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Value of cranial CT imaging in detection of neurogenic pulmonary edema in a pregnant Woman in late pregnancy: A case report

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► *Case report*

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ABSTRACT

Background: Neurogenic pulmonary edema (NPE) is an acute, noncardiogenic pulmonary edema that can follow a major central nervous system insult. In pregnancy, rapid respiratory deterioration has a broad differential diagnosis, making prompt neurologic and thoracic imaging particularly important. ***Case presentation:*** A 36-year-old woman at 30+2 weeks of gestation presented with a two-week history of headache, poor appetite, generalized weakness, drowsiness, tachypnea, and wheezing. Cranial computed tomography (CT) demonstrated a large patchy hypodense lesion involving the left cerebellar hemisphere and pons, with obstructive hydrocephalus and interstitial cerebral edema. External ventricular drainage improved consciousness and hydrocephalus, but respiratory and circulatory failure subsequently developed, with bilateral pulmonary opacities on chest radiography. NPE was considered after multidisciplinary assessment. Emergency cesarean delivery was followed by venovenous extracorporeal membrane oxygenation (VV-ECMO) and supportive therapy. The patient recovered and remained in good condition at more than six months after discharge. ***Conclusion:*** In pregnant patients with acute neurologic disease and unexplained respiratory failure, prompt cranial CT together with chest imaging may help identify the neurologic trigger and support timely consideration of NPE. VV-ECMO may provide rescue support for refractory hypoxemia in carefully selected patients within multidisciplinary care.

INTRODUCTION

Neurogenic pulmonary edema (NPE) is a potentially life-threatening form of acute pulmonary edema that occurs after an acute central nervous system insult. Proposed mechanisms include an intense sympathetic discharge with pulmonary vasoconstriction, redistribution of blood to the pulmonary circulation, increased hydrostatic pressure, and increased pulmonary capillary permeability [1]. NPE has been described after subarachnoid hemorrhage, traumatic brain injury [3, 4], seizures, hydrocephalus, and neurosurgical procedures [1, 5-8]. Its diagnosis is clinical and requires a close temporal relationship to neurologic injury together with exclusion of competing causes of pulmonary edema, including cardiogenic edema, aspiration, infection, and other forms of acute respiratory distress [9-11].

Pregnancy adds diagnostic and therapeutic complexity because acute pulmonary edema has obstetric, cardiac, infectious, thromboembolic, and neurologic causes. A previous report described NPE as a rare cause of maternal collapse after seizure activity [12]. Rapid neuroimaging can be decisive when neurologic deterioration accompanies respiratory failure. Recent case reports in the International Journal of Radiation Research have likewise emphasized the value of CT/CT angiography and multimodal neuroimaging in urgent neurologic diagnosis and management [13, 14].

The novelty of the present case is the combination of late pregnancy, an intracranial lesion with obstructive hydrocephalus, subsequent severe respiratory and circulatory failure compatible with NPE, and rescue treatment that included VV-ECMO. Serial cranial CT and chest radiography helped link the neurologic and pulmonary abnormalities and guided multidisciplinary management. We report the imaging findings, clinical course, and treatment to increase awareness of this uncommon but critical brain-lung complication.

Case presentation

A 36-year-old woman at 30±2 weeks of gestation was admitted to the Obstetrics and Gynecology Department on May 20, 2024, after two weeks of headache, poor appetite, generalized weakness, epigastric discomfort, drowsiness, fatigue, tachypnea, and wheezing. She was transferred to the intensive care unit within 24 hours because of clinical deterioration. On ICU assessment, heart rate was 137 beats/min, respiratory rate was 42 breaths/min, blood pressure was 107/65 mmHg, and oxygen

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saturation was 92% during mechanical ventilation.

Admission and preoperative assessment integrated the bedside cardiopulmonary examination, serial imaging, and the documented clinical course when evaluating alternative causes of pulmonary edema. The case presentation therefore focuses on the clinically documented findings that informed diagnosis and management.

Additional preoperative and ICU investigations showed a white blood cell count of 12.8 × 10^9/L, neutrophils 86.1%, hemoglobin 104 g/L, platelet count 176 × 10^9/L, C-reactive protein 18.6 mg/L, and procalcitonin 0.11 ng/mL. Serum albumin was 27.8 g/L, creatinine 61 μmol/L, alanine aminotransferase 29 U/L, and aspartate aminotransferase 37 U/L. High-sensitivity cardiac troponin I was 0.010 ng/mL and NT-proBNP was 186 pg/mL. Arterial blood-gas analysis during mechanical ventilation with FiO_2 0.70 showed pH 7.34, $PaCO_2$ 34.6 mmHg, PaO_2 61.2 mmHg, and lactate 2.3 mmol/L, corresponding to a PaO_2/FiO2 ratio of approximately 87 mmHg. Bedside echocardiography showed preserved left-ventricular systolic function (LVEF 63%) without a major valvular abnormality, regional wall-motion abnormality, or right-heart strain. Blood cultures obtained before escalation of antibiotics showed no growth, and procalcitonin remained low. Lower-extremity venous ultrasonography showed no deep-vein thrombosis. The cumulative fluid balance during the 24 h before pulmonary deterioration was +310 mL, without marked peripheral edema.

Imaging technique: Non-contrast cranial CT was performed on a 64-detector-row SOMATOM Definition AS scanner (Siemens Healthineers, Germany) using axial acquisition at 120 kVp with automatic tube-current modulation (reference 230 mAs), 5-mm routine brain reconstruction, and 1-mm thin-section reconstruction. Portable anteroposterior digital chest radiographs were obtained at the bedside using a MobileDiagnost wDR system (Philips Healthcare, the Netherlands). Images were reviewed on Vue PACS version 12.2 (Carestream Health, United States) by the treating team.

Initial cranial CT demonstrated a large patchy hypodense lesion involving the left cerebellar hemisphere and pons, with obstructive hydrocephalus and interstitial cerebral edema (figure 1A). After multidisciplinary consultation, external ventricular drainage through a frontal burr hole was performed on May 21, 2024. Postoperative consciousness improved, and follow-up cranial CT showed the ventricular drain and improvement of hydrocephalus (figure 1B). Despite neurologic improvement, the patient developed tachycardia, hypotension, and worsening respiratory failure. Chest radiography demonstrated diffuse bilateral pulmonary opacities (figure 2). Following hospital-wide and citywide expert consultation, the working diagnoses included a suspected malignant lesion of the left cerebellar hemisphere, obstructive hydrocephalus after ventricular drainage, respiratory and circulatory failure, and NPE.

Cardiogenic pulmonary edema, aspiration, infection, fluid overload, pulmonary embolism, and other causes of acute respiratory failure were considered during multidisciplinary evaluation. No alternative diagnosis was identified in the documented clinical course that better explained the close temporal association between acute neurologic deterioration and the rapid development of bilateral pulmonary opacities; NPE was therefore retained as the favored working diagnosis. Residual diagnostic uncertainty is acknowledged because this is a single clinical case.

The preserved LVEF, absence of right-heart strain, low cardiac-biomarker burden, modest positive fluid balance, low procalcitonin concentration, negative blood cultures, and absence of lower-extremity deep-vein thrombosis made a predominantly cardiogenic, infectious, marked volume-overload, or clinically overt thromboembolic explanation less likely. Pulmonary embolism was not considered definitively excluded because computed-tomography pulmonary angiography was not performed during the unstable period. These findings were therefore interpreted together with the close temporal association between the acute neurologic process and the rapid development of bilateral pulmonary opacities, supporting NPE as the favored working diagnosis while retaining appropriate diagnostic uncertainty.

On May 22, 2024, the patient underwent

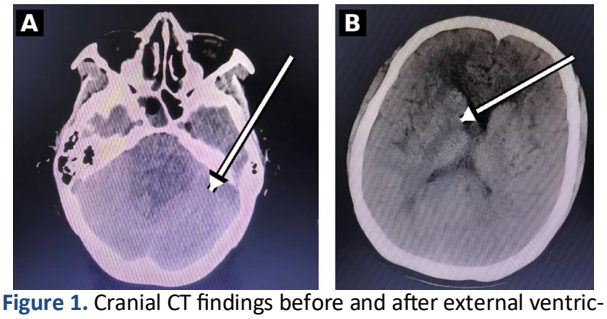


Figure 1. Cranial CT findings before and after external ventricular drainage. **(A)** Preoperative axial non-contrast cranial CT shows a large hypodense abnormality in the posterior fossa/left cerebellar region (arrow). The clinical CT interpretation also described obstructive hydrocephalus and interstitial cerebral edema. **(B)** Postoperative axial cranial CT after frontal burr-hole lateral ventricular drainage; the arrow indicates the ventricular drainage catheter. The treating team interpreted follow-up imaging as showing improvement of hydrocephalus.

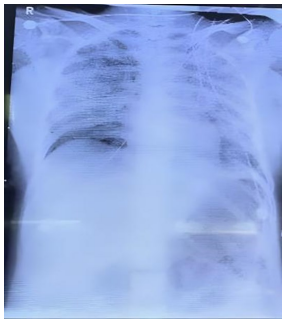


Figure 2. Portable chest radiograph obtained after clinical deterioration. Diffuse bilateral pulmonary air-space/interstitial opacities are present, supporting pulmonary edema in the clinical context of acute neurologic injury and respiratory failure. These findings were interpreted together with the multidisciplinary evaluation of alternative causes of acute pulmonary edema.

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emergency obstetric surgery consisting of a transabdominal lower-segment cesarean section, abdominal wall scar excision, uterine cavity tamponade, and gauze tamponade. Postoperatively, persistent oxygenation instability required VV-ECMO support. She was subsequently transferred to the Affiliated Hospital of Zunyi Medical University for further treatment. After improvement of cerebral edema, the ventricular drain was removed.

Supportive devices and treatment systems: Invasive mechanical ventilation was provided with an Evita V500 ICU ventilator (Drägerwerk AG & Co. KGaA, Germany) using a lung-protective ventilation strategy. VV-ECMO was delivered with a CARDIOHELP centrifugal-pump extracorporeal system (Getinge/Maquet Cardiopulmonary GmbH, Germany) and a QUADROX-i adult membrane oxygenator (Getinge/Maquet Cardiopulmonary GmbH, Germany). Continuous renal replacement therapy was performed using a Prismaflex platform with an ST150 high-flux hemofilter (Baxter International Inc., United States).

During VV-ECMO support, continuous blood purification was used as part of fluid management and multiorgan supportive care. Antibiotics were administered according to the treating team's clinical judgment; plasma was given for coagulation support, and human albumin was used in the setting of hypoproteinemia. Serial chest imaging was used to follow the pulmonary abnormalities (figure 3). The patient's cardiopulmonary and neurologic status subsequently improved, and she was discharged. Follow-up extending beyond six months after discharge indicated that she remained in good condition.

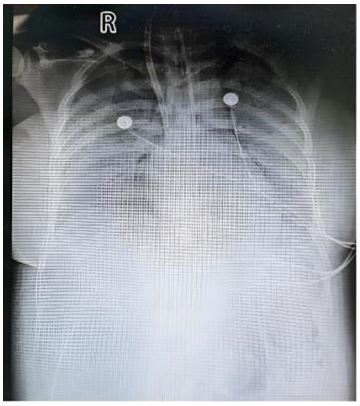


Figure 3. Portable chest radiograph during VV-ECMO support. Bilateral pulmonary opacities remain visible together with support lines/tubes. Serial radiography was used to assess the pulmonary course during intensive care treatment. No statistical hypothesis testing was performed because this report describes a single patient; therefore, p values are not applicable.

DISCUSSION

NPE typically develops within minutes to hours after a substantial central nervous system insult, although delayed presentations are reported [1, 5]. The syndrome is thought to involve a catecholamine surge and sympathetic overactivity that increase pulmonary vascular pressure and permeability, producing rapid alveolar fluid accumulation [1, 5]. Diagnostic features commonly include an acute neurologic event, hypoxemia, bilateral pulmonary opacities, and the absence of a better cardiogenic, infectious, aspiration-related, or volume-overload explanation. Because these features overlap with other causes of acute respiratory failure, the diagnosis depends on integration of neurologic findings, cardiopulmonary assessment, imaging, and the temporal course.

The association between raised intracranial pressure/hydrocephalus and NPE is supported by previous case reports. NPE has been described after endoscopic third ventriculostomy for hydrocephalus [7] and in a patient with obstructive hydrocephalus caused by a cerebellar metastatic lesion before neurosurgical treatment [10]. NPE has also been reported after vestibular schwannoma surgery [8]. In the present patient, cranial CT demonstrated a posterior fossa lesion with obstructive hydrocephalus, and pulmonary deterioration occurred around the period of acute neurologic decompensation and ventricular drainage. The temporal sequence supports a brain-lung association but does not establish ventricular drainage as the cause of NPE.

This case is also unusual because the patient was in late pregnancy. Farooq *et al.* reported near-fatal NPE in a pregnant woman after seizure activity, illustrating that NPE should be considered among neurologic causes of maternal respiratory collapse [2]. Pregnancy simultaneously broadens the differential diagnosis and increases the need for coordinated obstetric, neurologic, radiologic, and critical-care decision making. In this setting, cranial CT provided rapid visualization of the intracranial abnormality and hydrocephalus, while chest radiography documented the accompanying pulmonary process. CT-based emergency neuroimaging has similarly been emphasized in an obstetric neurologic emergency reported in IJRR [13], and multimodal neuroimaging has been shown to aid differentiation of acute neurologic mimics [14].

Severe NPE may require advanced respiratory support. Previous reports describe successful ECMO use for fulminant NPE after aneurysmal subarachnoid hemorrhage [11], and more recent experience suggests that carefully selected neurosurgical patients with severe NPE can undergo treatment while supported with VV-ECMO, although bleeding and anticoagulation risks require meticulous management [12]. In our patient, VV-ECMO was used as rescue support when oxygenation remained unstable after emergency obstetric surgery. The favorable course is consistent with the concept that temporary extracorporeal support may bridge selected patients through a reversible pulmonary insult while the neurologic cause and systemic complications are addressed.

Several limitations should be acknowledged. First,

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this is a single case and cannot establish causality or treatment efficacy. Second, the exact contribution of NPE relative to other potential causes of pulmonary edema depends on the completeness of the cardiac, infectious, aspiration, thromboembolic, and fluid-status evaluation. Third, imaging and supportive-care techniques are reported at the modality and procedure level rather than as device-specific performance comparisons. Finally, the intracranial lesion was clinically suspected to be malignant, but pathological confirmation was not available; the report therefore does not assign a definitive histopathologic diagnosis.

CONCLUSION

NPE should be considered when acute respiratory failure with bilateral pulmonary opacities develops in temporal association with a serious intracranial process. In this late-pregnancy case, cranial CT rapidly demonstrated a posterior fossa lesion and obstructive hydrocephalus, while chest radiography documented the pulmonary abnormality. Early multidisciplinary evaluation, treatment of the neurologic problem, obstetric management, and rescue VV-ECMO support were associated with clinical recovery. This single case supports awareness and timely imaging rather than proving the efficacy of any specific intervention.

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Conflict of interest: The authors declare no conflict of interest related to this case report.

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Ethical considerations: This case report was reviewed and approved by the Ethics Committee of the Affiliated Hospital of Zunyi Medical University (Approval No. KLL-2025-021; approval date: January 14, 2025). Written informed consent for publication was obtained from the patient. The report contains no direct patient identifiers.

Authors' contributions: Y.H., drafted the manuscript and contributed to editing and revision. Y.C., B.F. and X.F., contributed to editing and revision. Y.Y., S.L., and Z-X.X., contributed to manuscript review and final approval. All authors reviewed and approved the final manuscript. The authors prepared and revised the manuscript and used professional English-language editing for grammar and readability. The language-editing service had no role in the clinical care, data interpretation, scientific conclusions, or decision to submit the report.

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