarried and nulliparous, with a history of ovarian teratoma resection, presented to the neurology department due to an acute episode of mental disorder, including depressive symptoms and suicidal ideation. She initially experienced mild fever, diarrhea, dizziness, and drowsiness for approximately 10 days. The local psychiatric hospital diagnosed her with "encephalitis, depressive state" and treated her with olanzapine, lorazepam, agomelatine, and zolpidem, among other medications.However, her symptoms did not significantly improve, and her condition gradually worsened, leading to depressive symptoms and suicidal ideation. Her mRS score was 2, prompting her referral to our hospital for a comprehensive evaluation and treatment on February 28, 2024.

On examination, she was febrile to 38.3 degrees, but all other vitals were within normal limits. The cardiopulmonary examination showed no abnormalities. She was conscious but in a poor mental state, occasionally speaking incoherently. Neurological examination showed normal muscle strength, but impaired consciousness and uncooperative behavior.

Laboratory tests showed a slight increase of serum blood glucose (7.5 mmol/L) and tumor markers (AFP 256 ng/mL, CA125 103 U/mL), while other routine analyses were within the normal range. Cerebrospinal fluid (CSF) analysis showed normal glucose and protein levels, with mild lymphocytosis, but no evidence of viral infection. The electroencephalogram (EEG) was normal, and the cranial MRI showed no abnormalities. Serum and cerebrospinal fluid autoimmune encephalitis antibody tests for 24 items both indicated: anti-glutamate receptor (NMDAR) antibody IgG at 1:100. Abdominal ultrasound revealed a mixed echoic area measuring 138mm×115mm×84mm within the right ovary, suggesting an ovarian teratoma (Figure 1A). Pelvic CT prominently showed a mass of mixed density with high and low signals on the right side of the abdomen, with clear boundaries, approximately 116mm×61mm×122mm in size, accompanied by calcification and fat components (Figure 1B).

Combining clinical manifestations with auxiliary examinations, the diagnosis was considered to be anti-NMDAR encephalitis associated with an ovarian teratoma. Between days 13 and 17 following the onset of symptoms, she was initially treated with high-dose intravenous methylprednisolone (IVMP,1.0g/day) and intravenous immunoglobulin (IVIG,20g/day), accompanied by active management of psychiatric symptoms, improvements in sleep, and sedative therapy. Despite these interventions, her condition continued to worsen, exhibiting behavioral abnormalities such as incoherent speech, self-injurious behavior, and aggression towards others. On day 18, after a comprehensive multi-disciplinary evaluation, she underwent an exploratory laparotomy. Intraoperative frozen section pathology identified an immature teratoma. Considering her fertility requirements, the malignant potential of an immature teratoma, and the imperative to achieve complete resection of the antigen source to halt the encephalitis, a right salpingo-oophorectomy was performed after thorough discussion with her family. Postoperative pathology confirmed a Grade 2 immature teratoma (FIGO stage 1A) (Figure 1C–F). No chemotherapy was administered post-surgery. Her mental status significantly improved following the operation, and she was subsequently treated with oral prednisone and intravenous rituximab(RTX). All psychiatric symptoms resolved, and she was discharged on day 26 with a mRS score of 0. During a 17-month follow-up, she experienced no recurrence (Figure 2).

Case 2

A 16-year-old Chinese female presented with a high fever, headache, and dizziness. She self-medicated with ibuprofen without improvement and began to exhibit delirious speech. On March 1, 2024, she was taken to the neurology department of a local hospital by her family due to her worsening condition, which included a coma, frequent seizures, weakness in movement, and the need for intubation and ventilator support. Her mRS score was 5. She received analgesic and sedative therapy, antiepileptic treatment, steroids, antibiotics, and nutritional support, but her seizure symptoms were poorly controlled. She was transferred to a higher-level hospital for further treatment. There, she continued to receive ventilator support, airway management, anti-infection treatment, and nutritional support. Autoimmune encephalitis was considered, and steroid treatment was administered. On day 26 post-symptom onset, Further tests for autoimmune encephalitis in the serum showed NMDAR antibody IgG 1:32, and CSF tests showed NMDAR antibody IgG 1:100. A CT scan indicated inflammation in both lungs, and a head CT scan showed the formation of a cavum septum pellucidum, with no other significant abnormalities on

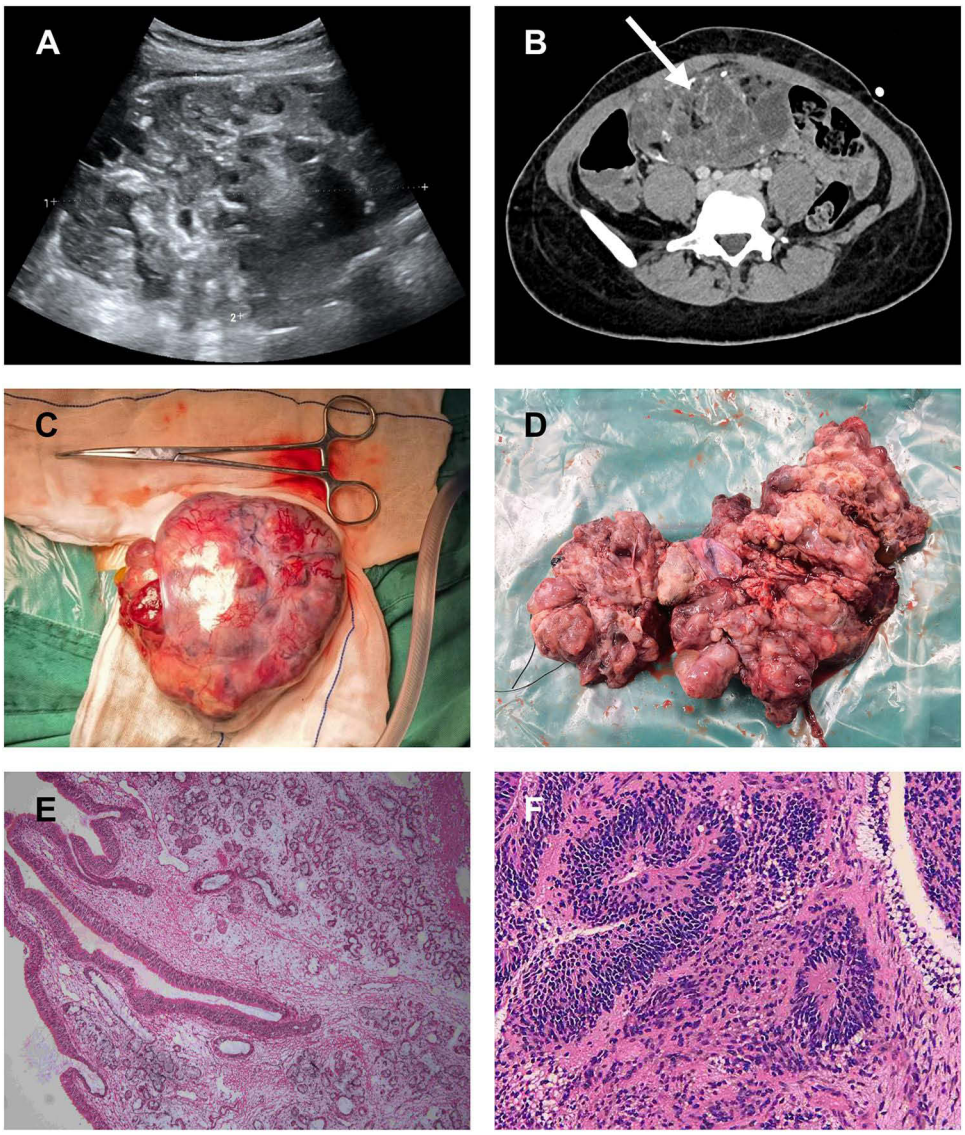

Figure 1 Diagnostic imaging, intraoperative findings, and pathological examination in case 1. (**A**) Transabdominal ultrasonography. (**B**) Pelvic CT scan, arrow showed a tumor with calcifications and fatty tissue in the right ovarian. (**C**) Intraoperative findings. (**D**) Gross appearance of the excised ovarian exhibiting a characteristic skin, hair, fat, and bone tissue. (**E** and **F**) Histologic analysis revealed an immature teratoma containing cartilage, fatty tissue, skin, skin appendages, bone tissue, with a significant amount of glial tissue and immature local nerve tissue and hair follicles.

plain scans. Pelvic CT scan showed a low-density shadow with calcification in the right adnexal area, suggesting the possibility of an ovarian teratoma, with a diameter of 22mm. Considering the clinical manifestations and auxiliary examinations, the diagnosis was anti-NMDAR encephalitis caused by an ovarian teratoma. On March 28, the day 28 post-symptom onset, she underwent a laparoscopic removal of the right ovarian ovarian teratoma. Postoperative pathology revealed a mature cystic teratoma in the right ovary. Despite treatment with steroids, human immunoglobulin, and plasma exchange, her condition did not improve. She continued to have frequent seizures, muscle tremors, and symptoms of consciousness disturbance. She underwent a tracheotomy on day 38 post-symptom onset. Her lung infection subsequently worsened, with recurrent fevers. On day 66, she was transferred to our hospital's Intensive Care Unit (ICU).

Considering the patient's chronic and recurrent condition, previous treatments, including steroid pulse therapy, immunoglobulin, and plasma exchange, have been ineffective. Upon admission on day 70 post-symptom onset, a further serum NMDAR antibody test was still positive at a titer of 1:320. The EEG indicated moderate abnormalities in brain waves. Pelvic CT and MRI revealed an abnormal signal focus in the right ovary, approximately 11mm×14mm×11mm in size, suggesting an

https://doi.org/10.2147/IJWH.S573051

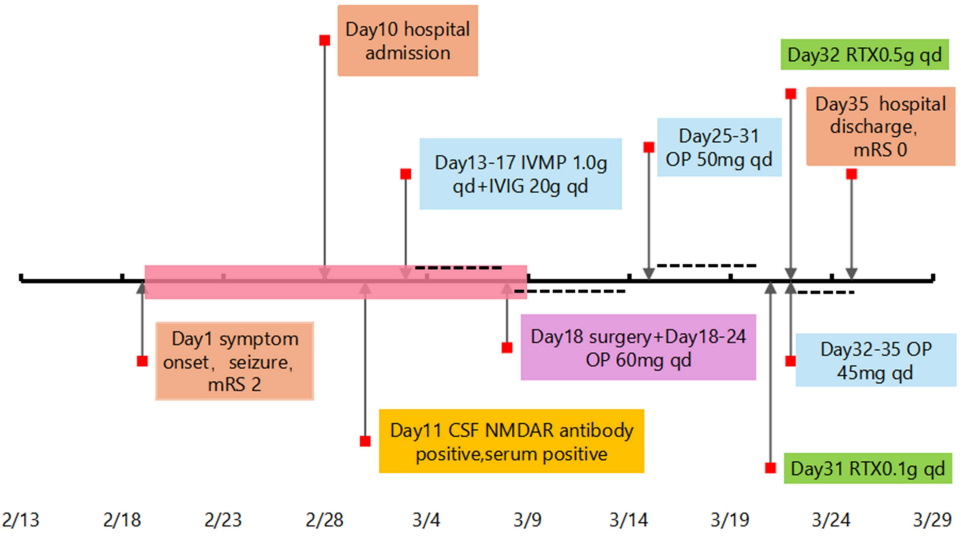

Figure 2 Timeline of Clinical Events and Treatment in case 1. Timeline showing major clinical events (Orange), Mental disorder (red), First-line immunotherapy (blue), Second-line immunotherapy (green), Surgery or operation (purple), and NMDAR antibody status (yellow) of the patient from symptom onset to discharge. Red bar =Mental disorder; dashed line = ongoing immunotherapy.
Abbreviations: CSF, cerebrospinal fluid; IVIG, IV immunoglobulin; IVMP, intravenous methylprednisolone; OP, oral prednisone; RTX, rituximab.

ovarian teratoma (Figure 3A and B). Her parents refused second surgery and requested a second-line treatment option. This regimen utilized rituximab, a B-cell function inhibitor, to inhibit antibody production while IVIG treatment was continued. After these treatments, the patient's symptoms improved, but recovery was still relatively slow. After obtaining consent through multiple discussions with her parents,A second laparoscopic resection of a right ovarian teratoma was performed on June 4, which corresponds to day 95 post-symptom onset.Pathology indicated a mature cystic teratoma (Figure 3C–F). Her mental state continued to improve. On postoperative day 8, her tracheostomy tube was removed. She was discharged 20 days post-operatively with mild quadriparesis, ataxia, memory deficit, and language defect, with a mRS score of 4 (Figure 4). During a 14-month follow-up, she had no recurrence and the mRS score is 2.

Discussion

Anti-NMDAR Encephalitis Associated with Ovarian Teratomas

Anti-NMDAR encephalitis is a severe autoimmune disorder that is frequently associated with ovarian teratomas, especially in young females. According to a multi-institutional observational study, approximately 35% of patients diagnosed with anti-NMDAR encephalitis were found to have ovarian teratoma, with the highest prevalence in females aged 12 to 45 years.[2]

The clinical presentation of anti-NMDAR encephalitis can vary significantly between adolescents and young adults. Initial symptoms often include fever, headache, and dizziness, which can be observed in both age groups. However, the progression and severity of symptoms differ markedly. In adolescents, the condition often rapidly progresses to severe neurological symptoms, such as seizures, abnormal movements, insomnia, and irritability. A study by Titulaer et al found that among adolescents with anti-NMDAR encephalitis, 75% developed seizures and 60% exhibited abnormal movements within the first week of symptom onset. In contrast, young adults are more likely to present with prominent psychiatric symptoms, including depression, anxiety, and suicidal ideation. In a retrospective analysis of adult patients, 65% presented with psychiatric symptoms as their initial manifestation, with depression and anxiety being the most common.[2]

In our comparative case report, these age-specific differences in symptoms are clearly demonstrated. The 16-year-old patient (Case 2) initially presented with high fever, headache, and dizziness, which rapidly progressed to severe neurological symptoms, including coma and frequent seizures. This rapid progression to severe neurological involvement is typical for adolescents with anti-NMDAR encephalitis. In contrast, the 34-year-old patient (Case 1) initially experienced milder symptoms such as mild

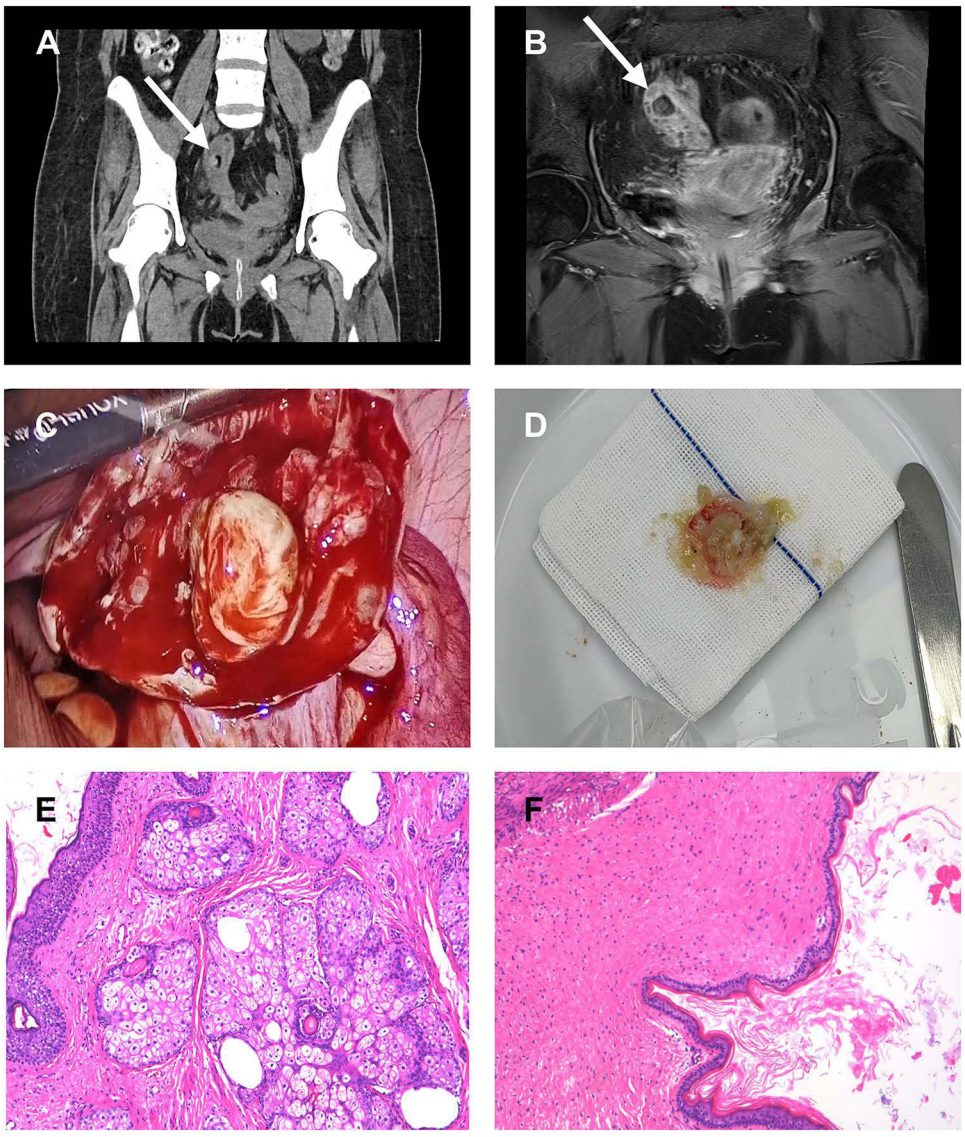

Figure 3 Diagnostic imaging, intraoperative findings, and pathological examination in case 2. (**A**) Pelvic CT scan,arrow showed a tumor with calcifications to the right ovarian (**B**) Pelvic MRI scan, arrow showed a tumor in the right ovarian. (**C**) Intraoperative findings. (**D**) Gross appearance of the excised ovarian tumor exhibiting a characteristic fat tissue. (**E** and **F**) Histologic analysis revealed a mature teratoma containing fatty tissue.

fever, diarrhea, dizziness, and drowsiness, which gradually worsened to significant psychiatric manifestations, including depressive symptoms and suicidal ideation. This presentation is more consistent with the common manifestation in young adults, where psychiatric symptoms often dominate. Our cases underscore the importance of recognizing these age-specific differences in clinical presentation to facilitate early diagnosis and appropriate management of anti-NMDAR encephalitis.

Diagnostic Strategies and Early Identification

The early and accurate diagnosis of anti-NMDAR encephalitis is crucial for the timely initiation of treatment and the improvement of prognosis. The diagnosis is based on a combination of clinical suspicion, serological and CSF testing for anti-NMDAR antibodies, and neuroimaging to exclude other causes. A high level of suspicion is necessary in young females presenting with acute neuropsychiatric symptoms, especially when accompanied by fever or other prodromal illnesses. In both cases we examined, the diagnosis was confirmed by the detection of anti-NMDAR antibodies in serum and CSF, which is considered the gold standard. Importantly, the search for an associated ovarian teratoma must be an integral part of the diagnostic process. Pelvic imaging, including ultrasound, CT, or MRI, should be promptly conducted

https://doi.org/10.2147/IJWH.S573051

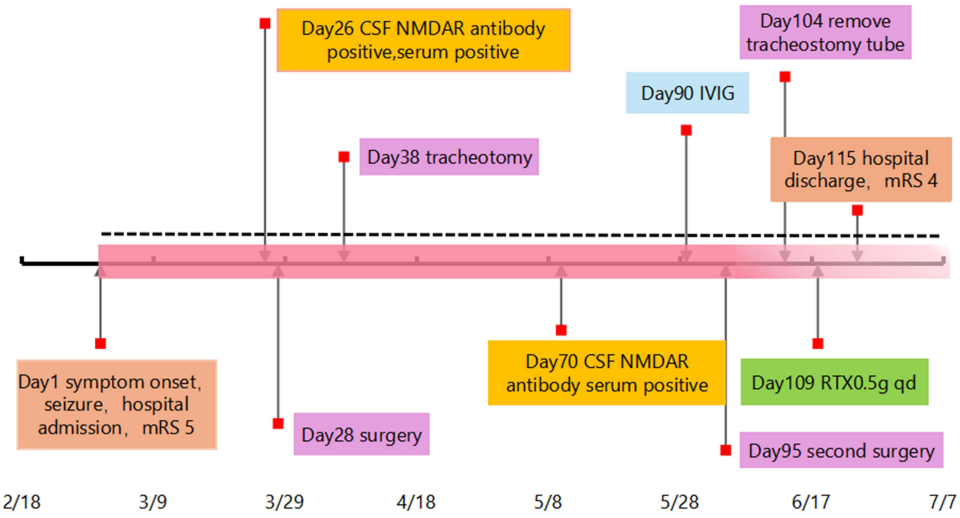

Figure 4 Timeline of Clinical Events and Treatment in case 2. Timeline showing major clinical events (Orange), Mental disorder (red), First-line immunotherapy (IVIG) (blue), Second-line immunotherapy (green), Surgery or operation (purple), and NMDA-R antibody status (yellow) of the patient from symptom onset to discharge. Red bar =seizure activity; dashed line = ongoing First-line immunotherapy (corticosteroids, IV immunoglobulin, plasma exchange).
Abbreviations: CSF, cerebrospinal fluid; IVIG, IV immunoglobulin; RTX, rituximab.

in all female patients with anti-NMDAR encephalitis, regardless of age.[1,3] As our cases have shown, imaging can reveal teratomas that may be clinically silent. Case 1 presented with a large, easily identifiable mass, whereas Case 2 had a small teratoma that was initially detected but whose residual focus was subsequently missed, emphasizing the need for high-resolution imaging and meticulous technique. Early and systematic imaging facilitates early surgical planning and intervention, which is directly correlated with better outcomes. A multidisciplinary team, including neurologists, psychiatrists, gynecologists, and radiologists, is essential for coordinating rapid diagnosis and treatment initiation.

Treatment of Anti-NMDAR Encephalitis

The management of anti-NMDAR encephalitis is a multifaceted approach that combines surgical and medical interventions. If a teratoma exists, surgical resection is essential. Timely detection and resection can significantly improve prognosis, as it eliminates the source of self-antigen stimulation, especially in young women with ovarian teratomas.[5,6] Immunotherapy is the cornerstone of treatment, initially involving corticosteroids to suppress the immune system and reduce inflammation, intravenous immunoglobulin (IVIG) to neutralize pathogenic autoantibodies, and plasma exchange to clear circulating autoantibodies. Therefore, surgery and immunotherapy are the most important management procedures for teratoma-associated anti-NMDAR encephalitis.[7] Most patients (approximately 80%) experience significant improvement or complete relief of clinical symptoms after receiving immunotherapy and surgical resection of related tumors (if necessary). For refractory cases, other immunotherapies such as rituximab (a B-cell depletion agent) can be used to further reduce autoantibody levels and improve prognosis.[8]

The treatment strategy is highly individualized, taking into account the severity of the patient's symptoms, the presence and nature of the teratoma, and the patient's response to initial therapies. In our cases, both patients benefited from a combination of surgical intervention and targeted immunotherapy. The 34-year-old patient (Case 1) underwent right salpingo-oophorectomy, followed by corticosteroids and rituximab, resulting in significant clinical improvement. The 16-year-old patient (Case 2), despite initial severe symptoms, showed gradual improvement with a combination of surgical removal of the teratoma, corticosteroids, IVIG, plasma exchange, and additional immunotherapies. These cases highlight the importance of a tailored, multidisciplinary approach to achieve the best outcomes.

Surgical Management and Decision-Making

Considering factors such as patient age, teratoma type, and clinical presentation, the surgical approach for ovarian teratoma in patients with anti-NMDAR encephalitis is highly personalized. In adolescents, the main goal is complete

ovarian teratoma resection with the lowest risk of recurrence and preservation of the healthiest ovarian tissue. After comprehensive evaluation, laparoscopic surgery for benign ovarian teratomas is safe and feasible.[9] The recommended surgical method is ovarian cystectomy. However, any form of ovarian cyst surgery may affect the reserve function of the ovaries, and it is necessary to fully communicate the condition with the patient and their family.[10]

Among young people, surgical methods may vary depending on the size and nature of the teratoma. There is no clear evidence of the safety of laparoscopic surgery for tumors with uncertain properties. For mature cystic teratomas, conservative surgery such as cystectomy is usually sufficient. Studies have shown that unilateral oophorectomy for premenopausal benign ovarian tumors may lead to premature menopause and increase the incidence of low estrogen-related complications such as cardiovascular disease, Alzheimer's disease, Parkinson's disease, etc.[11] However, for immature teratomas, more extensive surgery may be required, such as for germ cell tumors with lesions limited to one ovary in individuals aged ≤ 39 years. Surgery to preserve fertility may be performed,unilateral salpingo-oophorectomy may be adopted, and staged surgery may not be necessary if imaging does not indicate lymph node enlargement.[12,13] Postoperative adjuvant therapy should be performed based on pathology and risk stratification. The choice of surgical procedure should be tailored to the individual patient's needs and the specific characteristics of the teratoma. A multidisciplinary approach involving neurologists, gynecologic oncologists, and immunologists is essential to optimize patient outcomes.

In our case series, the surgical management of ovarian teratomas in patients with anti-NMDAR encephalitis was guided by careful consideration of patient age, fertility demand, teratoma type, and tumor size. The 16-year-old patient (Case 2) presented with a mature cystic teratoma, which was managed with a laparoscopic ovarian teratoma resection. Given the benign nature of mature teratomas and the patient's young age, this conservative approach was deemed appropriate and resulted in significant improvement in her neurological symptoms. In contrast, the 34-year-old patient (Case 1) had an immature teratoma, which is associated with a higher risk of recurrence and malignancy. Therefore, a more extensive surgical intervention, specifically right salpingo-oophorectomy, was chosen to ensure complete removal of the teratoma. This tailored surgical approach underscores the importance of individualizing treatment based on the specific characteristics of the teratoma and the patient's clinical presentation.

Timing of Surgical Intervention

The timing of surgical intervention is crucial in treating anti-NMDAR encephalitis, as early removal of the teratoma is closely linked to better clinical outcomes and faster recovery. Recent studies have demonstrated that patients who undergo teratoma surgical resection within the first month of symptom onset exhibit a significantly higher complete recovery rate compared to those who delay surgery.[14] Hence, early detection and surgical removal of ovarian teratomas are safe and effective treatments for combating NMDAR encephalitis.[15,16] Severe systemic and neurological complications should not be regarded as surgical contraindications.[16,17] For critically ill patients, early surgical resection of tumors is imperative, and multidisciplinary involvement from anesthesiology, ICU, and neurology is essential.

In our case series, the importance of early surgical intervention was clearly demonstrated through the contrasting outcomes of our two patients. The 34-year-old patient (Case 1) underwent surgical removal of the teratoma within eighteen days of symptom onset. This early intervention was followed by targeted immunotherapy, which led to a significant improvement in her mental status. She was discharged from the hospital within 25 days of symptom onset, with complete resolution of neurological symptoms and a marked improvement in her psychiatric condition.

In contrast, the 16-year-old patient (Case 2) experienced a delay in diagnosis, which resulted in a later surgical intervention. She underwent her first laparoscopic ovarian teratoma resection on day 28 of symptom onset. Post-operation, the follow-up imaging was neglected, and her condition did not improve. Residual tumor tissue was detected in the follow-up imaging 42 days post-operation. The family requested a second-line treatment plan, and the second laparoscopic ovarian teratoma resection was performed on day 95 after onset. Despite subsequent intensified immunotherapy, her recovery was slower and more complicated. She was discharged from the hospital 20 days after the second surgery with mild quadriparesis, ataxia, mild language deficits, and memory impairment. These residual neurological deficits persisted for over six months, highlighting the significant impact of delayed diagnosis and residual tumor tissue on the clinical course and recovery in anti-NMDAR encephalitis.

The comparative results in our case emphasize the importance of timely surgical intervention in the treatment of anti-NMDAR encephalitis associated with ovarian teratoma. Early intervention can not only address the root cause of autoimmune reactions, but also minimize the duration of exposure to pathogenic autoantibodies, which is crucial for preventing long-term nerve damage.

Strategies for Achieving Complete Resection

Ensuring complete resection of the teratoma is crucial for achieving long-term remission of anti-NMDAR encephalitis. Patients whose tumors have not been completely removed or whose tumors have not been detected may experience immune-mediated recurrence of neurological symptoms.[16,18] Therefore, a comprehensive strategy encompassing precise preoperative evaluation, meticulous intraoperative techniques, and vigilant postoperative monitoring is essential for reducing the risk of recurrence and improving patient prognosis.

A cornerstone of this strategy is thorough preoperative imaging assessment. Multimodal pelvic imaging is indispensable for surgical planning and aims at achieving complete resection. While ultrasound is a useful first-line screening tool, pelvic magnetic resonance imaging (MRI) is the preferred modality due to its superior soft-tissue contrast, which allows for more accurate characterization of the teratoma, delineation of its boundaries, and importantly, the detection of small or bilateral lesions that may be missed by computed tomography (CT) or ultrasound.[15] A detailed preoperative map of the disease is the first critical step in ensuring no tumor tissue is overlooked during surgery.

Guided by the preoperative roadmap, the following intraoperative measures are essential for achieving complete resection. Primarily, meticulous dissection is crucial for identifying and removing all visible tumor tissues. Secondly, the use of intraoperative ultrasound or other imaging techniques can help identify any residual tumor tissue that may not be visible to the naked eye, particularly for deep-seated or very small nodules. Thirdly, careful inspection of the surgical site and both ovaries before closure is mandatory.Finally, postoperative imaging examinations and follow-up should not be neglected. Regular follow-up imaging studies, such as pelvic MRI, should be performed to verify the absence of residual or recurrent tumor tissue, enabling timely intervention if needed.

In our case series, the importance of a comprehensive approach to complete resection was clearly demonstrated through the contrasting outcomes of our two patients. In Case 1, the patient benefited from a detailed preoperative CT and ultrasound evaluation. The intraoperative frozen section then guided the definitive surgical extent (salpingo-oophorectomy), ensuring complete removal. Postoperative imaging confirmed the absence of residual tumor tissue, and the patient remained recurrence-free during the 17-month follow-up period. This early and complete intervention was associated with a rapid improvement in neurological symptoms.

In contrast, the 16-year-old patient (Case 2) experienced a delayed recovery following her initial laparoscopic cystectomy. Follow-up imaging identified residual tumor tissue, which required a second surgical intervention. The primary cause of this residual lesion likely stemmed from inadequate preoperative evaluation that failed to detect the microscopic lesion, compounded by the absence of real-time imaging guidance during the operation. The presence of residual tumor tissue exacerbated both the prolonged recovery period and persistent neurological symptoms, highlighting the consequences of incomplete surgical removal.

Conclusions

The optimal management of anti-NMDAR encephalitis associated with ovarian teratomas hinges on early detection and prompt intervention. Timely and complete resection of the teratoma is pivotal in mitigating the autoimmune response and enhancing long-term remission.However, our findings are based on a small, dual-case series and should be interpreted with caution. Future studies with larger, multicenter cohorts are warranted to validate the impact of surgical timing and completeness of resection on long-term outcomes.

Data Sharing Statement

All available information is included in the manuscript.

Ethics Approval and Informed Consent

This study was approved by the Ethics Committee of the Guangxi Hospital Division of the First Affiliated Hospital, Sun Yat-sen University (Approval No. KY-LW-2025(001)). The Ethics Committee of the Guangxi Hospital Division of the First Affiliated Hospital, Sun Yat-sen University also granted approval for publication of anonymized case details. Written informed consent was obtained from all participants or their legally authorized representatives for the use of anonymized clinical data in this retrospective case series. This study was performed in accordance with the ethical standards as laid down in the Declaration of Helsinki and its later amendments.

Consent for Publication

The report of this study adheres to the CARE guidelines.Written informed consent was obtained from all participants or their legally authorized representatives for publication of this case report and any accompanying images.

Acknowledgments

We would like to acknowledge our team for their role in completing this research and thank the patients who consented for the study.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This work was supported by (1) National Key Research and Development Program of China (Grant No. 2022YFC2704102), (2) Natural Science Foundation of Guangdong Province (Grant No.2023A1515010018 and 2025A1515012542), (3) Guangdong basic and applied basic research foundation (No. 2022A1515220143), (4) Colin Nova Project of the First Affiliated Hospital of Sun Yat-sen University (Grant No. R08013), (5) Jieyang Special Guidance Project for Science and Technology Innovation Development (No.DZX083), (6) Jieyang Healthcare and Medical Projects (No.2022wsyl016), (7) Student Innovation Training Program of Sun Yat-Sen University (Grant No. 20252700, 20252684), (8) Self-fundedResearch Project of Health Commission of Guangxi Zhuang Autonomous Region (Grant No.Z-A20230572), (9) Guangxi Hospital Division of The First Affiliated Hospital, Sun Yat-sen University for Young Scientists (Grant No.YQ2024010).

Disclosure

All authors declare no conflicts of interest in this work.

References

1. Dalmau J, Tüzün E, Wu HY, et al. Paraneoplastic anti-N-methyl-D-aspartate receptor encephalitis associated with ovarian teratoma. *Ann Neurol*. 2007;61:25–36. doi:10.1002/ana.21050
2. Titulaer MJ, McCracken L, Gabilondo I, Armangué T, Glaser C, Iizuka T, et al. Treatment and prognostic factors for long-term outcome in patients with anti-NMDA receptor encephalitis: an observational cohort study. *Lancet Neurol*. 2013;12:157–165. doi:10.1016/S1474-4422(12)70310-1
3. Dalmau J, Armangué T, Planagumà J, Radosevic M, Mannara F, Leypoldt F, et al. An update on anti-NMDA receptor encephalitis for neurologists and psychiatrists: mechanisms and models. *Lancet Neurol*. 2019;18:1045–1057. doi:10.1016/S1474-4422(19)30244-3
4. Dalmau J, Graus F. Antibody-mediated encephalitis. *N Engl J Med*. 2018;378(9):840–851. doi:10.1056/NEJMra1708712
5. Dalmau J, Gleichman AJ, Hughes EG, Rossi JE, Peng X, Lai M, et al. Anti-NMDA-receptor encephalitis: case series and analysis of the effects of antibodies. *Lancet Neurol*. 2008;7:1091–1098. doi:10.1016/S1474-4422(08)70224-2
6. Jiang XY, Lei S, Zhang L, Liu X, Lin MT. Blumcke I,et al.Co-expression of NMDA-receptor subunits NR1, NR2A, and NR2B in dysplastic neurons of teratomas in patients with paraneoplastic NMDA-receptor-encephalitis: a retrospective clinico-pathology study of 159 patients. *Acta Neuropathol Commun*. 2020;8:130. doi:10.1186/s40478-020-00999-2
7. Lin J, Wang M, Wang J, Li J. Ovarian teratoma-related paraneoplastic neurological syndromes. *Front Oncol*. 2022;12:892539. doi:10.3389/fonc.2022.892539

8. Dalmau J, Lancaster E, Martinez-Hernandez E, Rosenfeld MR, Balice-Gordon R. Clinical experience and laboratory investigations in patients with anti-NMDAR encephalitis. *Lancet Neurol*. 2011;10:63–74. doi:10.1016/S1474-4422(10)70253-2
9. Michelotti B, Segura BJ, Sau I, Perez-Bertolez S, Prince JM, Kane TD. Surgical management of ovarian disease in infants, children, and adolescents: a 15-year review. *J Laparoendosc Adv Surg Tech A*. 2010;20:261–264. doi:10.1089/lap.2009.0137
10. Mohamed AA, Al-Hussaini TK, Fathalla MM, El Shamy TT, Abdelaal II, Amer SA. The impact of excision of benign nonendometriotic ovarian cysts on ovarian reserve: a systematic review. *Am J Obstet Gynecol*. 2016;215:169–176. doi:10.1016/j.ajog.2016.03.045
11. Rice MS, Hankinson SE, Tworoger SS. Tubal ligation, hysterectomy, unilateral oophorectomy, and risk of ovarian cancer in the nurses' health studies. *Fertil Steril*. 2014;102:192–198.e3. doi:10.1016/j.fertnstert.2014.03.041
12. Mangili G, Sigismondi C, Lorusso D, et al. The role of staging and adjuvant chemotherapy in stage I malignant ovarian germ cell tumors (MOGTs): the MITO-9 study. *Ann Oncol*. 2017;28:333–338. doi:10.1093/annonc/mdw563
13. Mahdi H, Swensen RE, Hanna R, Kumar S, Ali-Fehmi R, Semaan A, et al. Prognostic impact of lymphadenectomy in clinically early stage malignant germ cell tumour of the ovary. *Br J Cancer*. 2011;105:493–497. doi:10.1038/bjc.2011.267
14. Lee WJ, Lee ST, Shin YW, et al. Teratoma Removal, Steroid, IVIG, Rituximab and Tocilizumab (T-SIRT) in Anti-NMDAR Encephalitis. *Neurotherapeutics*. 2021;18:474–487. doi:10.1007/s13311-020-00921-7
15. Zhang L, Lu Y, Xu L, Liu L, Wu X, Zhang Y, et al. Anti-N-methyl-D-aspartate receptor encephalitis with accompanying ovarian teratoma in female patients from East China: clinical features, treatment, and prognostic outcomes. *Seizure*. 2020;75:55–62. doi:10.1016/j.seizure.2019.12.016
16. Dai Y, Zhang J, Ren H, et al. Surgical outcomes in patients with anti-N-methyl D-aspartate receptor encephalitis with ovarian teratoma. *Am J Obstet Gynecol*. 2019;221:485.e1–485.e10. doi:10.1016/j.ajog.2019.05.026
17. Guan HZ, Ren HT, Cui LY. Autoimmune encephalitis: an expanding frontier of neuroimmunology. *Chin Med J*. 2016;129:1122–1127. doi:10.4103/0366-6999.180514
18. Liu Y, Tian Y, Guo R, et al. Anti-NMDA receptor encephalitis: retrospective analysis of 15 cases, literature review, and implications for gynecologists. *J Healthc Eng*. 2022;2022:4299791. doi:10.1155/2022/4299791