Treatment of Hypertensive Intracerebral Hemorrhage and Traumatic Brain Injury

with a Visualized Intracranial Access Catheter Combined with Neuroendoscopy

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PRESENTATION ROADMAP

CONTENTS

Clinical evidence, technique selection, device workflow and case outcomes

Page ranges include each section overview page

EVIDENCE BASE AND CLINICAL DECISION-MAKING

A Daunting Challenge: The Current Status of Intracerebral Hemorrhage (ICH)

Intracerebral hemorrhage is the subtype of stroke associated with the highest mortality and disability rates, representing a significant global healthcare burden with limited effective therapeutic options currently available to clinicians.

> 3 Million

Annual Global Incidence

China accounts for approximately one-third of the global total, making it a major public health concern that demands urgent attention.

30-40%

30-day Mortality Rate

This rate is 4-6 times higher than that of ischemic stroke, highlighting the critical and life-threatening nature of acute ICH management.

> 70%

Severe Disability at 1 Year

A very high proportion of survivors have an mRS score ≥ 3, indicating profound long-term functional impairment and reduced quality of life.

Clinical Implication

There is an urgent need for innovative surgical decision-making guided by rigorous evidence-based medicine. Current clinical practices require optimization to address the unmet need for improving patient outcomes and reducing the profound societal impact of ICH.

A 60-Year Jigsaw Puzzle of Evidence: From Uncertainty to Dawn

1961

McKissock

The first surgical RCT for ICH, pioneering evidence-based research in neurosurgical intervention and setting the stage for future trials.

2005

STICH I

Primary outcome was negative overall, but a critical positive signal emerged in the subgroup of superficial lobar hemorrhage patients.

2013

STICH II

A near-positive primary outcome significantly boosted confidence in minimally invasive surgical approaches for carefully selected ICH patients.

2019

MISTIE III

Functional outcome was negative, but a clear survival benefit was observed. It also proposed the ≤15mL evacuation standard as a key procedural metric.

2024

ENRICH

A precisely designed trial built on 60 years of accumulated data finally yielded positive results, validating the new standard of precision care.

Core Conclusion

Six decades of relentless research, iterative learning from setbacks, and refining surgical paradigms have finally culminated in a successful, evidence-backed model of precision and minimal invasiveness for ICH. The ENRICH trial represents not just a clinical victory, but the dawn of a new era in patient care—turning decades of uncertainty into actionable hope and a clear path forward for treating this devastating condition.

The Dawn of a New Era: Key Clinical Trials of 2024-2025

ENRICH (NEJM 2024)

The trial evaluated MIPS for lobar ICH and yielded positive results, demonstrating a new minimally invasive approach that significantly improves functional outcomes for selected patients with spontaneous intracerebral hemorrhage.

MISICH (BMC Med 2024)

A large Chinese multicenter three-arm RCT confirming neuroendoscopy efficacy. This study provided high-quality evidence supporting minimally invasive surgery as a superior option over conventional methods in the Asian patient population.

MIND (JAMA Neurol 2025)

The Artemis procedure showed notable improvement in the 30-day secondary outcome measure. This trial explored a novel catheter-based technique for hematoma evacuation, aiming to reduce surgical trauma while achieving effective clot removal.

SWITCH (Lancet 2024)

Decompressive craniectomy for deep hemorrhage showed a positive trend in functional recovery. Addressing a long-standing debate, this trial provided critical insights into the potential benefits of surgical intervention for deep ICH locations.

INTERACT3 (Lancet 2023)

Emergency comprehensive care protocol improved patient outcomes across multiple metrics. It emphasized the critical role of early management, aggressive blood pressure control, and interdisciplinary collaboration in acute ICH care.

EMBOLISE (NEJM 2024)

MMA embolization for cSDH yielded positive results in reducing recurrence. This study introduced a promising endovascular alternative to traditional surgical drainage, offering a less invasive treatment path for eligible patients.

Summary: The surgical treatment of ICH has entered a transformative new era, with these landmark studies collectively reshaping clinical practice and offering renewed hope through evidence-based innovation.

A Three-Tier Screening Model for Clinical Decision-Making

Tier 1: Is surgery indicated?

Critical patient and imaging parameters form the first filter: Hematoma volume, the presence of mass effect, initial GCS score, and the patient's age combined with their baseline neurological condition are evaluated to determine if surgical intervention is a primary consideration.

Tier 2: Suitability for MIS?

After confirming surgery is needed, we assess feasibility for minimally invasive techniques. This involves ruling out active secondary hemorrhage and rigorously screening for critical radiological warning signs that would contraindicate a less invasive approach.

Tier 3: Selecting the Technique

The final tier matches pathology to procedure: Lobar ICH typically leads to MIPS; deep-seated hemorrhage may require visualized endoscopy; while large-volume deep hemorrhages causing significant shift necessitate decompressive craniectomy.

Core Principle

Precision screening is the key to achieving individualized treatment. By systematically applying these three tiers, clinicians can move beyond a one-size-fits-all approach, ensuring that each patient receives the most appropriate and effective surgical strategy tailored to their unique clinical presentation.

Detailed Design of the ENRICH Trial (NEJM 2024)

Study Design Overview

Trial Type

Prospective, International Multicenter Randomized Controlled Trial (RCT)

Enrollment Size

N = 300 adult patients with spontaneous ICH

Active Intervention

MIPS (Minimally Invasive Surgery) + Optimal Medical Management

Control Arm

Best Medical Management Alone (no surgical evacuation)

Primary Outcome:180-day unweighted modified Rankin Scale (uwmRS) score

Eligibility Criteria

Key Inclusion Requirements

Age between 18–80 years; Spontaneous supratentorial ICH (30–80mL volume); GCS score of 5–14 (moderate to severe neurological deficit); and decompressive surgery initiated within 24 hours of symptom onset.

Critical Exclusion Criteria

Secondary causes of ICH (e.g., tumor, AVM, aneurysm); significant intraventricular hemorrhage (IVH); primary deep brain hemorrhages (thalamic/infratentorial); or irreversible coagulopathy.

Source: Pradilla G, Mayer SA, Hanley DF, et al. Minimally Invasive Surgery with Medical Management for Intracerebral Hemorrhage.*New England Journal of Medicine*2024; 390(14): 1277–1289. DOI: 10.1056/NEJMoa2310580. This landmark trial addressed the equipoise in surgical management of spontaneous ICH.

ENRICH Results: Primary Endpoint and Subgroup Analysis

Overall uwmRS Difference

0.084

BCI 0.005–0.163, posterior probability of superiority 0.981, confirming a statistically significant advantage of minimally invasive surgery in the overall population.

30-Day Mortality Comparison

9.3% vs 18.0%

Absolute risk reduction of 8.7 percentage points. The minimally invasive surgery group showed a critical survival benefit trend in severe ICH patients.

Conversion Rate to Decompressive Craniectomy

3.3% vs 20.0%

A reduction of 16.7 percentage points. Significantly reduced secondary trauma from treatment escalation and the incidence of severe postoperative complications.

Lobar ICH Subgroup (n=208, 69.3%)

uwmRS Difference +0.127 (BCI 0.035–0.219)

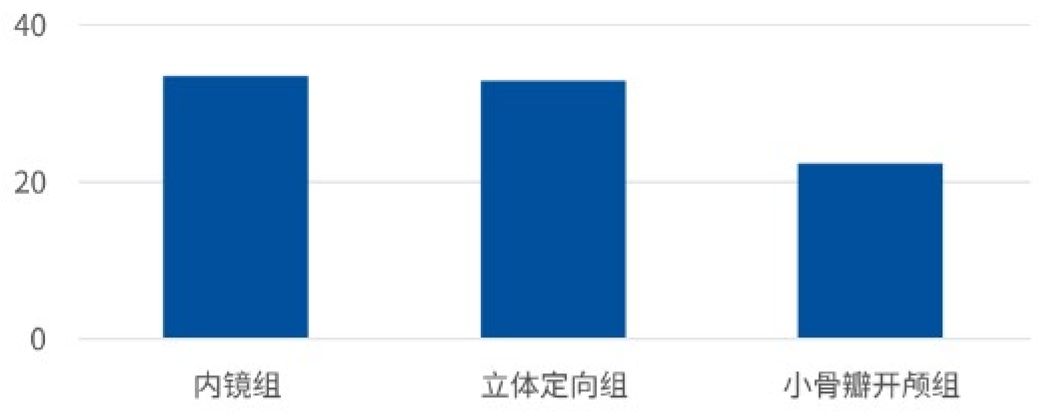
Strong positive benefit. This subtype is the optimal population for minimally invasive surgery; clinical evidence supports it as the first-line treatment to improve functional outcomes.

Anterior Basal Ganglia ICH Subgroup (n=92, 30.7%)

uwmRS Difference -0.013 (BCI -0.147–0.116)

No significant clinical benefit. The interim analysis triggered the futility stopping rule, indicating no advantage in this deep hemorrhage subtype; strict patient selection is required.

MISICH: A 3-Arm Head-to-Head RCT from 16 Chinese Centers



Core Study Overview

A total of 733 patients were enrolled and randomized 1:1:1 into three groups. Results showed the endoscopic group was non-inferior to the craniotomy group in the primary functional outcome endpoint, with significant clinical benefits. Led by Prof. XU Xinghua and Prof. CHEN Xiaolei from PLA General Hospital, this study provides strong Class A evidence for minimally invasive neurosurgical treatment.

Hematoma Evacuation Rate

88.3%

Superior to aspiration (60.3%)
Non-inferior to craniotomy (86.5%)

Mean Surgical Time

2.0h

43% shorter than craniotomy
Improves surgical efficiency

Pneumonia Incidence

22.6%

Lower than craniotomy (31.9%)
Reduces infection risk

Total Hospitalization Cost

¥9.2万

Lower than craniotomy (¥101,000)
Reduces economic burden

ENRICH vs. MISICH: Complementary, Not Contradictory

ENRICH (NEJM 2024) · Lobar ICH

Inclusion: Supratentorial lobar ICH, hematoma volume 30–80 mL, GCS 9-14, onset within 24h.

Intervention: BrainPath® Minimal Invasive Passage (MIPS) evacuation vs. standard medical care.

Key Finding: Minimally invasive group had significantly higher 90-day functional independence rate and lower mortality.

MISICH (BMC Med 2024) · Deep ICH

Inclusion: Primary basal ganglia/thalamic ICH, supratentorial hematoma ≥20mL, GCS≥8, onset within 72h.

Intervention: Transparent-channel endoscopy/aspiration vs. conventional craniotomy.

Key Finding: Minimally invasive group had fewer complications and better neurological outcomes than craniotomy group.

SWITCH: A Third Path for Large-Volume Deep Intracerebral Hemorrhage

Multicenter Collaborative Network

Covering 9 European countries, 42 high-level neurosurgical centers participated. The study design is rigorous, aiming to address treatment bias caused by regional healthcare disparities.

Sample Size and Execution

201 patients were actually enrolled. The original plan was 300 cases, but the project was terminated early due to funding depletion. Despite insufficient sample size, it still holds important exploratory value.

High-Risk Patient Population

Deep ICH hematoma volume 30-100mL with a GCS score of 8-13. These patients have extremely high mortality rates, and conventional medical treatment often yields poor results, making them a clinical challenge.

Surgical Intervention Protocol

Standard large craniectomy (bone flap ≥12cm), with the key beingno **hematoma evacuation**during surgery. It aims to reduce pressure without exacerbating injury through surgical trauma.

Primary Efficacy Endpoint

Functional prognosis at 180 days postoperatively. A modified Rankin Scale (mRS) score of 5-6 (severe disability or death) was used as the primary adverse endpoint to evaluate treatment effectiveness.

Principal Investigator (PI)

Prof. Jürgen Beck from the Department of Neurosurgery, University Hospital Bern, Switzerland. The center is internationally renowned for its surgical treatment of traumatic brain injury and intracerebral hemorrhage.

44%
DC + BMT 组

58%
BMT alone 组

Comparison of primary endpoint event rates: The intervention group showed a significant reduction, demonstrating a trend of clinical benefit.

Statistical Analysis Results: Trend of Benefit

aRR 0.77 (95% CI 0.59 – 1.01) · P = 0.057

The Lancet commented that it provides "weak evidence" for clinical practice and new ideas for managing extreme cases.

Cerebellar ICH — Class I Recommended Surgical Indications

Absolute Indications for Emergency Surgery

Emergency surgical evaluation is required if the patient presents with any of the following:
1. Cerebellar hemisphere hematoma ≥ 15 mL, or vermian hemorrhage with ventricular compression;
2. Progressive decline in level of consciousness (≥2-point decrease in GCS score from baseline);
3. Imaging evidence of fourth ventricle occlusion or significant deformation;
4. Acute obstructive hydrocephalus unresponsive to medical treatment;
5. New-onset neurological deficits indicating brainstem compression.

Guideline Recommendation Level

COR I

Evidence Level: B-NR
Strong recommendation based on high-quality observational studies. Delayed surgery for eligible patients significantly increases morbidity and mortality; urgent surgical intervention should be initiated promptly.

Standard Surgical Intervention Strategies

Select based on surgeon's experience and patient's condition:
1. Standard craniotomy: Posterior fossa craniectomy with hematoma evacuation + duraplasty for decompression;
2. Minimally invasive endoscopy: Precise hematoma evacuation via cerebellar vermian/paramedian corridor;
3. Emergency shunting: External ventricular drainage (EVD) to relieve acute hydrocephalus;
4. Salvage surgery: Foramen magnum decompression (for foramen magnum herniation).

Decision-Making in Intracerebral Hemorrhage Surgery · A Threshold Parameter Reference Table

Hemorrhage Subtype	Hematoma Volume Threshold	GCS Range	Time Window	Preferred Surgical Procedure	Source of Evidence
Lobar Intracerebral Hemorrhage	30–80 mL	5 – 14	≤ 24 h	MIPS (Minimally Invasive Parasulcal Surgery)	ENRICH 2024
Deep Basal Ganglia Hemorrhage	25 – 60 mL	5 – 13	6 – 24 h	Visualized Neuroendoscopy	MISICH 2024
Deep Thalamic Hemorrhage	≥ 15 mL	≥ 5	8 – 24 h	Visualized Neuroendoscopy	Chinese Guidelines 2019
Large-Volume Deep Hemorrhage	30 – 100 mL	8 – 13	24 – 72 h	Standard Large Craniotomy for Decompression	SWITCH 2024
Cerebellar Hemorrhage	≥ 15 mL	Progressive Deterioration	Emergency Surgery	Posterior Fossa Craniotomy for Decompression	AHA 2022

OVERVIEW OF GUIDELINE RECOMMENDATIONS

This page summarizes important guidelines and consensuses on the diagnosis and treatment of intracerebral hemorrhage (ICH) from recent years, both domestically and internationally.

AHA/ASA Guidelines

2022

Suggests that minimally invasive surgery (e.g., endoscopy) may be considered for supratentorial spontaneous ICH patients who meet specific criteria (e.g., GCS score 9-12, hematoma volume 20-60mL, <1cm from cortical surface).

ESO (Germany/China) Guidelines

2014

Recommends neuroendoscopy as an effective technical method for hematoma evacuation in ICH patients, especially for deep-seated hematomas.

Chinese ICH Guidelines

2019

Proposes that for supratentorial ICH patients, craniotomy, minimally invasive surgery, or endoscopic surgery can be selected based on specific circumstances.

Expert Consensus on Neuroendoscopic Protection

2024

Emphasizes the importance of protecting brain tissue and vital vascular and nerve structures during neuroendoscopic surgery, and proposes specific operational norms.

Neuroendoscopy Consensus

2020

Summarizes the application status, advantages, limitations, and future development directions of neuroendoscopic technology in ICH treatment.

PREOPERATIVE ASSESSMENT AND SURGICAL STRATEGY

CONTRAINDICATIONS FOR ENDOSCOPIC SURGERY - SECONDARY ETIOLOGIES TO BE ALERTED TO

Hemorrhagic Brain Tumors

- Glioblastoma, metastases, etc. Rich blood supply, high surgical risk, may require combination with preoperative embolization or postoperative comprehensive treatment.

Primary Intracerebral Hemorrhage (ICH)

- Commonly seen in hypertension, amyloid angiopathy, etc. Requires strict assessment of the patient's general condition and coagulation function.

AVM Rupture

- Hemorrhage caused by rupture of arteriovenous malformation. Requires emergency treatment, timing/method to be determined with angiographic results.

Aneurysmal Subarachnoid Hemorrhage (aSAH)

- Caused by aneurysm rupture. Primary task is to treat aneurysm to prevent rebleeding; hematoma evacuation is secondary.

Cavernous Angioma Hemorrhage

- A type of vascular malformation. Surgical goal is complete resection to prevent rebleeding.

Dural Arteriovenous Fistula (DAVF) with Hemorrhage

- Rare, from abnormal dural arteriovenous communication. Treatment is mainly interventional embolization, surgery as adjunct.

Special Area Hemorrhage

- Deep critical areas (brainstem, thalamus). Extremely high surgical risk; strict assessment of indications is required.

Summary Tip

For the above etiologies, especially tumors or vascular malformations with rich blood supply, preoperative vascular assessment (e.g., CTA/MRA/DSA) should be completed to fully evaluate surgical risks and benefits.

DANGER SIGNS IN PREOPERATIVE ASSESSMENT · 8 KEY OBSERVATIONS

CTA Spot Sign

The presence of contrast extravasation within the hematoma on CTA is a strong predictor of active bleeding and a high risk of hematoma expansion. It is one of the most important factors determining whether a patient needs urgent surgery.

Free Voids

Hypodense areas around or within the hematoma may represent unclotted blood or cerebrospinal fluid. This sign indicates that bleeding may still be ongoing or the hematoma is in an unstable state, requiring close dynamic imaging follow-up.

Effacement of Ambient/Quadrigeminal Cisterns

This is an important sign of brainstem compression and increased intracranial pressure. Once it appears on imaging, it often indicates a critical condition with a high risk of herniation, usually requiring immediate surgical decompression.

Hypothalamus/Basal Ganglia Compression

These areas are vital centers of life and important motor/sensory pathways. Compression not only indicates a poor prognosis but also significantly increases the technical difficulty and risk of surgery.

Subarachnoid Hemorrhage (SAH) · ICH

Cerebral hemorrhage rupturing into the subarachnoid space. This situation will significantly increase the risk of cerebral vasospasm and hydrocephalus, leading to severe impairment of neurological function recovery and requiring timely targeted treatment.

Venous Hyperdensity Sign

Abnormal hyperdense shadows in cerebral veins or sinuses highly suggest venous thrombosis. If not treated emergently, it can rapidly lead to severe cerebral edema, venous infarction, and be life-threatening.

Subdural/Epidural Hematoma

In addition to intracerebral parenchymal hemorrhage, the combination of subdural or epidural hematoma makes the condition more complex. Acute and severe cases often require more complex surgical clearance, posing higher demands on the surgeon's skills.

Deep Brain Structural Injury

Including intraventricular hemorrhage, intraventricular cast formation, etc. This type of injury easily leads to acute obstructive hydrocephalus, causing a rapid increase in intracranial pressure, and usually requires urgent rescue measures such as external ventricular drainage.

IMAGING ASSESSMENT DECISION ALGORITHM

Starting Point: Non-contrast Head CT Scan

Decision Node: Core Spot Sign / Parenchymal Compression Ratio| Condition: (e.g., Parenchymal Compression Ratio > 10%)

Yes (Condition Met)

Next Step: Perform higher-level imaging examinations such as CTA + MRI + DSA.

Final Decision: Combined Surgery
Neuroendoscopy + Interventional Therapy, for complex vascular lesions or combined treatment cases.

No (Condition Not Met)

Next Step: Directly assess surgical indications based on current CT results.

Final Decision: Direct Surgical Treatment
Standard neuroendoscopic hematoma evacuation, for primary hypertensive ICH cases.

Explanation: This algorithm triages patients to optimal treatment pathways via rapid imaging assessment, optimizing resource use and improving patient outcomes.

COAGULATION DISORDERS AND ACTIVE BLEEDING · INDICATIONS FOR DELAYED SURGERY

INR Requirement

INR < 1.3

INR must be strictly controlled within this range to eliminate the risk of diffuse bleeding due to coagulation factor deficiency.

Platelet Requirement

PLT > 100 × 10^9/L

Ensure sufficient platelets for primary hemostasis. Patients on long-term antiplatelet drugs need special evaluation.

Imaging Assessment

CTA Spot Sign Negative/Stable

Enhanced CT excludes contrast extravasation (active bleeding) or confirms stable bleeding focus.

Vitamin K Antagonists (VKA)

Specific Drug: Warfarin

Use Vitamin K, FFP or PCC for antagonism. The core is to rapidly reverse INR to a safe range (<1.3). PCC is a more efficient choice for emergency surgery.

Novel Oral Anticoagulants (NOACs)

Specific Drugs: Dabigatran, Rivaroxaban, etc.

Select specific antagonists (e.g., Idarucizumab for Dabigatran). If unavailable, high-dose PCC is an alternative. Strictly monitor coagulation indicators.

Antiplatelet Drugs

Specific Drugs: Aspirin, Clopidogrel, etc.

Platelet transfusion is preferred for life-threatening bleeding. For elective surgery, balance bleeding and thromboembolic risks; stop drugs 5-7 days preoperatively if needed.

Clinical Decision Core

For patients with coagulation disorders, surgery timing depends on effective correction of coagulation function. Key indicators (INR, platelets) must meet standards and active bleeding must be ruled out before surgery to reduce complications.

TECHNICAL GOALS - 3 QUANTITATIVE METRICS

< 15 mL

Residual Hematoma

Source: AHA/ASA 2022 Guidelines

The smaller the postoperative residual hematoma volume, the better the patient's prognosis. Controlling it below 15 mL is a key goal.

≥ 80%

Evacuation Rate

Source: Chinese J Neurosurg 2020 Consensus

A higher evacuation rate helps reduce ICP and secondary brain injury. 80% is an ideal target for optimal outcomes.

< 10 mm

Cortical Injury

Source: Neuroendoscopic Protection Consensus

Minimizing cortical injury protects brain function. Controlling the injury within 10 mm reduces postoperative complications.

Summary

Achieving all three goals simultaneously = High-Quality Endoscopic Hematoma Evacuation Surgery

NAVIGATION AND VISUALIZED SHEATH PLACEMENT · "NO BLIND PUNCTURE"

"NO BLIND PUNCTURE" - Chinese Neuroendoscopy Consensus 2020, Recommendation 9

Sheath placement must be performed under visualized conditions. Three implementation methods:

1. Neuronavigation

Technology: StealthStation / iPlan/Rhino

Advantage: Precise, Expensive

Uses preoperative imaging data for 3D reconstruction to guide the sheath path in real-time. High precision but costly equipment.

2. Intraoperative Ultrasound

Technology: Real-time guidance using B-ultrasound

Advantage: Fast, Moderate Cost

Can real-time display brain parenchymal structures and hematoma location. Simple and fast operation, but requires high operator experience.

3. Visualized Puncture Sheath

Technology: Endoscopic direct vision

Advantage: Precise, Inexpensive (Disposable)

Directly observes the path through an endoscope built into the puncture sheath, achieving full-process visualization at a lower cost.

ENDOSCOPIC EVACUATION "THREE-STEP METHOD"

01 / Aspirate While Advancing

Low negative pressure aspiration to avoid damaging surrounding tissue.

Gently aspirate liquid or semi-solid hematoma using a low negative pressure aspirator to maintain a clear visual field.

02 / Irrigate While Advancing

Maintain a clear surgical field and detect bleeding points in a timely manner.

Continuously irrigate with normal saline to clear blood clot debris and help identify and manage active bleeding.

03 / Rotate While Advancing

360° observation to avoid residue and inspect the entire cavity.

Rotate the endoscope lens to conduct an omnidirectional exploration of the hematoma cavity to ensure no dead angles and evacuate the hematoma as completely as possible.

< 15 mL

Residual Hematoma

> 80%

Evacuation Rate

Minimally Invasive First

Core Principle

HEMOSTASIS STRATEGY · THREE-LEVEL PROGRESSION

Level 1: Warm Saline Pressure Irrigation

Method: Continuously irrigate the bleeding point with warm normal saline (around 40°C).

Core Logic: Uses thermal effect and water pressure to promote vasoconstriction for hemostasis. Suitable for small oozing points.

Level 2: Bipolar Coagulation

Method: Precisely coagulate the bleeding point using bipolar forceps.

Core Logic: Uses high-frequency current to coagulate tissue and seal the vessel stump. Suitable for relatively clear small arterial or venous bleeding.

Level 3: Hemostatic Matrix

Method: Cover the bleeding area with hemostatic materials such as Surgicel or Gelfoam.

Core Logic: Provides a physical barrier and initiates the coagulation cascade for hemostasis. Suitable for extensive oozing or areas difficult to coagulate.

Core Clinical Decision Principle

"Use gel for extensive oozing, use electrocoagulation for punctate active bleeding." During surgery, flexibly combine the three-level strategies based on the morphology (punctate/extensive), location (parenchymal/subarachnoid), and instrument conditions of the bleeding. The step-up processing logic is the core execution standard for ensuring surgical safety and maintaining a clear visual field.

CONVERSION TO CRANIOTOMY INDICATIONS + DRAINAGE TUBE MANAGEMENT

Indications for Conversion to Craniotomy

Absolute Indications

- Supratentorial hematoma volume > 30 mL with midline shift > 1 cm
- Compression of basal cisterns, effacement of ambient cistern

Relative Indications

- Preoperative disturbance of consciousness with hematoma > 20mL
- Intraoperative discovery of aneurysm or vascular malformation
- Deterioration of patient's condition

Postoperative Drainage Tube Management

Standardized Operation

- 24-48h post-op: Clamp the drainage tube
- 24h post-op CT review: Assess hematoma evacuation
- Extubation: Drainage < 50 mL/day, no significant rebleeding

Adjuvant Medication

- Urokinase: 4000-10000 U 4-6h post-op, clamp for 2h
- Extubation: Usually 48-72 hours post-op

EVIDENCE-BASED STRATIFICATION OF THREE TECHNIQUES

Tubular Retractor + MIPS

Evidence Level: ENRICH (High)

A first-line technique for intracranial hematoma evacuation, supported by high-level evidence-based medicine.

Visualized Endoscopy + Transparent Tubular Retractor

Evidence Level: MISH (Medium)

Combines the visualization advantage of endoscopy with the minimally invasive feature of tubular retractors, with moderate evidence level.

Blind Puncture Catheter (MISTIE series)

Evidence Level: MISTIE III (Low)

Traditional blind puncture catheter drainage technique, widely used but with relatively low evidence-based medicine level.

Core Insight

MIPS, as a representative of new technologies, has established its position in clinical practice. Although traditional technologies have been optimized, they still face challenges from evidence-based medicine. Future development will focus on further validation of innovative combinations and improved technologies, while traditional technologies may face elimination.

EXPERT CONSENSUS ON WHITE MATTER TRACT PROTECTION · RECOMMENDATION 14

For deep parenchymal hemorrhage or lobar hemorrhage near functional areas, it is recommended to use white matter tractography navigation for visualized puncture and craniotomy (e.g., Brainlab iPlan). This can optimize surgical guidance and help protect the structure and function of important white matter tracts such as the internal capsule. It is recommended to use DTI tractography technology to help with surgical path planning and corridor selection.

Recommendation Grade

IIa

Generally useful/effective, supported by most experts

Evidence Level

C-LD

Based on limited clinical data & expert experience

Expert Consent Rate

93.02%

High consensus among authoritative neurosurgical experts

Source: Chinese Medical Journal 2024;104(15); Evidence system refers to the EBM 2020 clinical guideline grading standards. This consensus clarifies the clinical value of neuro-navigation and DTI technology for functional protection in complex ICH surgery, providing important guidance for precision neurosurgical planning.

VISUALIZED TUBULAR RETRACTOR SYSTEM

VISUALIZED TUBULAR RETRACTOR SYSTEM

ONE STEP

Confirm arrival at hematoma + establish channel, simple and fast

Clever combination with departmental neuroendoscope for visualized puncture

Seamlessly integrate with the department's existing neuroendoscope system to fully include the entire process from puncture needle insertion to target in visual monitoring, eliminating the uncertainty of traditional blind puncture and reducing surgical risks fundamentally.

Zero-distance imaging, cold light source for clear identification

Equipped with high-performance cold light source illumination technology to achieve clear imaging at zero distance. Tissue layers, tiny blood vessel distribution and hematoma lesion boundaries in the surgical field of view are clearly distinguishable, providing precise operational guidance for surgeons.

Adaptable to 2.7mm-4.1mm diameter endoscopes

The system has strong compatibility and can flexibly adapt to endoscopes with different diameters from 2.7mm to 4.1mm. No need for additional customized special instruments, perfectly integrating into the department's existing surgical equipment system and reducing clinical application thresholds and costs.

Cerebral Cortex

Based on preoperative imaging planning, accurately lock the puncture entry, avoid important functional areas and vascular structures, and establish a safe and minimally invasive surgical approach starting point.

White Matter

Gently advance along the preset channel, avoid nerve fiber bundles under real-time visualization, minimize traction and collateral damage to normal brain tissue, and protect nerve function.

Hematoma Lesion

Accurately reach the core area of hematoma, immediately establish a stable working channel, paving the way for subsequent core treatment steps such as hematoma removal, hemostasis and drug perfusion.

VISUALIZED TUBULAR RETRACTOR SYSTEM

Operational Space Advantage

Within the limited operating space, the endoscope, bipolar forceps, aspirator, and irrigation tube can work simultaneously to perform aspiration, irrigation, and hemostasis, minimizing instrument interference for a safe and efficient procedure.

Multi-Instrument Parallel Channel

The tubular retractor creates an independent rigid cavity, arranging observation and treatment instruments axially. The non-overlapping coaxial vision maximizes surgical space, enabling precise positioning of complex instrument combinations in narrow channels.

Non-Interfering Action Synergy

Breaking spatial coupling limits, surgeons can perform aspiration, irrigation, and hemostasis in parallel. This workflow shortens step time, reduces repeated tissue traction, and enhances surgical fluency.

Intraoperative Risk Controllability

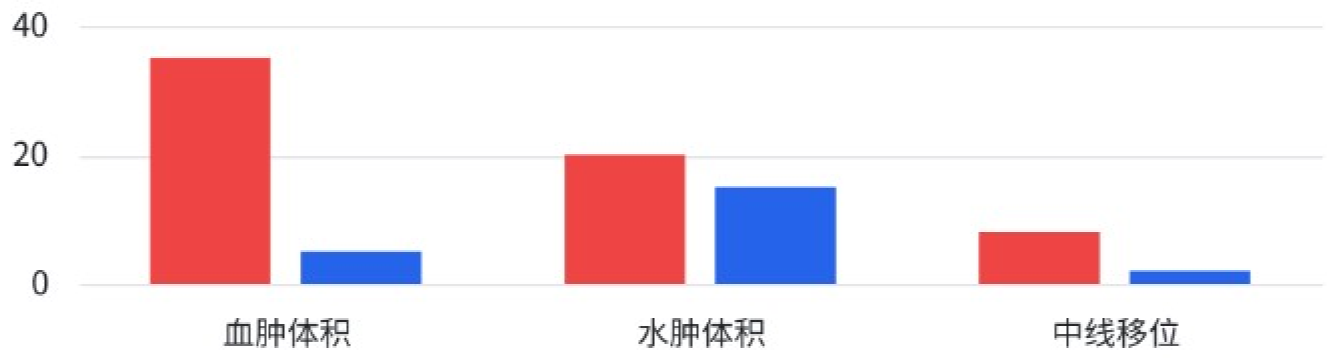
Eliminating physical interference reduces potential iatrogenic injury. Combined with clear visualization, it enables precise operation in complex anatomy, boosting the safety and reproducibility of high-difficulty MIS.

Clinical Value Insight: The visualized tubular retractor system innovates spatial design, transforming traditional 'passive avoidance' into 'active synergy'. This upgrade revolutionizes minimally invasive surgical concepts, granting surgeons open-surgery-like freedom in millimeter-scale channels, a key pillar for modern precision minimally invasive surgery.

MINS · CHINA MULTIMODAL IMAGING FUSION ENDOSCOPY EVIDENCE

Technology Combination: Sino Navigation + Visualized Tubular Retractor System + Neuroendoscope

This innovative integration breaks through the blind spots and operational limitations of traditional surgery, achieving millimeter-level precise localization of intracranial lesions and minimally invasive removal without traction injury, establishing a new technical paradigm for complex neurosurgical procedures.



Clinical Outcome

P < 0.014

Follow-up at 6 months post-operation showed a significant increase in the proportion of patients with mRS score 0-2 ($P < 0.014$), confirming the clinical value of neurofunctional protection.

This evidence-based study, through the organic integration of multimodal technologies, has not only achieved breakthrough improvements in immediate surgical anatomical indicators (hematoma clearance rate, midline reduction) but also demonstrated significant advantages in long-term neurological function recovery. This achievement reflects the independent innovation capability of domestic high-end medical technology and provides strong Chinese clinical evidence for the precision and intelligent development of global minimally invasive neuroendoscopic surgery, with extremely high promotion and application value.

2023-2026 TOP JOURNAL MILESTONES TOP 6

ENRICH

MIPS for ICH RCT Study (50 centers, 9 countries, RCT)

MISH

China-ICH-III RCT (20 centers, China)

MIG

Main Study (Germany) Drug + Stent Thrombectomy for ICH (n=246)

SWITCH

ICH for Bridging ICH Thrombectomy Trial (n=451)

INTRACT3

Optimal Medical Therapy

ENDOULIS / MAGIC-MT

China ICH Drug Therapy Trial / US ICH Drug Therapy Trial

Summary: The focus of ICH research has shifted from drugs to technology.

GLOBAL RCT BLUEPRINT FOR THE NEXT 5 YEARS

2026

EMINENT-ICH: China-ICH-IV Study (n=1500)

Focuses on optimizing early intervention for ICH patients, providing high-level evidence for clinical treatment.

RAVANA-Robot: Robot-Assisted ICH Surgery (n=100)

Explores the clinical application of precise surgical techniques in ICH treatment.

2026-27

EVACUATE: China-ICH-V Study (n=2000)

One of the largest ICH treatment RCTs to date, validating new hematoma evacuation techniques to update international guidelines.

2026+ AI-Assisted

AI-Assisted Planning

Developing AI decision systems with the Global ICH Surgery Collaborative Group to create personalized surgical paths via deep learning.

2026+ Cell Therapy

Cell Transplantation

Global multicenter translational research exploring stem cell therapy's potential for neural repair after ICH.

Strategic Insight: China is gradually becoming the global leader and source of ICH surgical trials.

From the intensive launch of thousand-patient multi-center RCTs to cutting-edge exploration of robotics, AI and regenerative medicine, China has become the core source of global ICH surgical trials, contributing to new global standards and leading technological innovation.

TAKE-HOME IN 3 SENTENCES

INDICATIONS DETERMINE PROGNOSIS

For lobar ICH > 20mL, endoscopic minimally invasive surgery is preferred (ENRICH); for deep ICH > 15mL, endoscopy is preferred (MISH); for cerebellar ICH > 10mL, endoscopy is preferred.

Core Strategy: Stratified surgical plans by anatomical location

THE SAFETY BOTTOM LINE IS TO RULE OUT SECONDARY ETIOLOGIES

Preoperative CTA/MRA/DSA is crucial to avoid misdiagnosing vascular malformations or aneurysms as hypertensive ICH and performing "pseudo-ICH" surgery.

Key Action: Preoperative cerebral vascular imaging assessment

THE RATIONAL APPLICATION OF VISUALIZED RETRACTOR CATHETERS DESERVES FURTHER PROMOTION

It combines precision, minimal invasiveness, and efficiency, helping to protect brain function, with an expert consensus recommendation rate of up to 93.02%.

Industry Consensus: 93.02% recommend priority use

OPERATION PROCESS AND DEVICE WORKFLOW

Detailed explanation of operation process and typical cases

Procedure for Using a Visual Single-Lumen Drainage Catheter

Step1: Drilling, incising the dura mater, holding the drainage tube. (Fig1)

Step2: Assess the consistency of the hematoma, pinpoint its location and depth, and determine the aspri-target point. Withdraw the endoscope, connect a syringe to the access port, and aspirate the hematoma. The endoscope may be reinserted at any time to inspect the morphology of the hematoma. (Fig3)

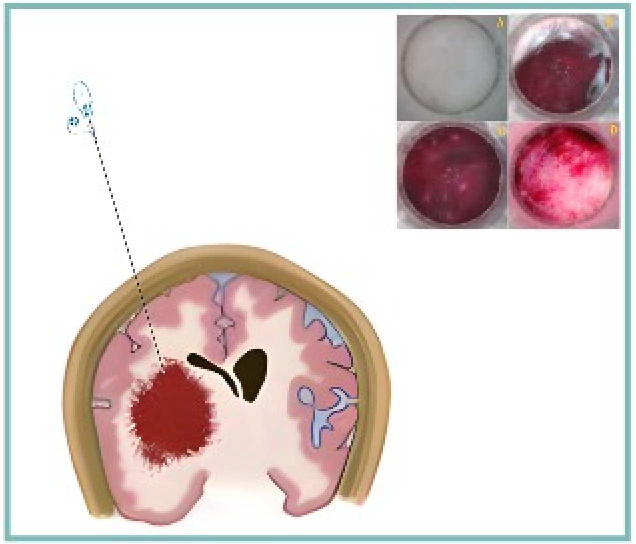


Fig1

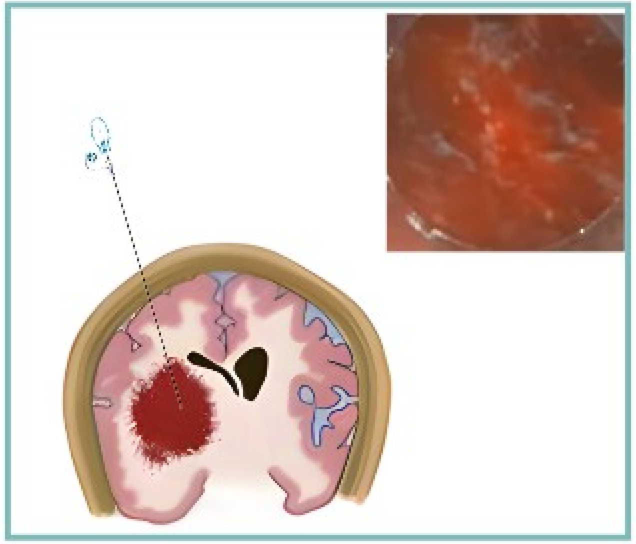


Fig2

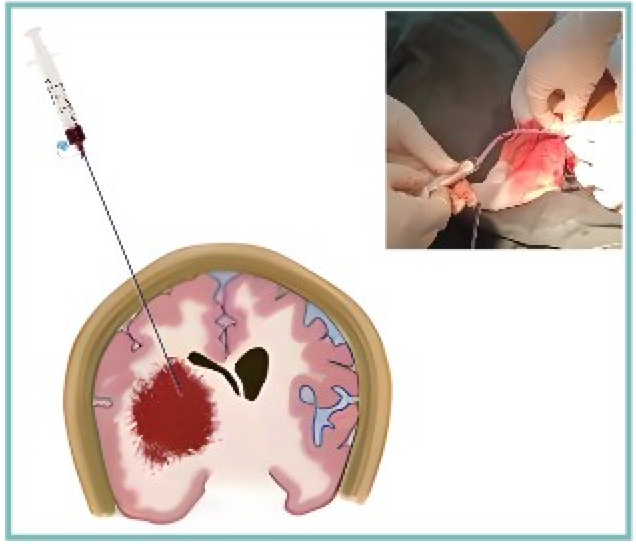


Fig3

Procedure for Using a Visual Single-Lumen Drainage Catheter

Step4: For firm hematomas observed under endoscopy, urokinase can be injected through the tail inlet to liquefy the clot. If flushing is required, normal saline can be injected to clear the tubing. (Fig4)

Step5: After the procedure, thoroughly inspect the surgical area to ensure complete hematoma removal. Create a subcutaneous tunnel, place a drainage catheter, and close the scalp flap. (Fig5)

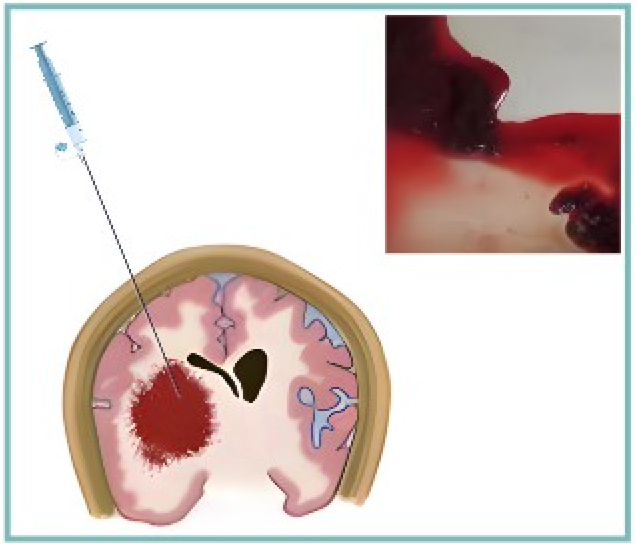


Fig4

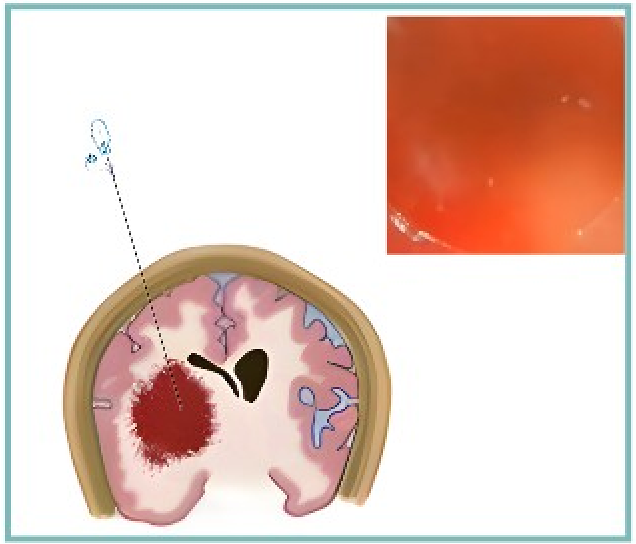


Fig5

Visual Dual-Lumen Drainage Catheter Procedure

Step1: Drilling, incising the dura mater, holding the drainage tube. （图1）

Step2: Assess the consistency of the hematoma, pinpoint its location and depth, and determine the aspri-target point. （图2）

Step3: Using the Y-shaped dual-lumen connector, attach a syringe to evacuate the hematoma under direct visualization, allowing simultaneous viewing and aspiration. （图3）

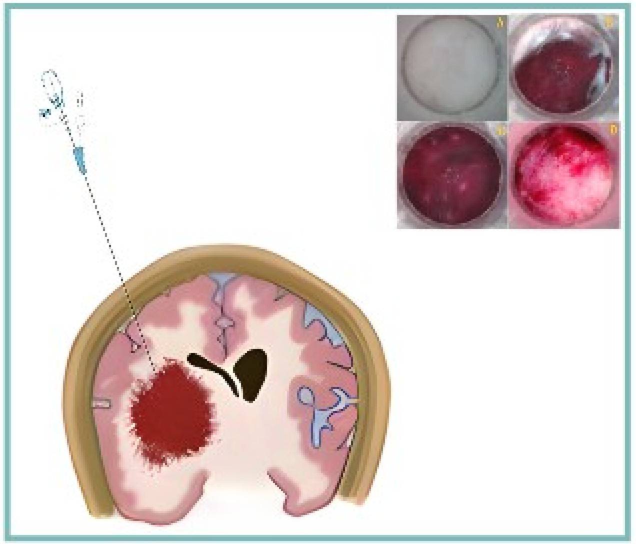


图1

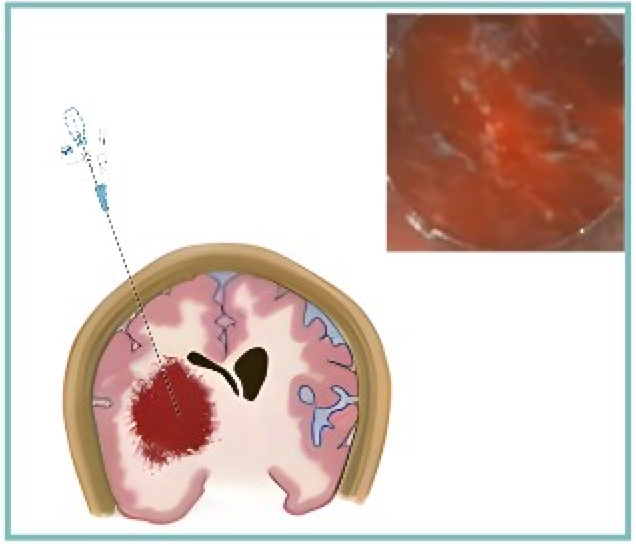


图2

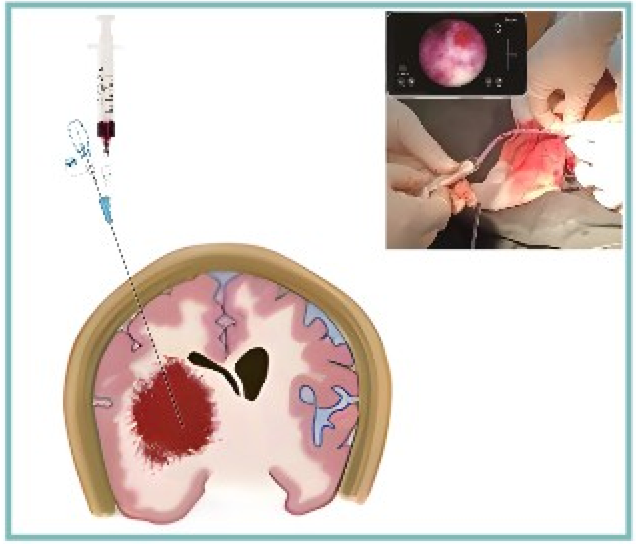


图3

Visual Dual-Lumen Drainage Catheter Procedure

Step4: For dense hematomas identified under visualization, urokinase can be injected through the Y-shaped connector to liquefy the clot. When irrigation is required, normal saline can be infused through the catheter to flush the lumen. (Fig4)

Step5: After the procedure, thoroughly inspect the surgical area to ensure complete hematoma removal. Create a subcutaneous tunnel, place a drainage catheter, and close the scalp flap. (Fig5)

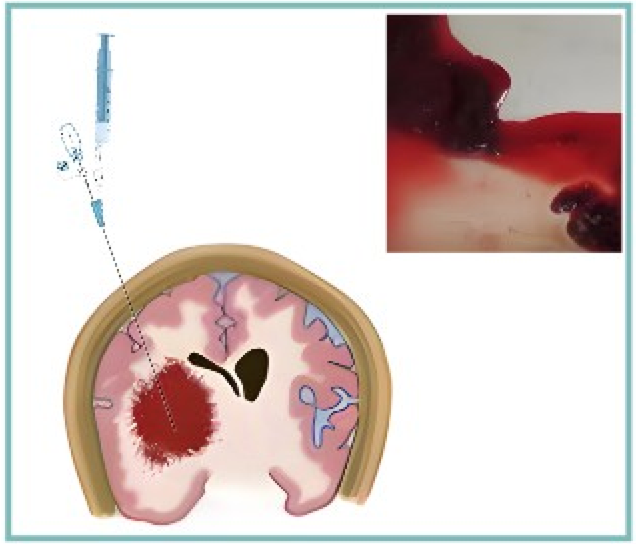


Fig4

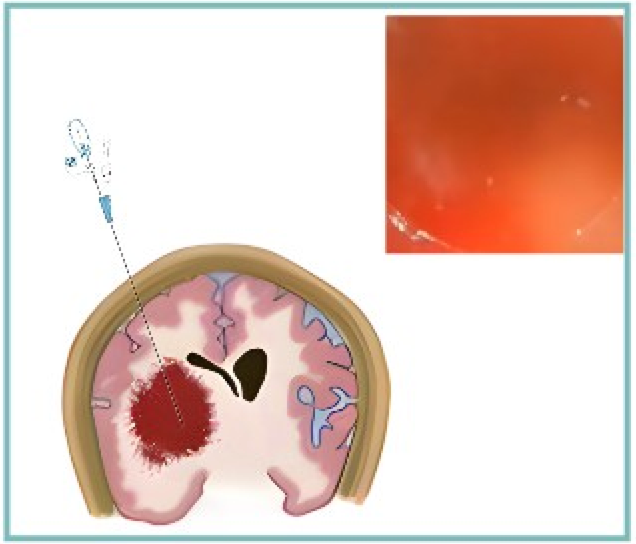
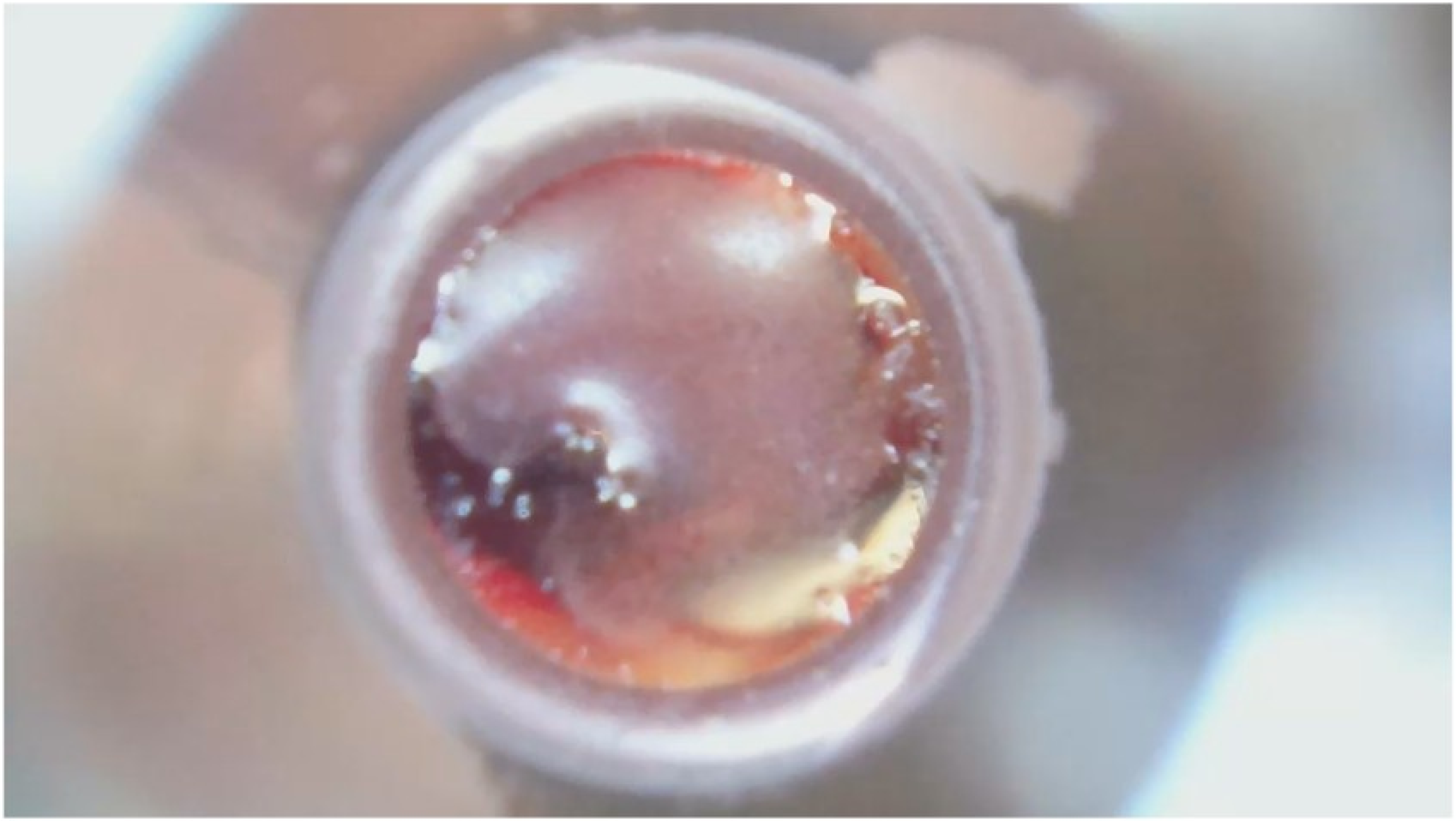


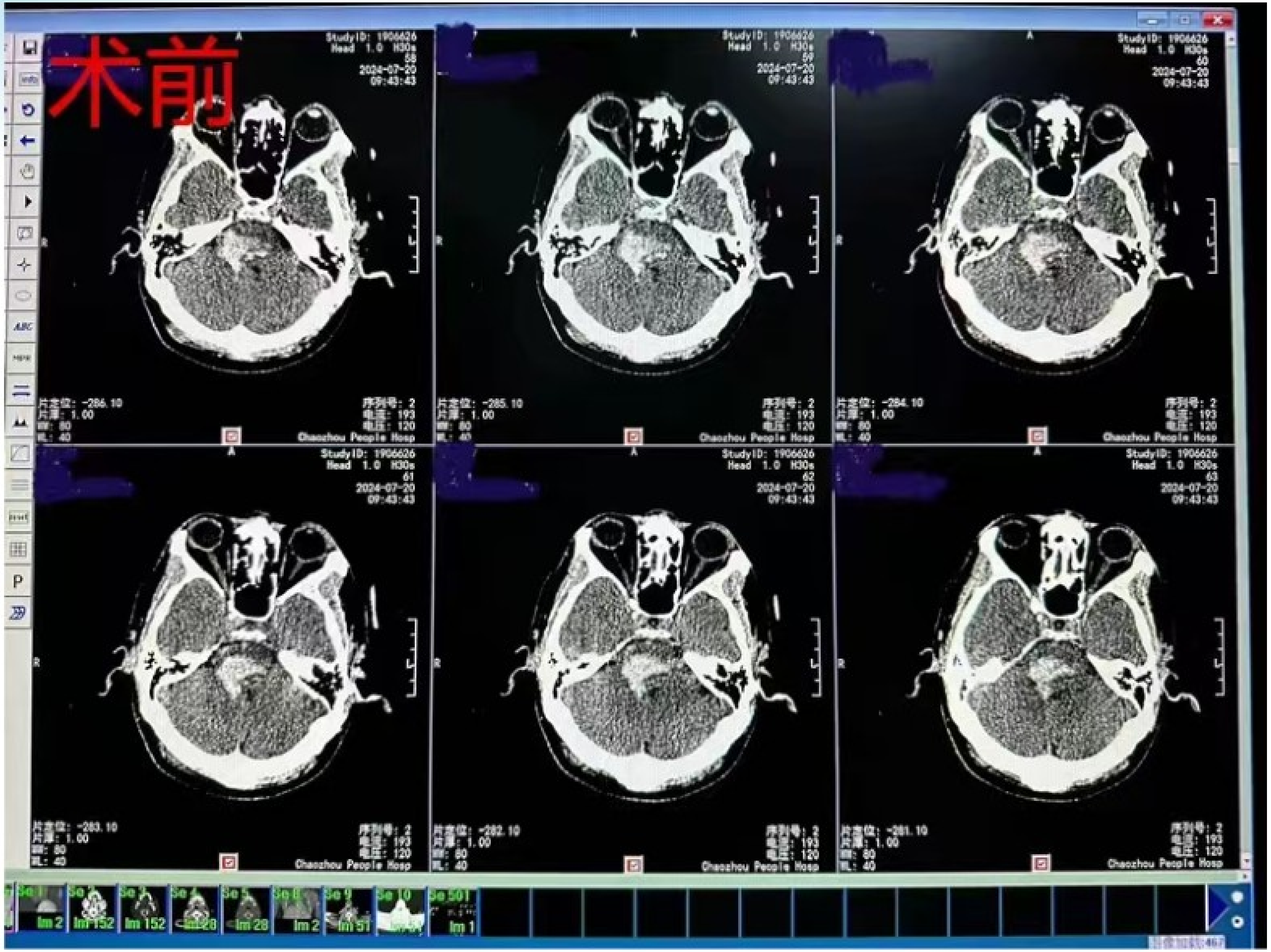
Fig5

Neuroendoscopic View During Procedures

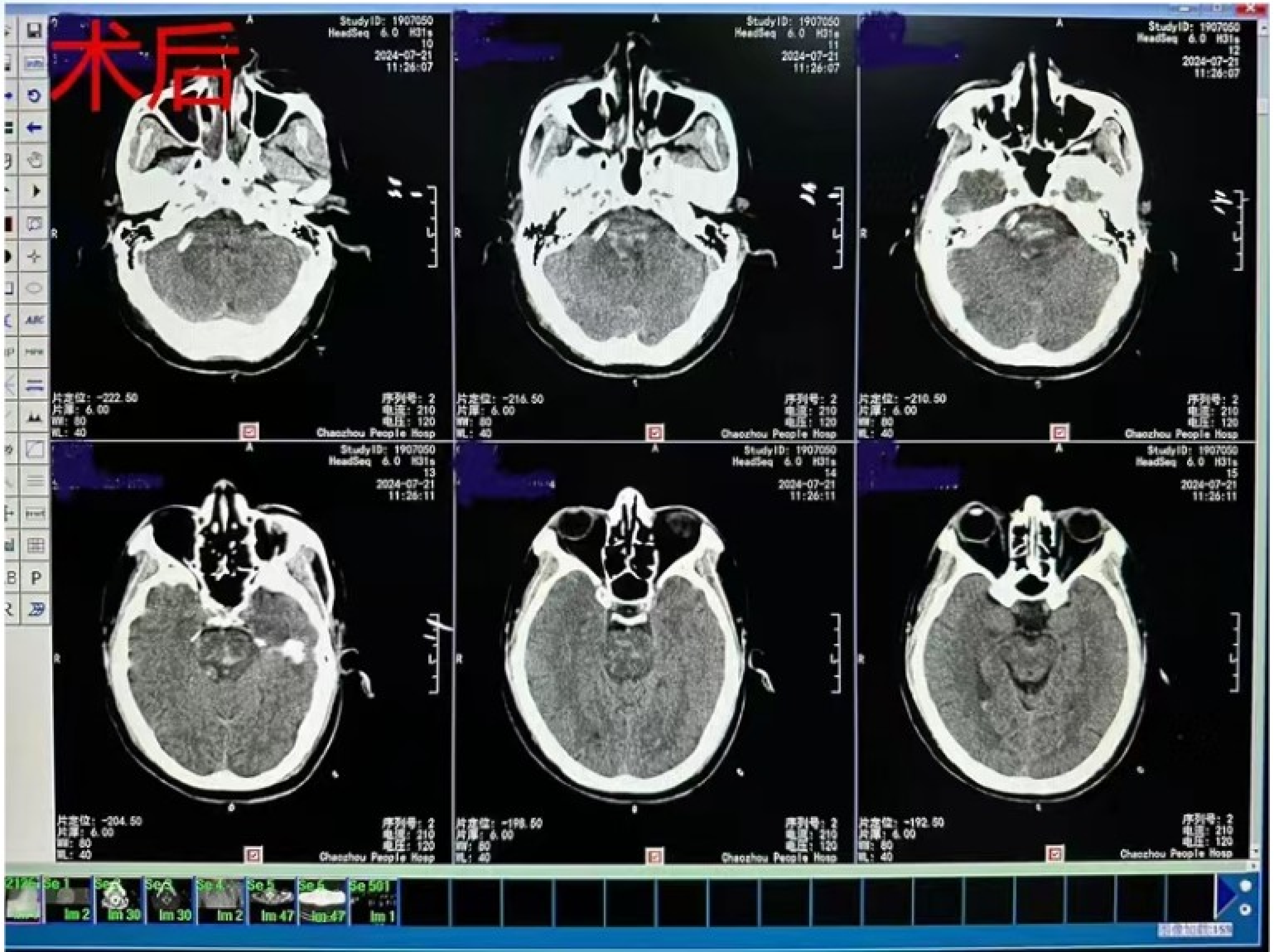


TYPICAL CASES AND CLINICAL OUTCOMES

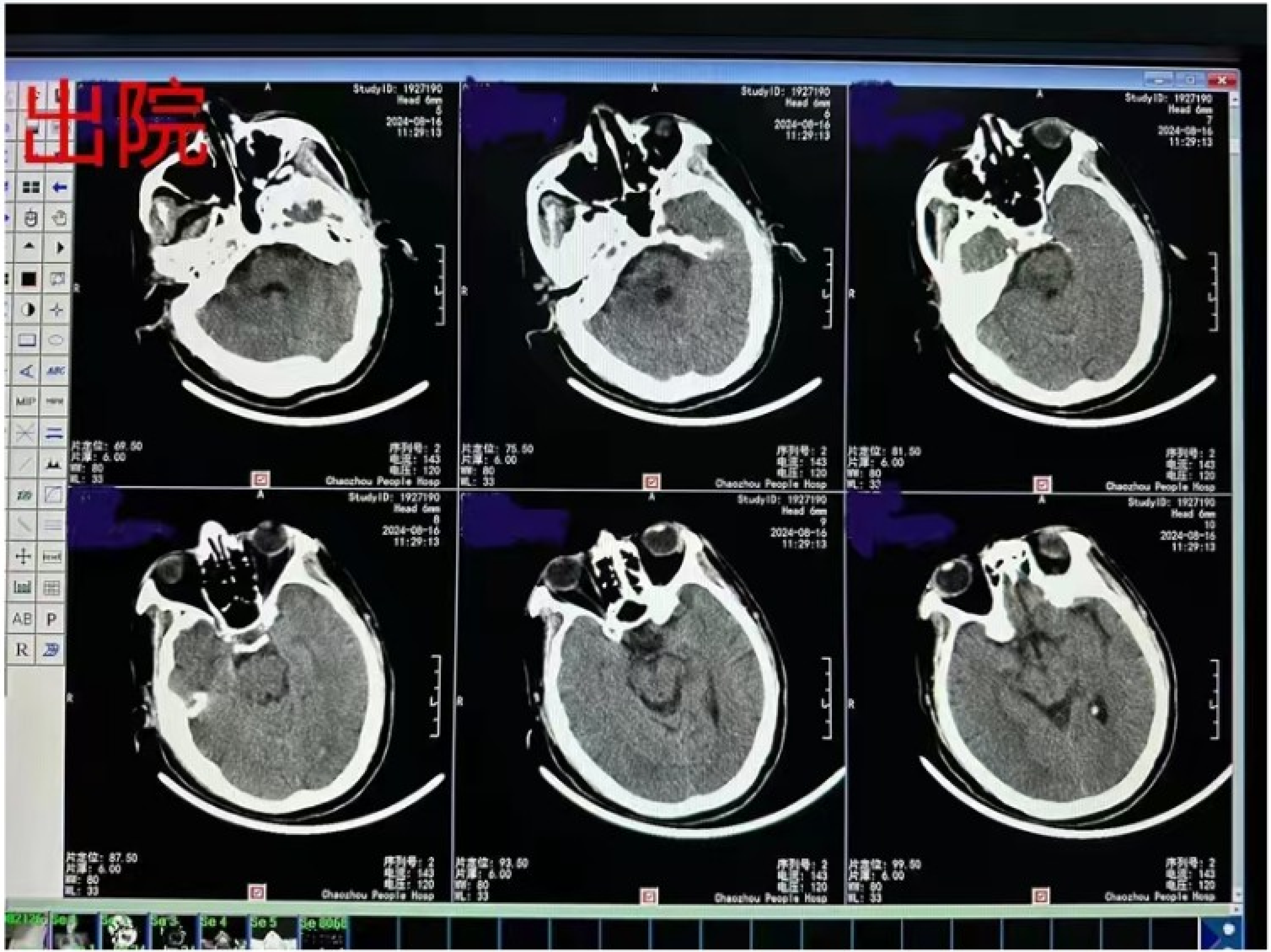
Typical case 1 Before procedure.



After procedure.



Leave hospital



Case sharing 2

Case Presentation:

1. Admission: A 41-year-old female patient was admitted to the emergency department at 09:28 on April 21, 2024, presenting with "sudden loss of consciousness for 1 hour."

2. History of Present Illness: At approximately 08:00, the patient experienced a sudden onset of unconsciousness while engaged in daily activities, accompanied by nausea, vomiting, and limb rigidity. Following initial management at a local health center, she was transferred to our hospital for emergency intervention.

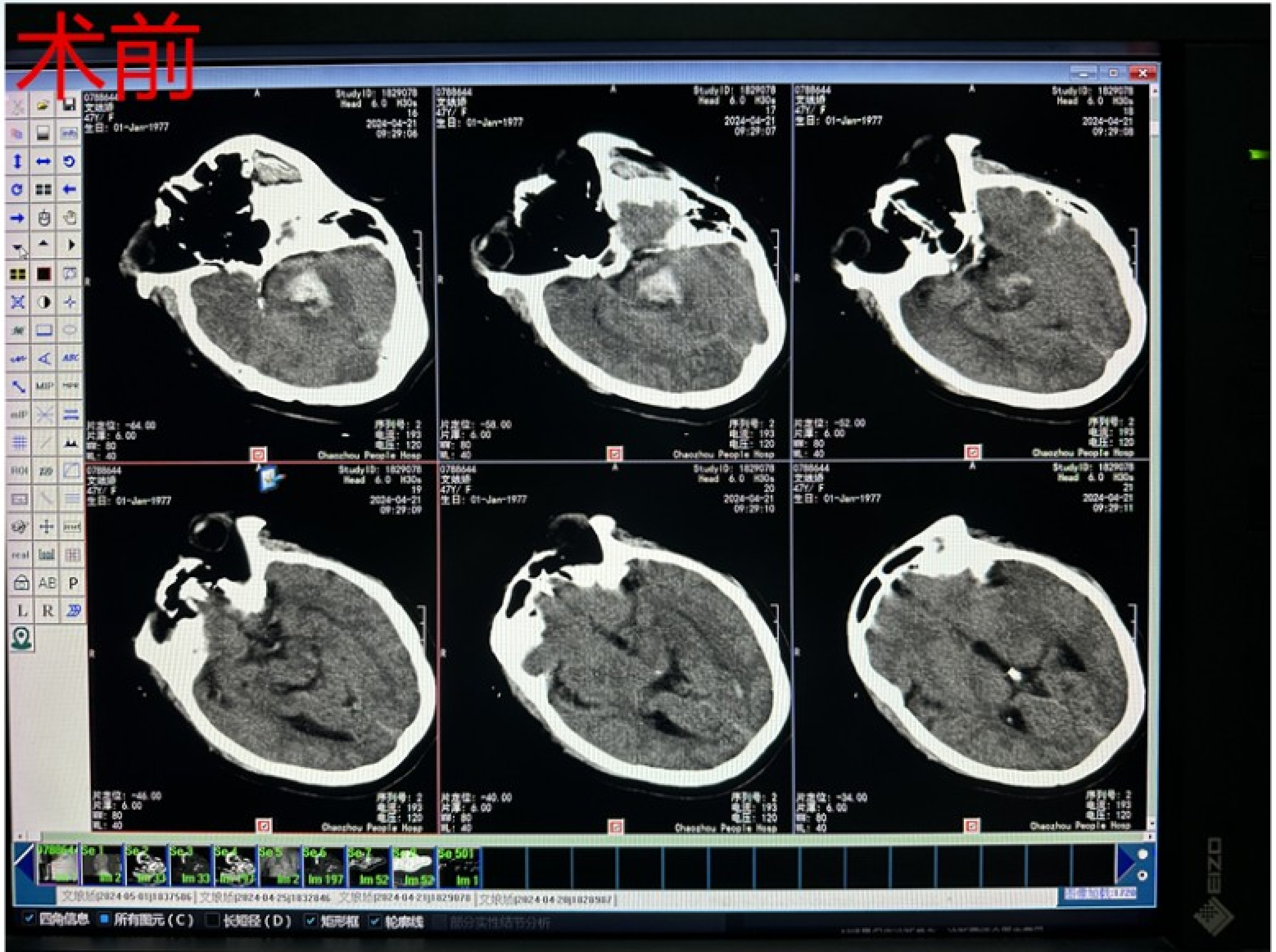
3. Past and Family History: According to her family, the patient had been overworked recently. She had a unremarkable past medical history, with no prior diagnosed hypertension, diabetes, or history of smoking and alcohol consumption.

4. Physical Examination:

Vital Signs: T: 39.2°C, P: 65 bpm, R: 18 breaths/min, BP: 195/106 mmHg.

Neurological Examination: The patient was in a deep coma with a GCS score of 4 ($E_1V_1M_2$). Respiratory rhythm was irregular. Pupils were bilaterally miotic (1.0 mm in diameter) with absent light reflex. Generalized limb rigidity and increased muscle tone were noted. Decerebrate posturing was observed upon painful/noxious stimuli. Bilateral pathological signs were positive.

Before procedure.



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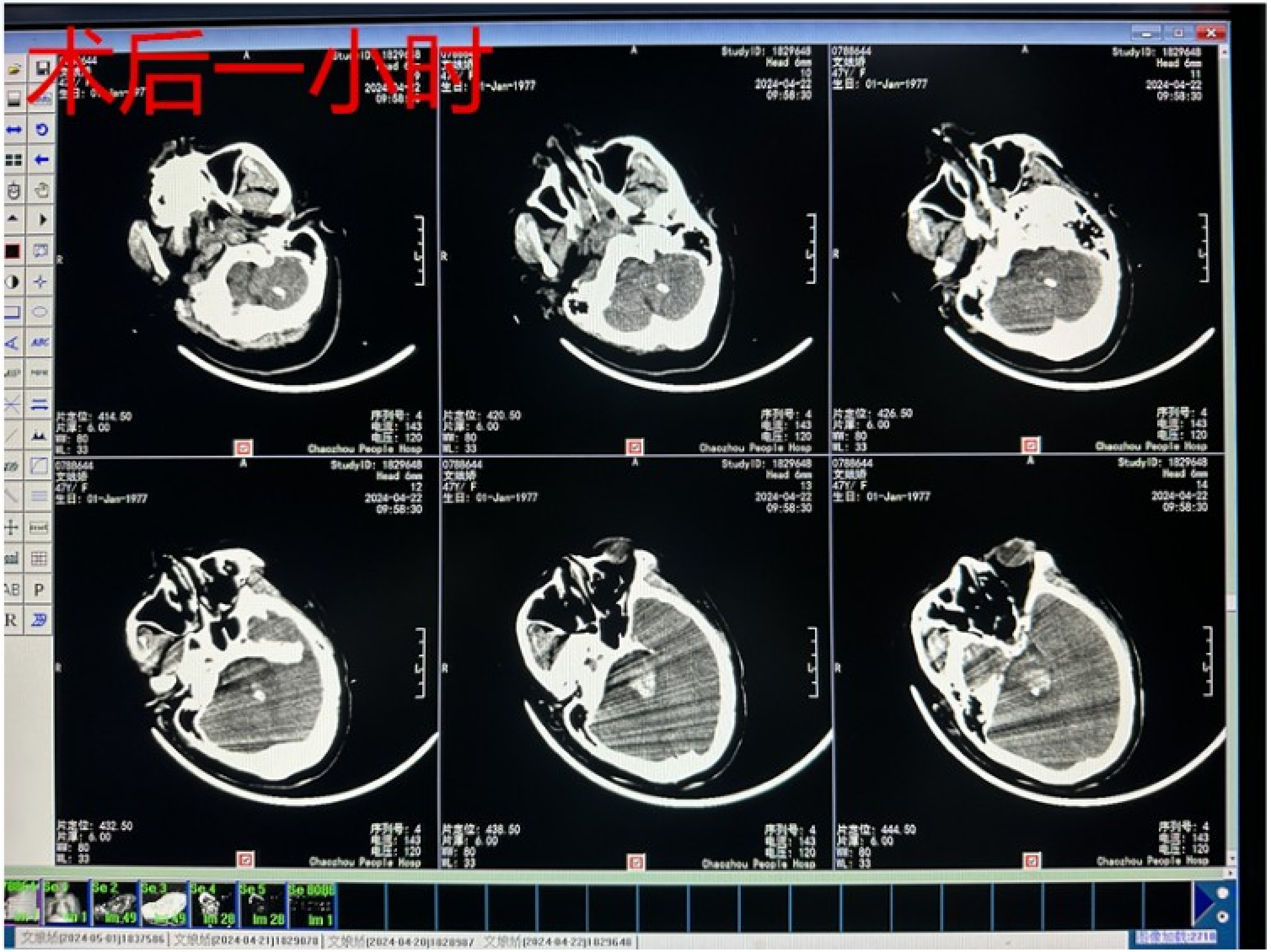
After procedure, one hour.



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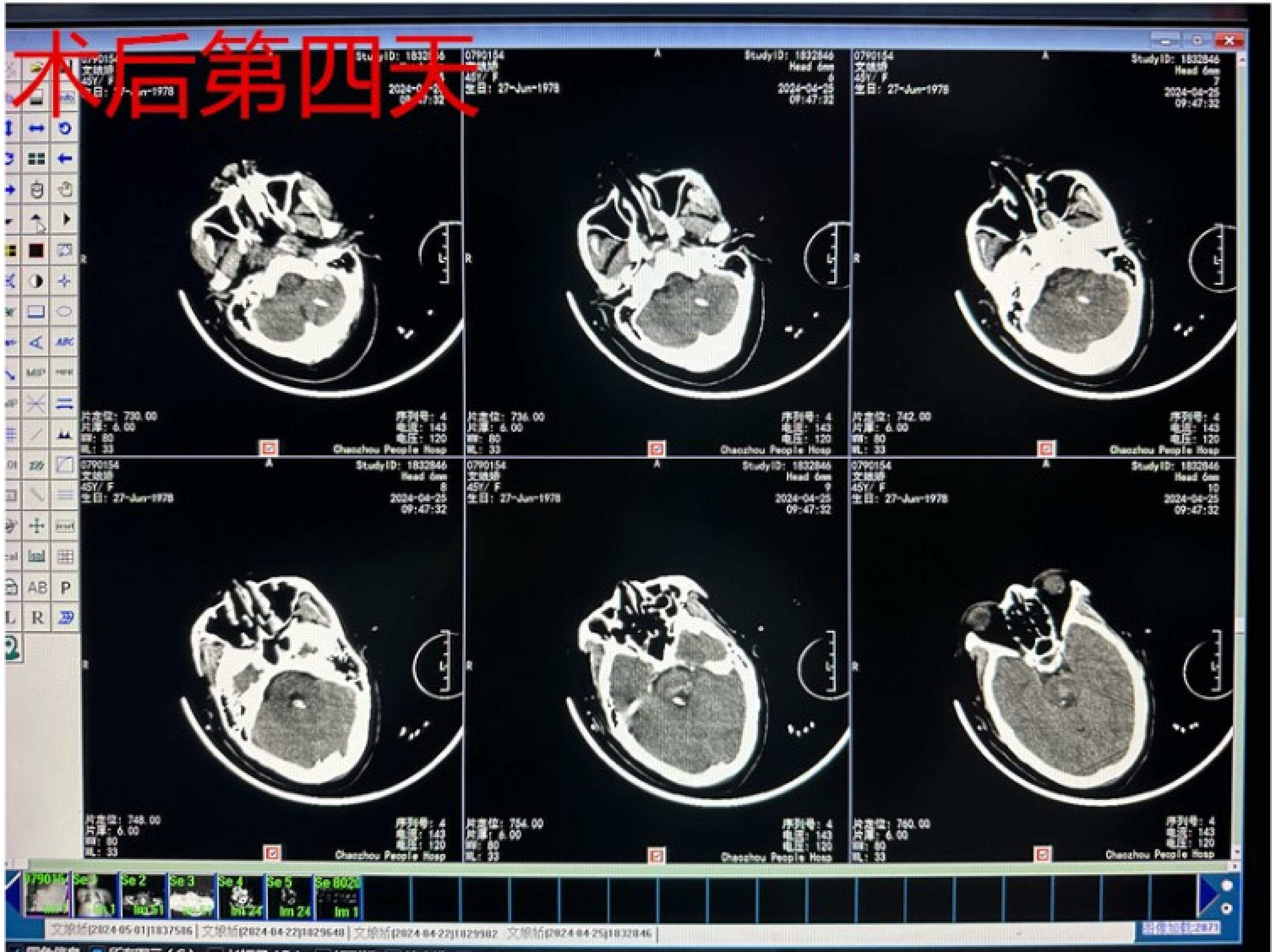
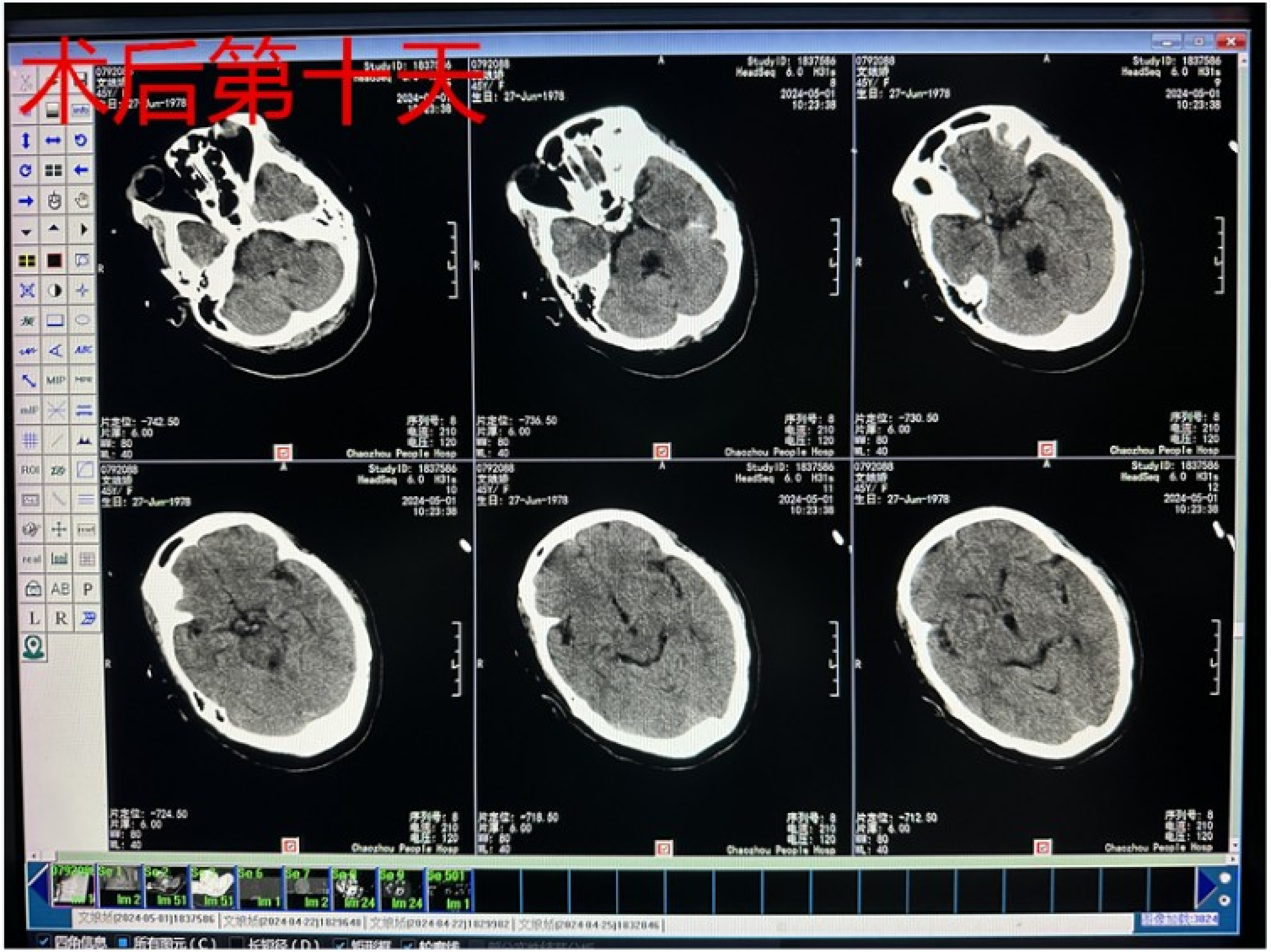
After a period of four days.



After the procedure, 10 days.

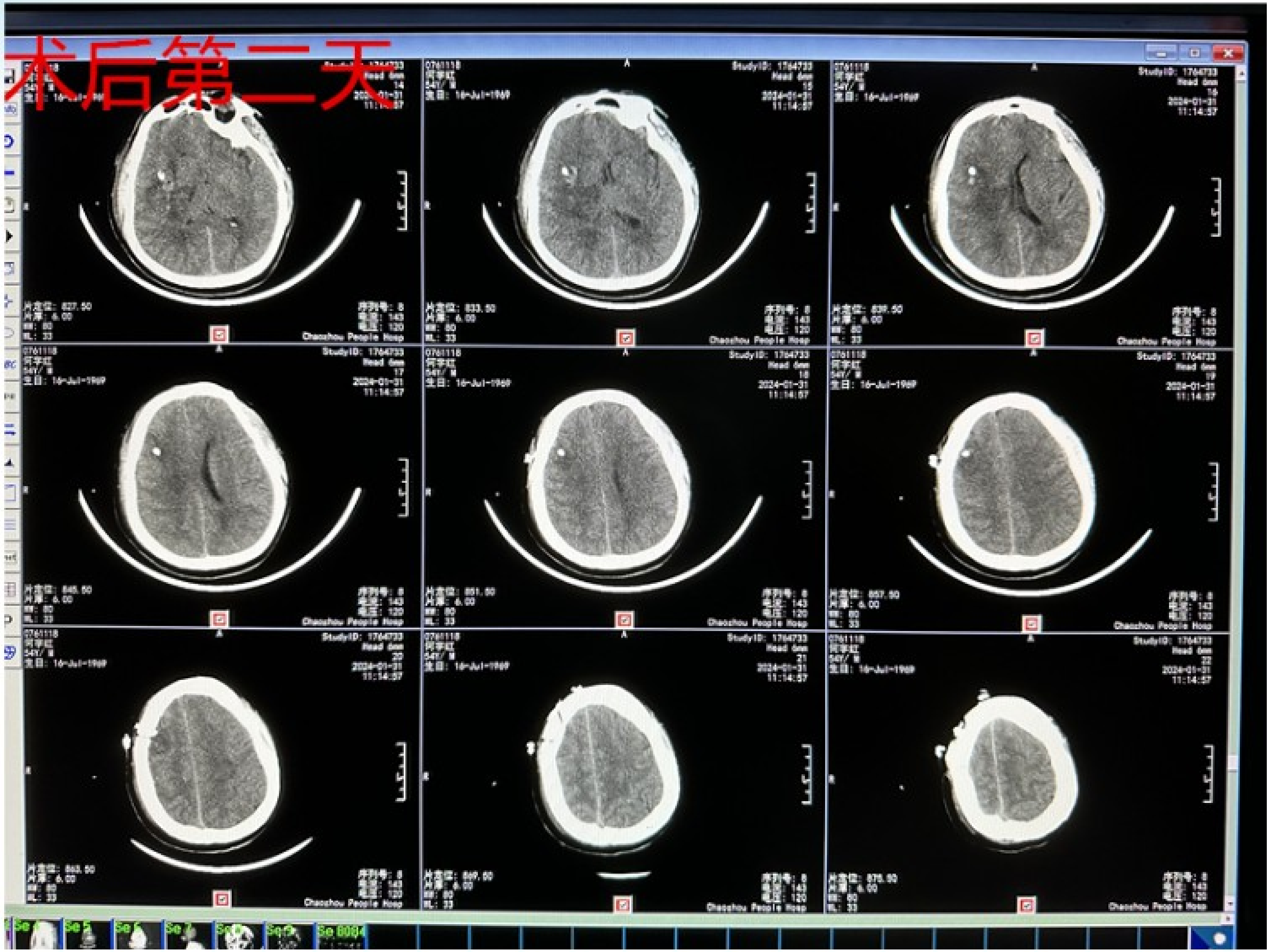


Postoperatively, the patient developed multiple complications, including diabetes insipidus, gastrointestinal bleeding, seizures, high fever, and a pulmonary infection, accompanied by severe hyponatremia and hypokalemia. Following **targeted and aggressive medical management**, the patient has **successfully mobilized** and is **currently able to ambulate independently**.

Case 3 He * Hong Before procedure

After the procedure, one hour.

After a procedural second day.



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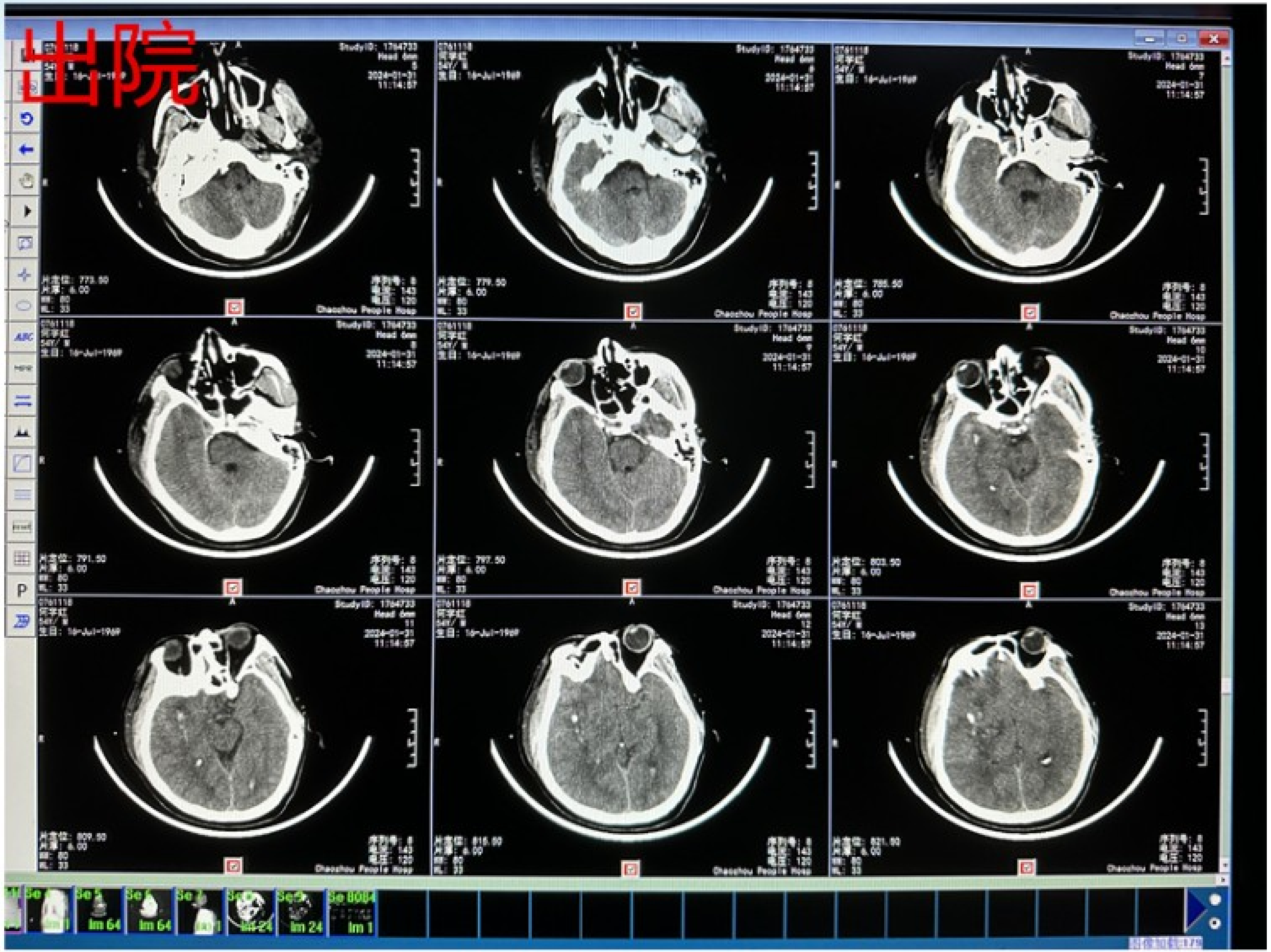
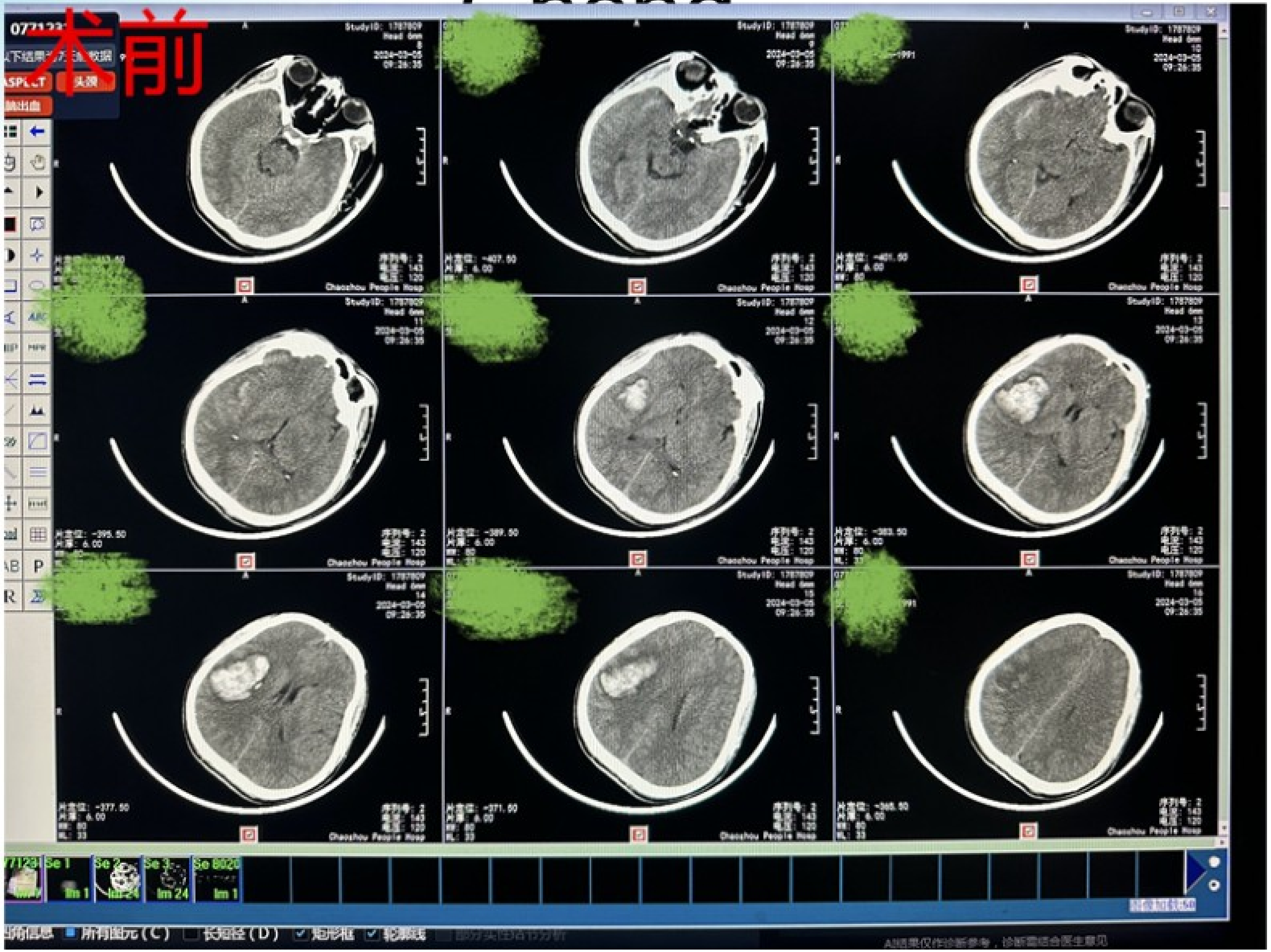
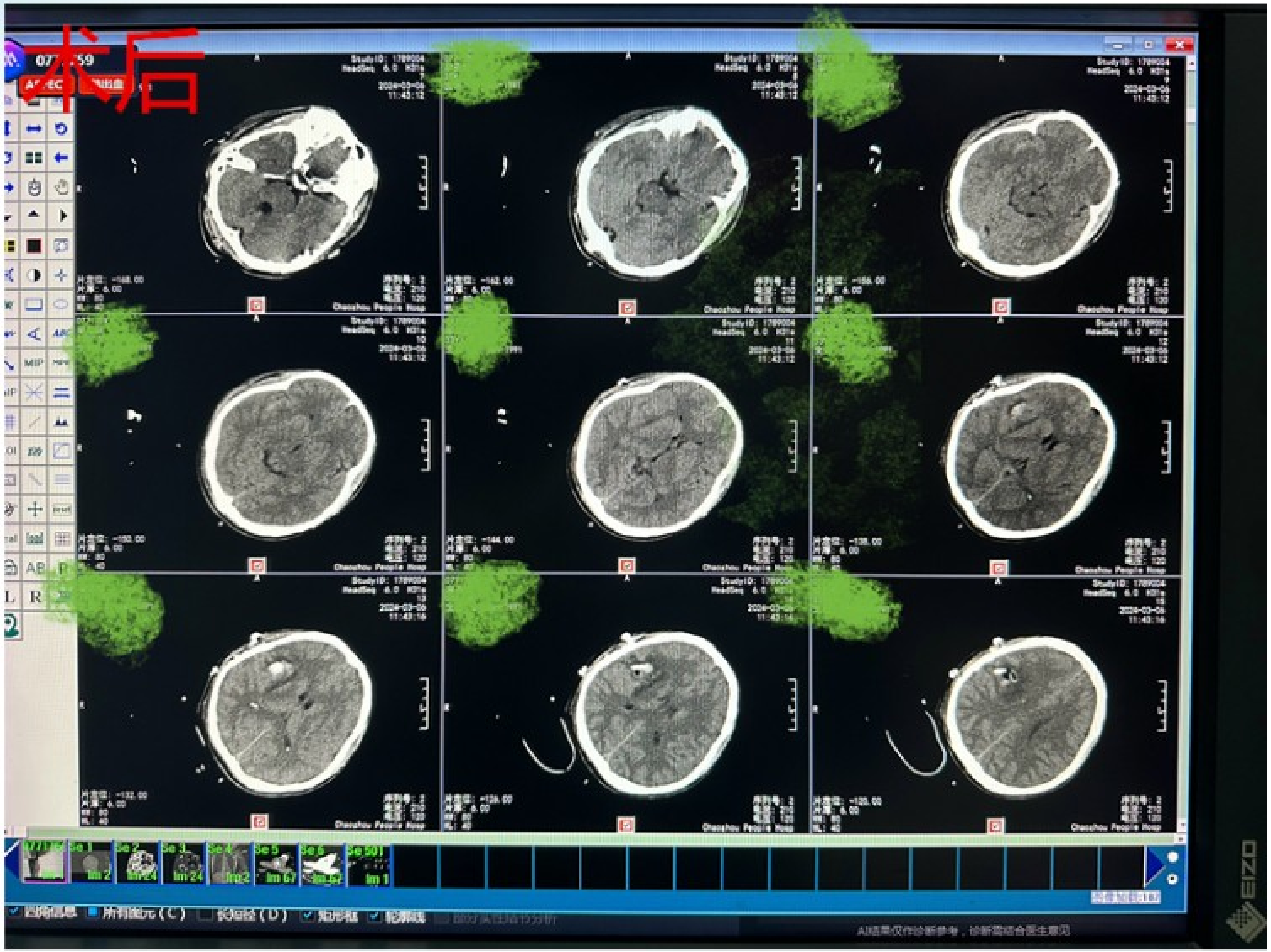
Leave hospital.



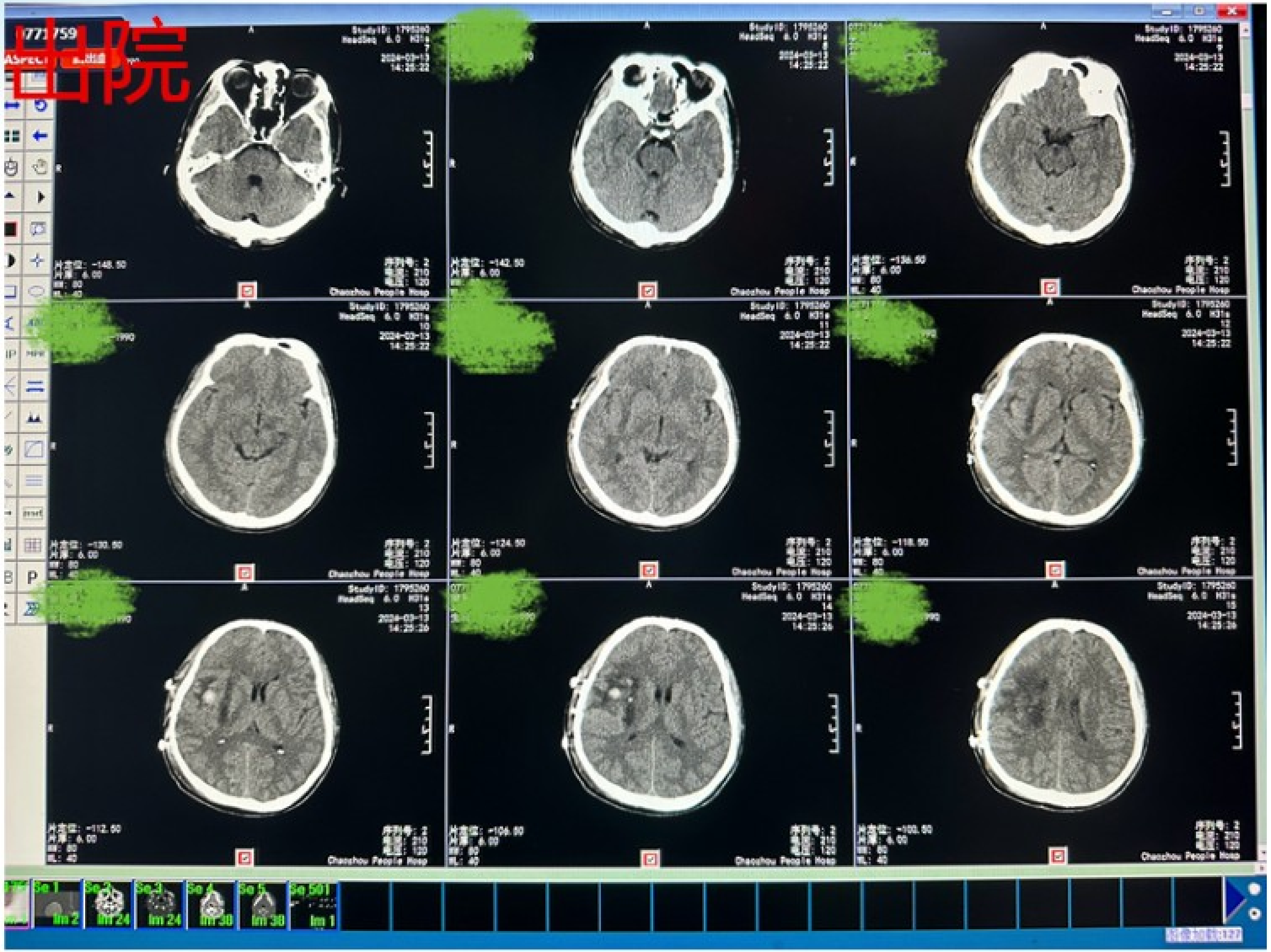
Case 4 Liao * Cheng



After surgery.



Leave the hospital.



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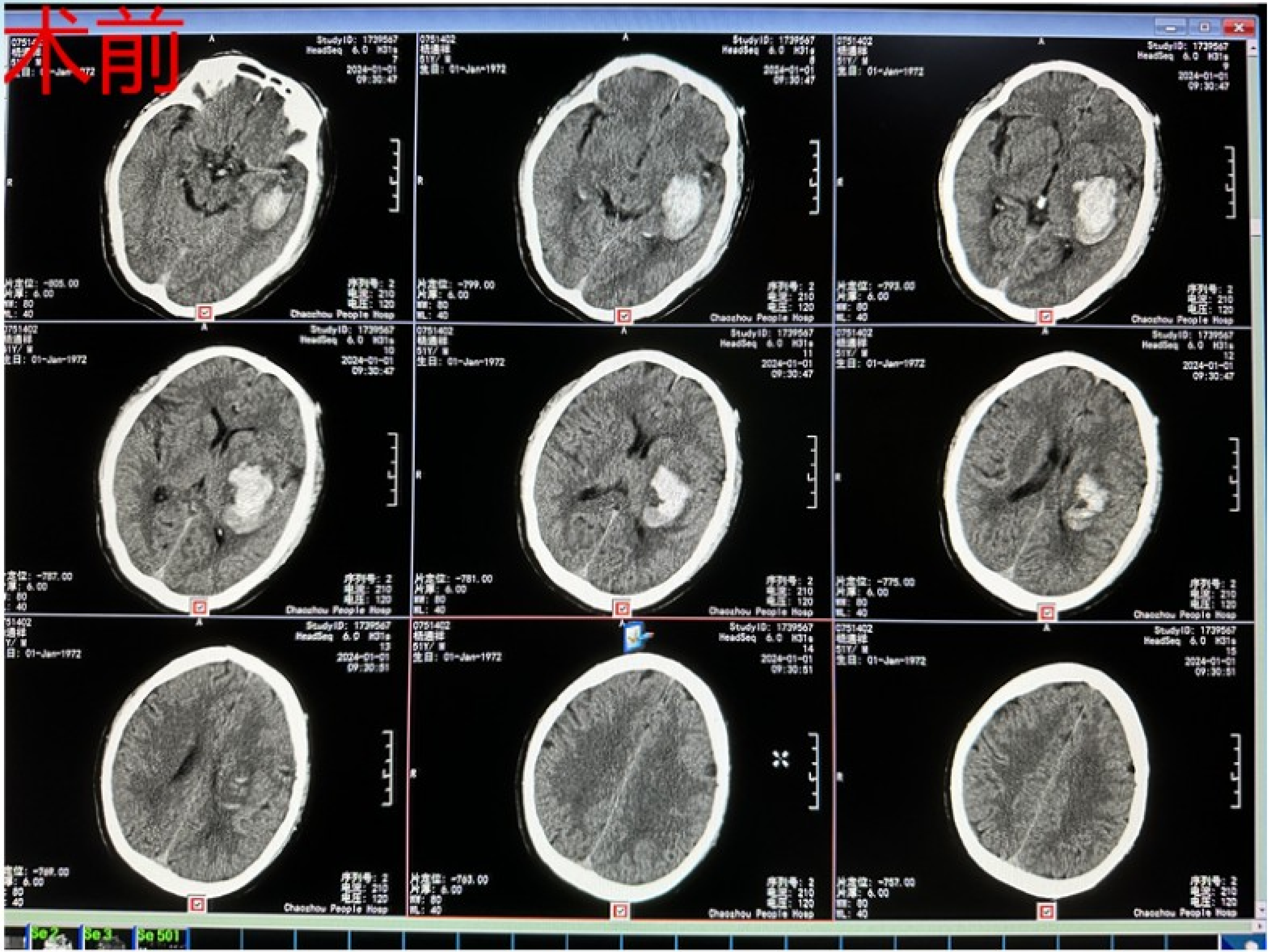
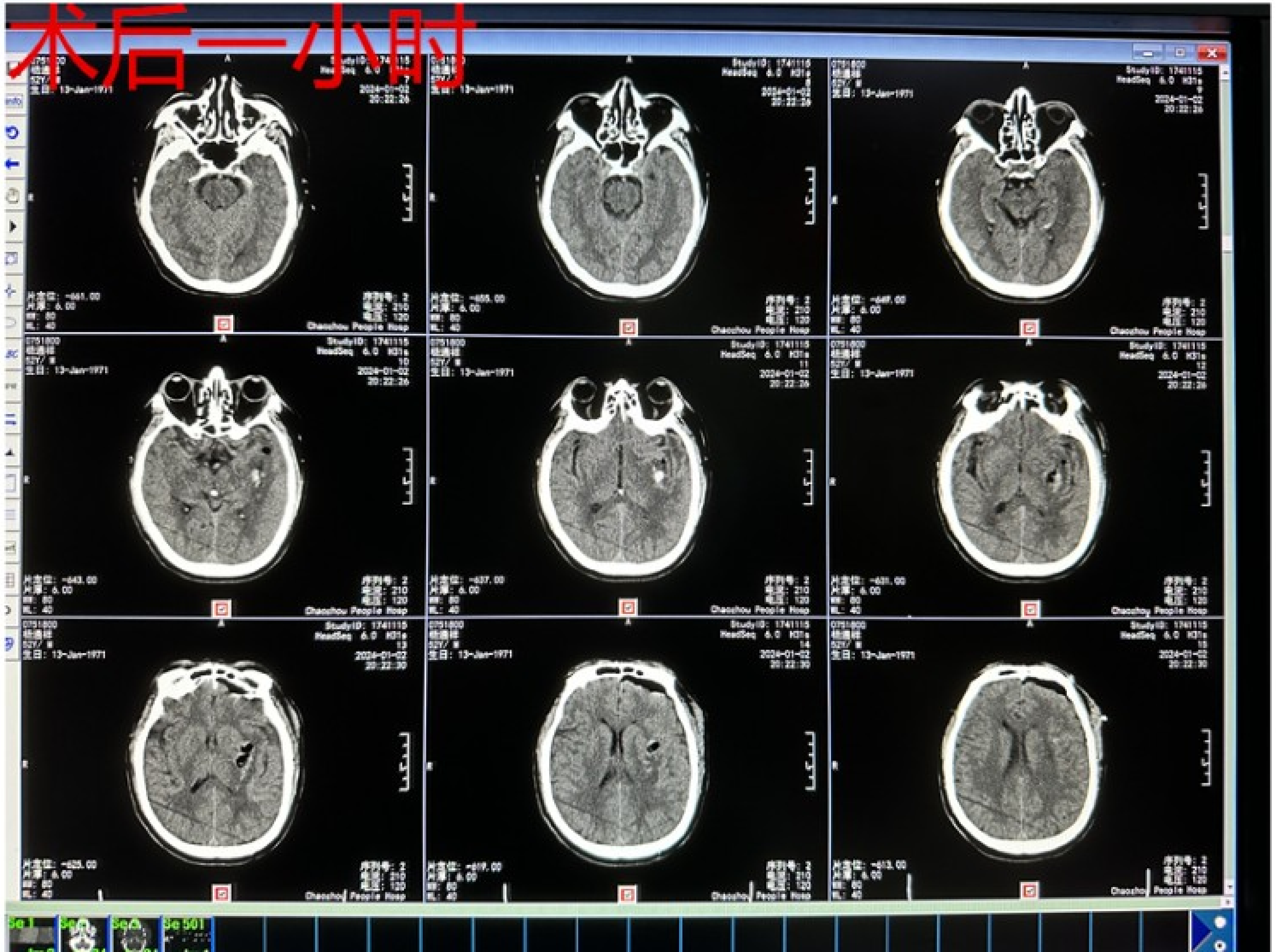
Case 5 Yang x Yang



After surgery, one hour.



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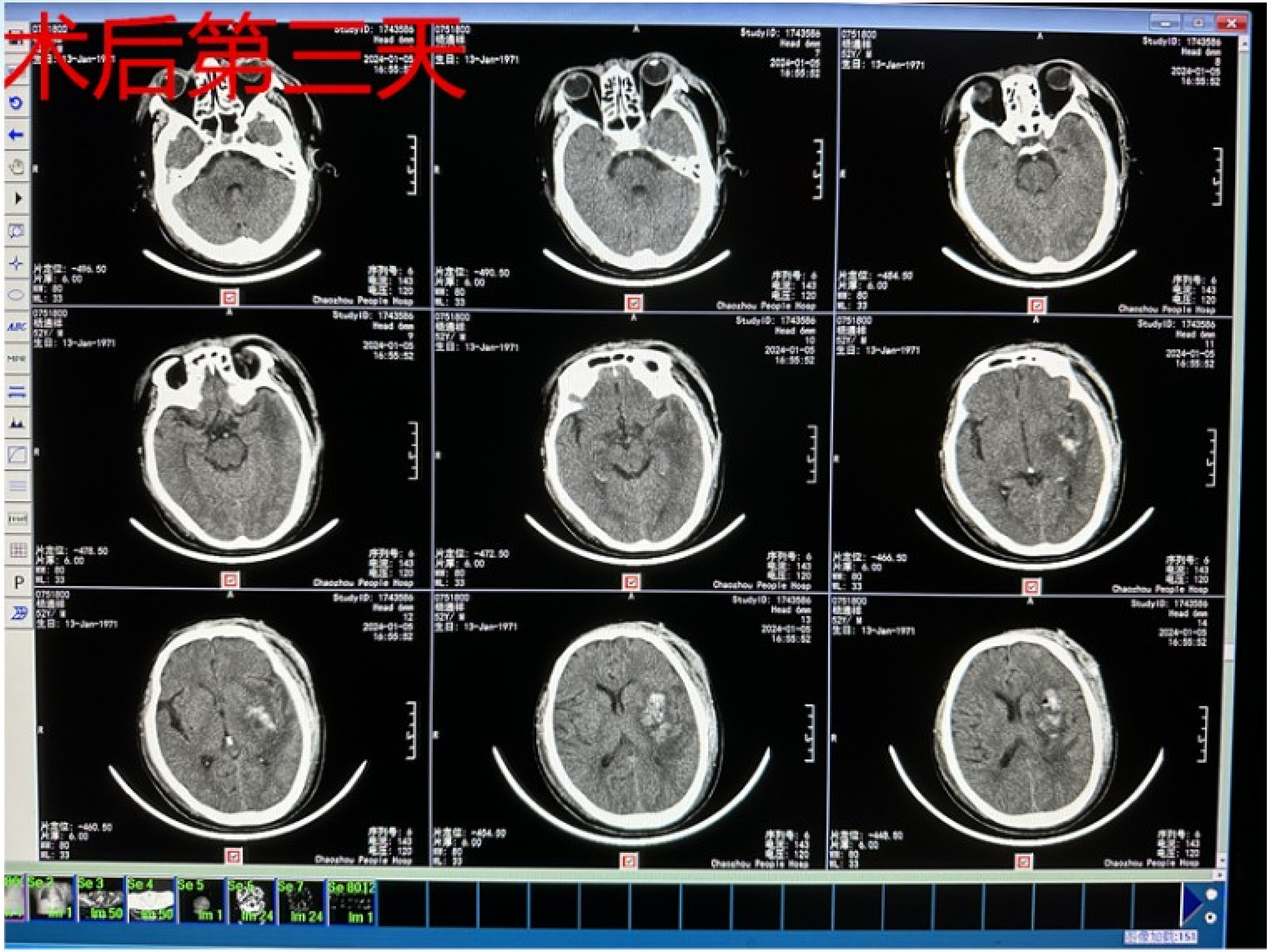
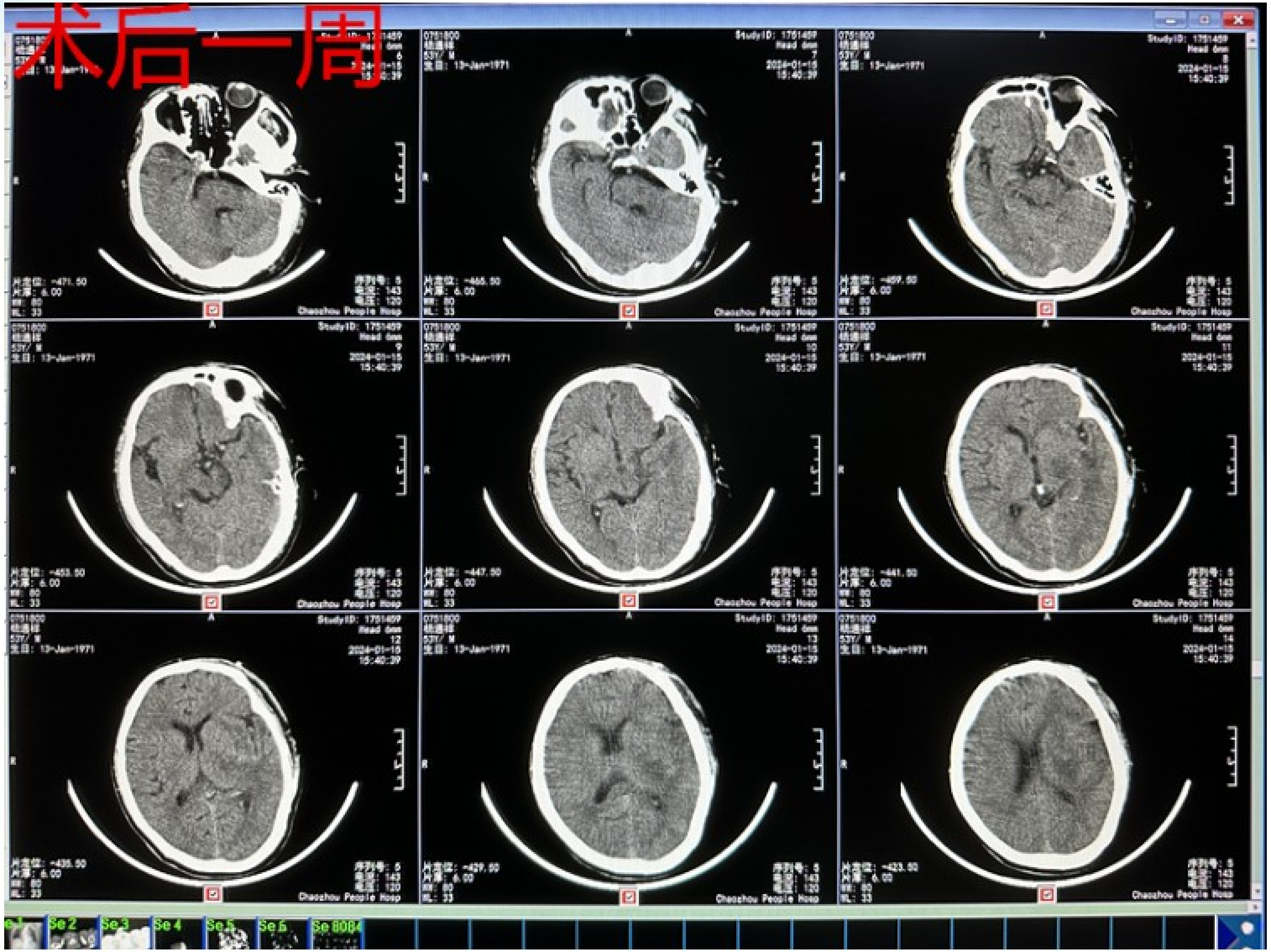
After surgery, 3 days



After surgery, one week.

术后一周



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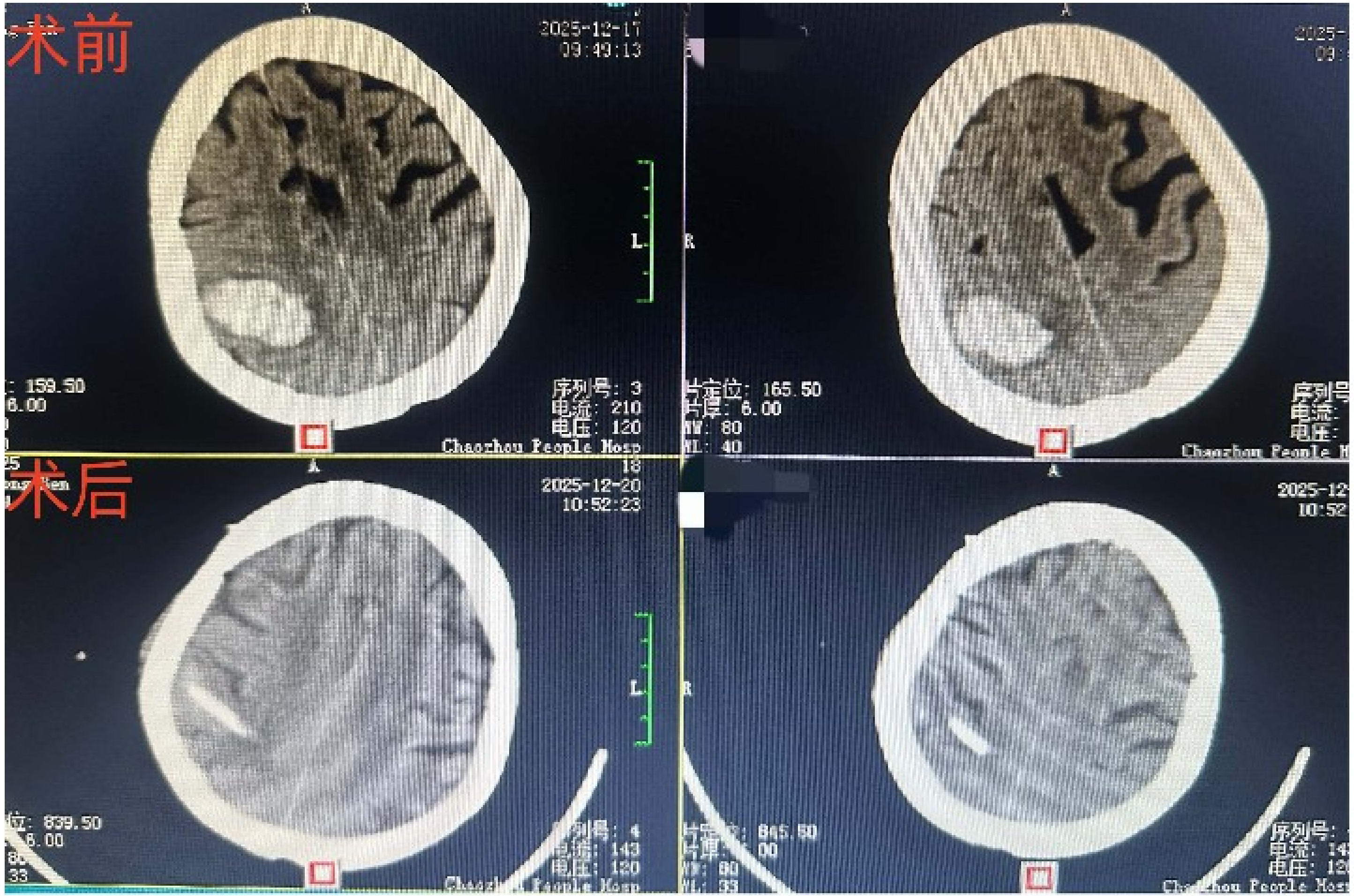
Case 6 Cai * Ben

Admission Summary: A 83-year-old male presented with a 1-hour history of sudden confusion and generalized seizures on December 17, 2025. On admission, he was comatose with a GCS of 10 (E2V3M5). He was diagnosed with right frontoparietal cerebral hemorrhage, secondary seizures, and Grade 3 hypertension (extremely high-risk). Regrettably, his seizures remained refractory and poorly controlled despite multidrug anticonvulsant therapy, which included intravenous valproate sodium and nasogastric administration of oxcarbazepine and phenytoin sodium.

Before surgery and after.

12-19: Puncture and drainage of cerebral hematoma with 3D printing and accurate positioning.



About 18ml hematoma was aspirated during the operation.

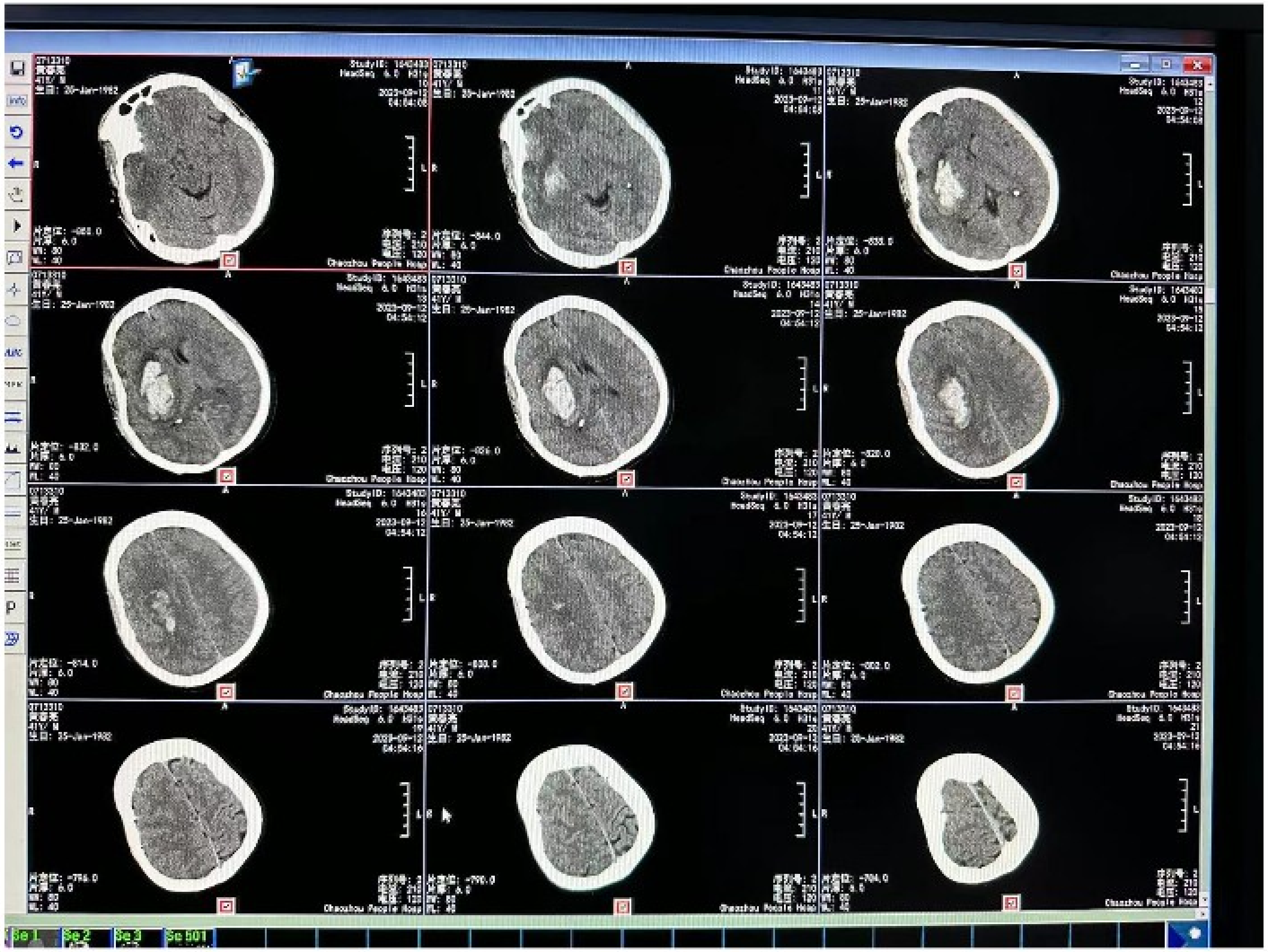
On the morning of 12-20, the patient's consciousness was clear, the answer was accurate, there was no seizure, the left lower limb could move autonomously, and the left upper limb activity was still poor. To remove the head drainage tube.

Case 7

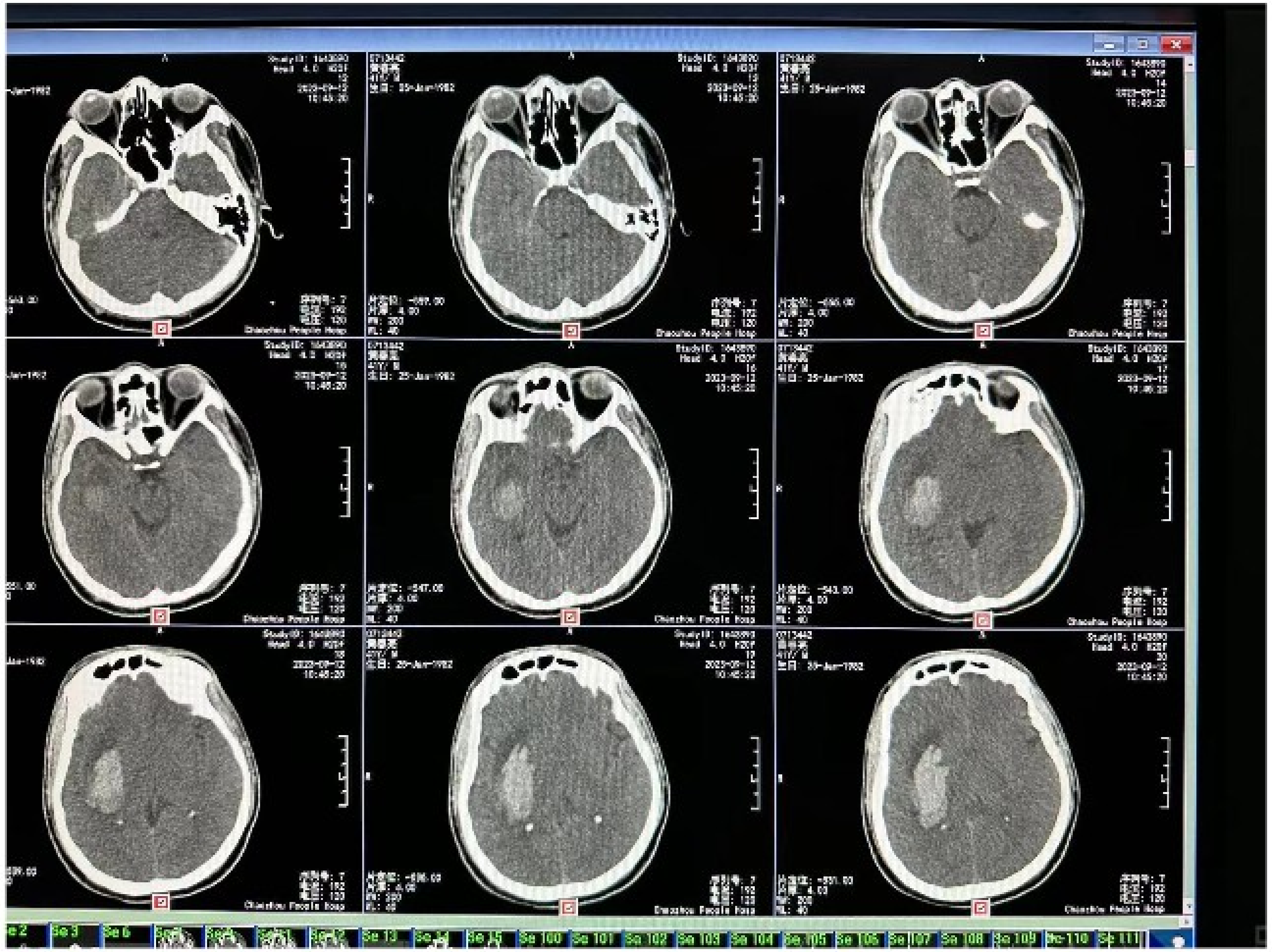
Acute Stroke Summary: A 41-year-old male presented to the ER at 04:40 in September 2023, 50 minutes after the acute onset of dizziness, left hemiparesis, dysarthria, and headache at 03:50. His condition progressed to confusion by 04:10. He had no history of hypertension or diabetes, but carried a 10-year smoking history.

Admission Examination: BP 197/98 mmHg, HR 90 bpm, RR 21/min, T 36.8°C. He was somnolent with a GCS of 13 (E2V5M6). Significant findings included tongue deviation to the left, Grade 0/5 muscle strength in the left upper and lower extremities (right sides normal at 5/5), and a positive left pathological sign.

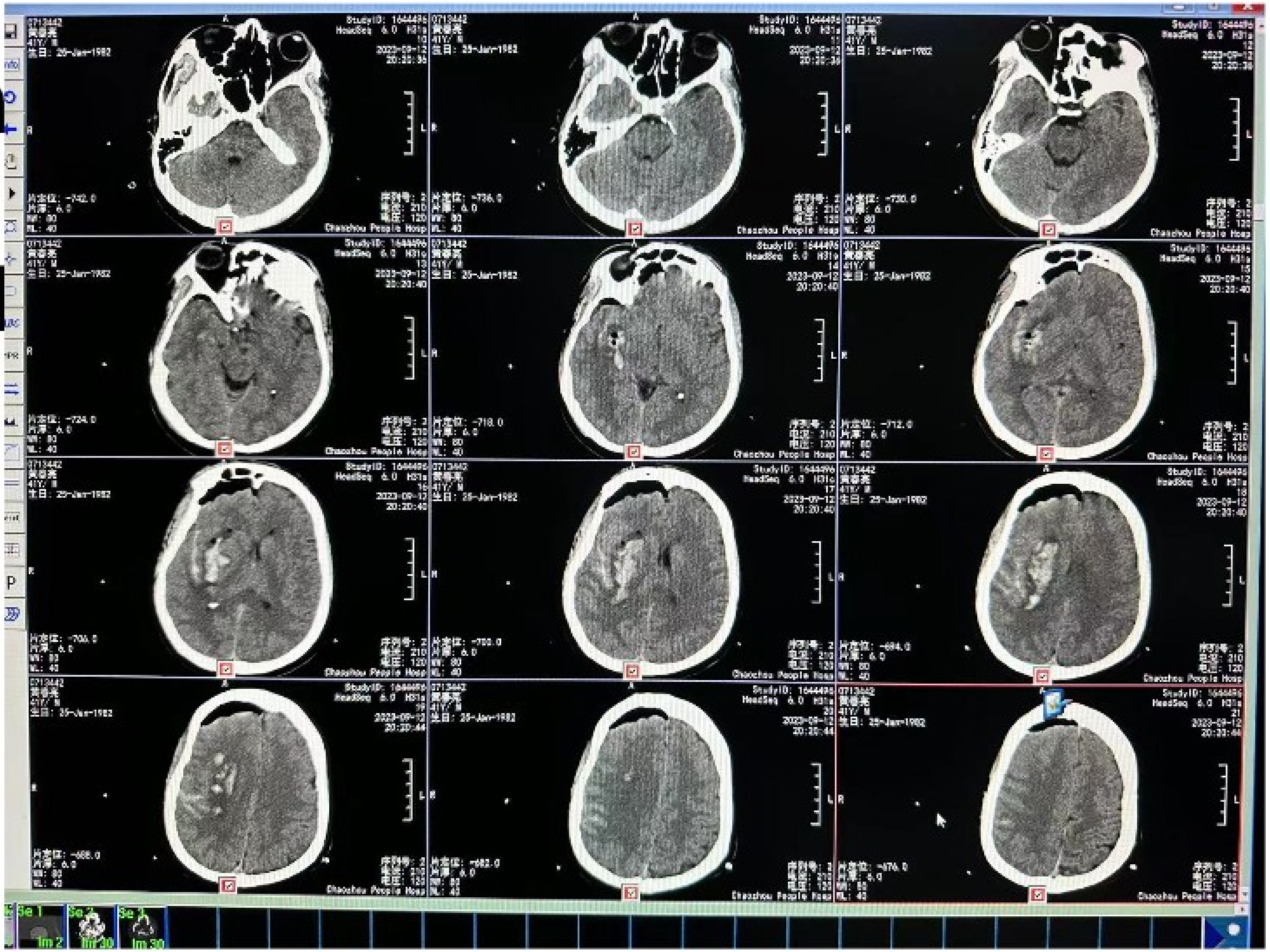
At 04: 54 on admission, the head CT was examined urgently.：



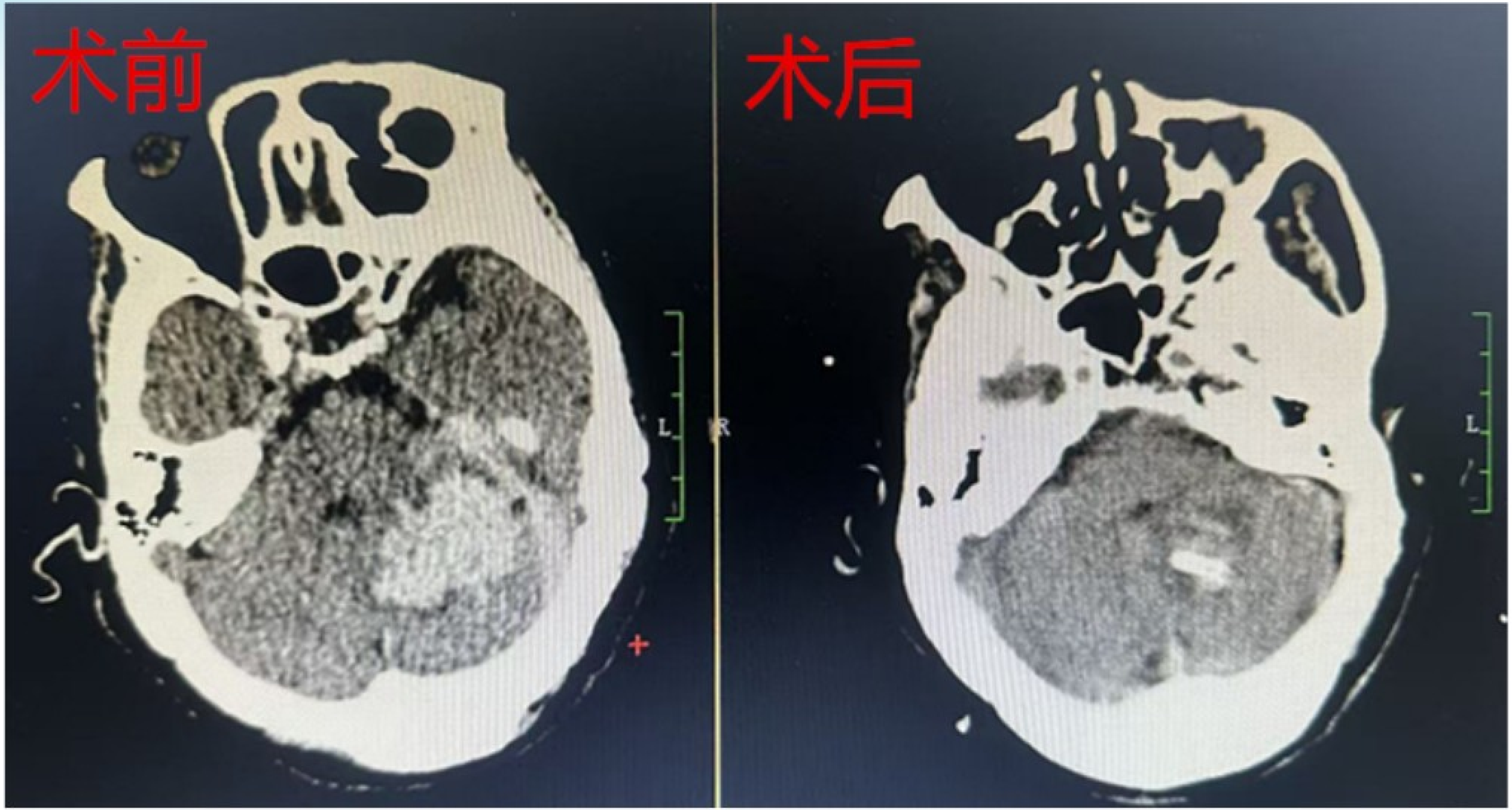
10：38 CTA



20: 20 after operation (the hematoma mass near thalamus is hard so it should be preserved).



Cerebellar hemorrhage 1



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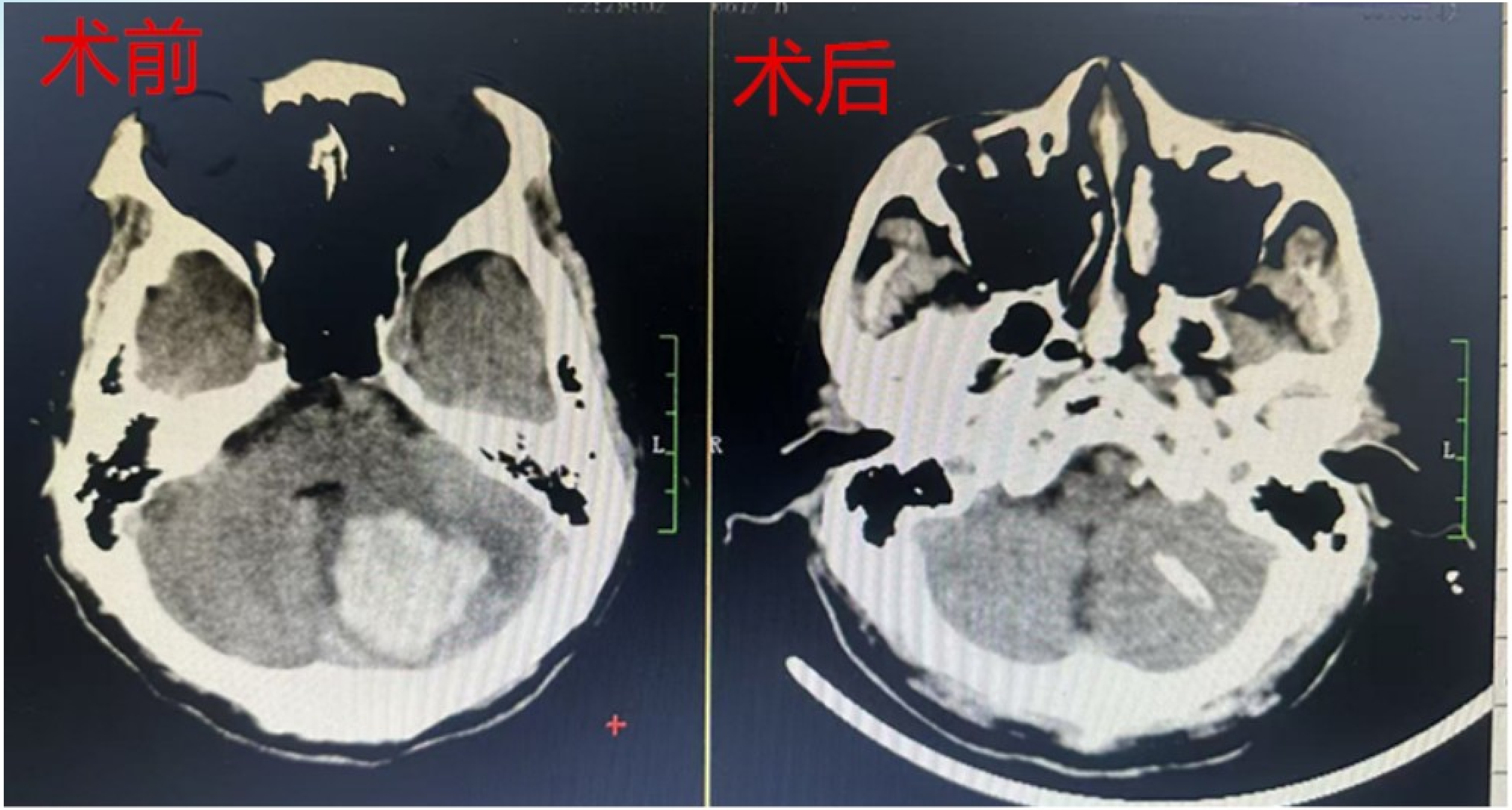
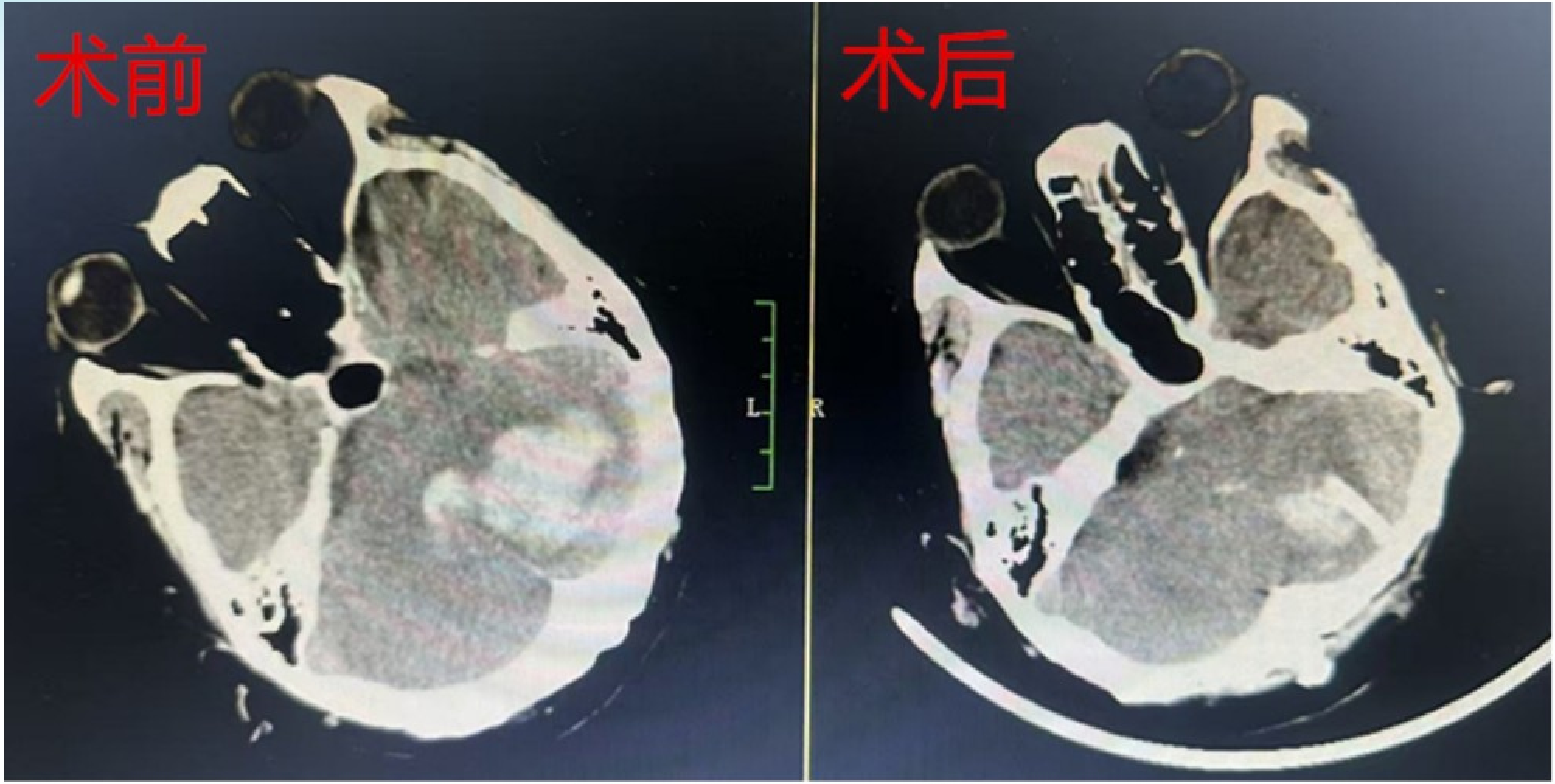
Cerebellar hemorrhage

2



Cerebellar hemorrhage 3



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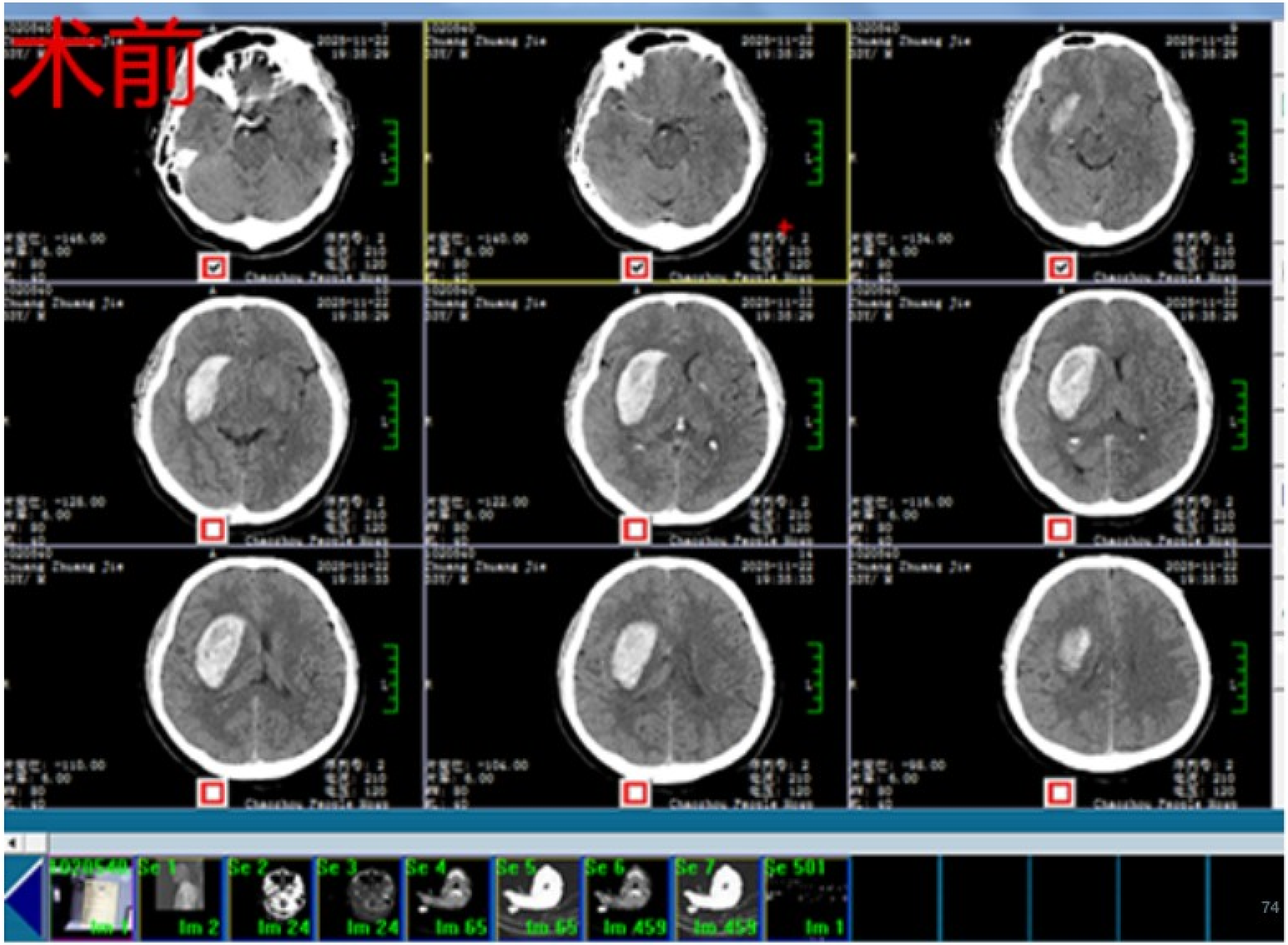
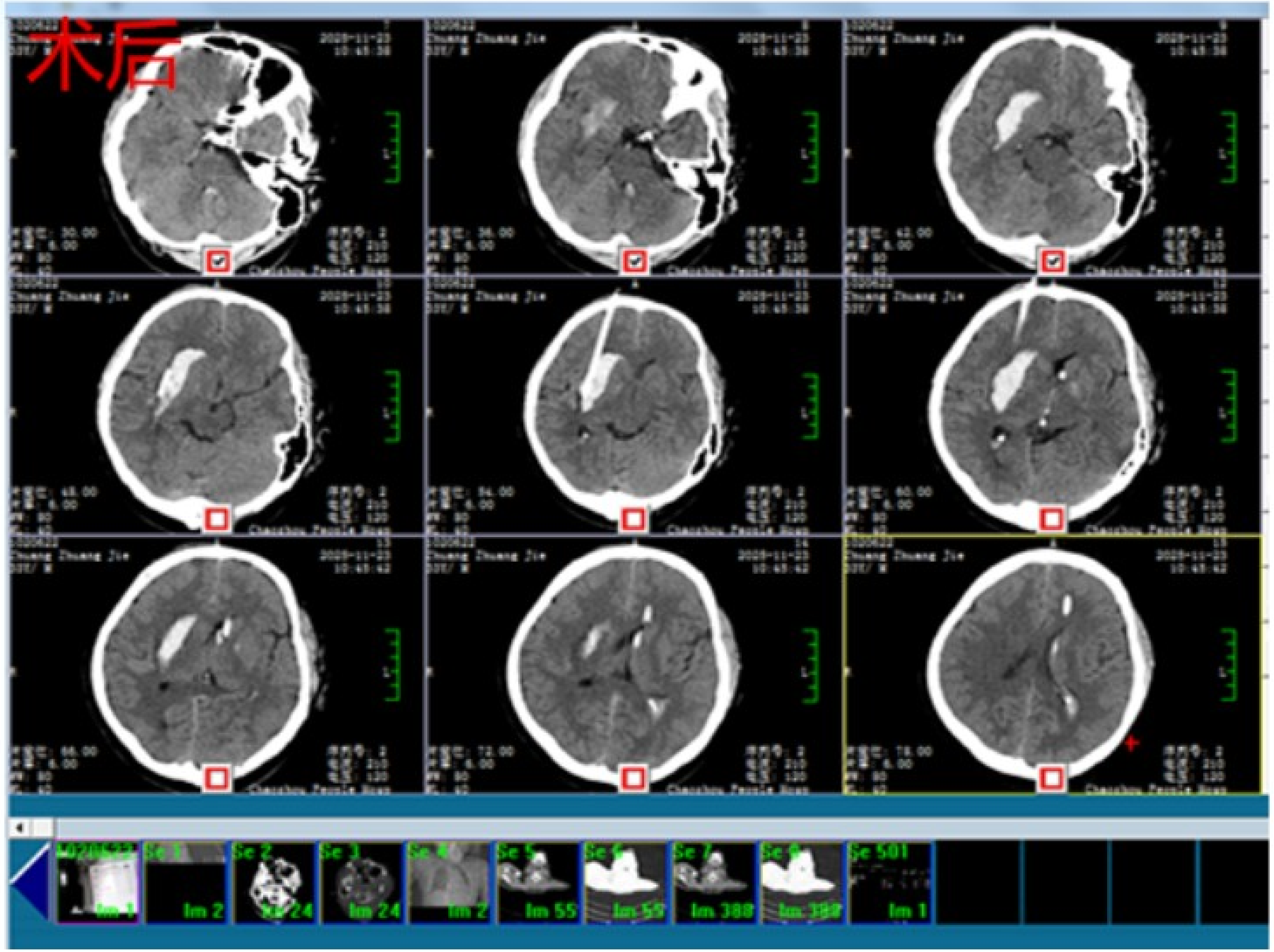
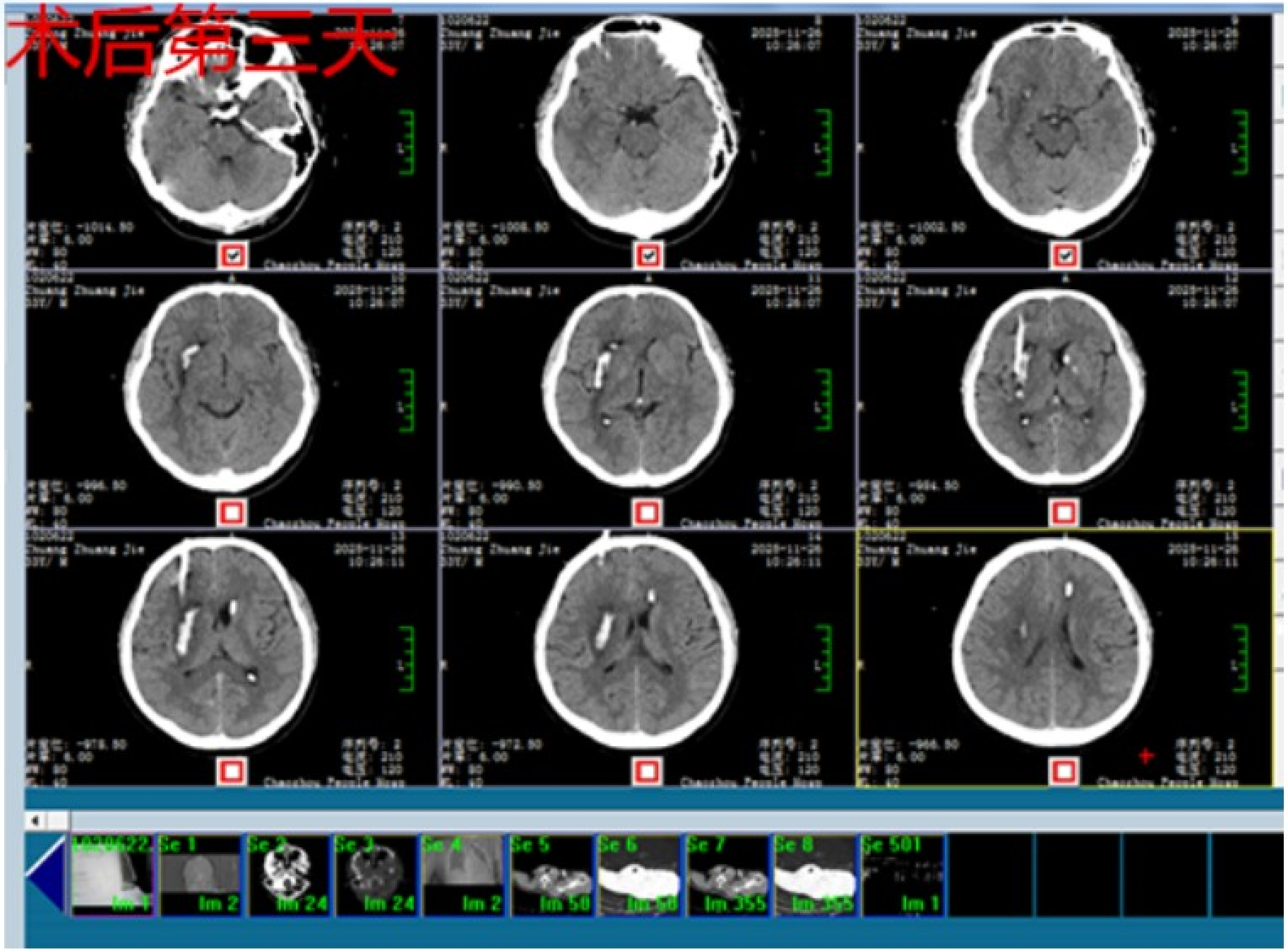
Special Case 1

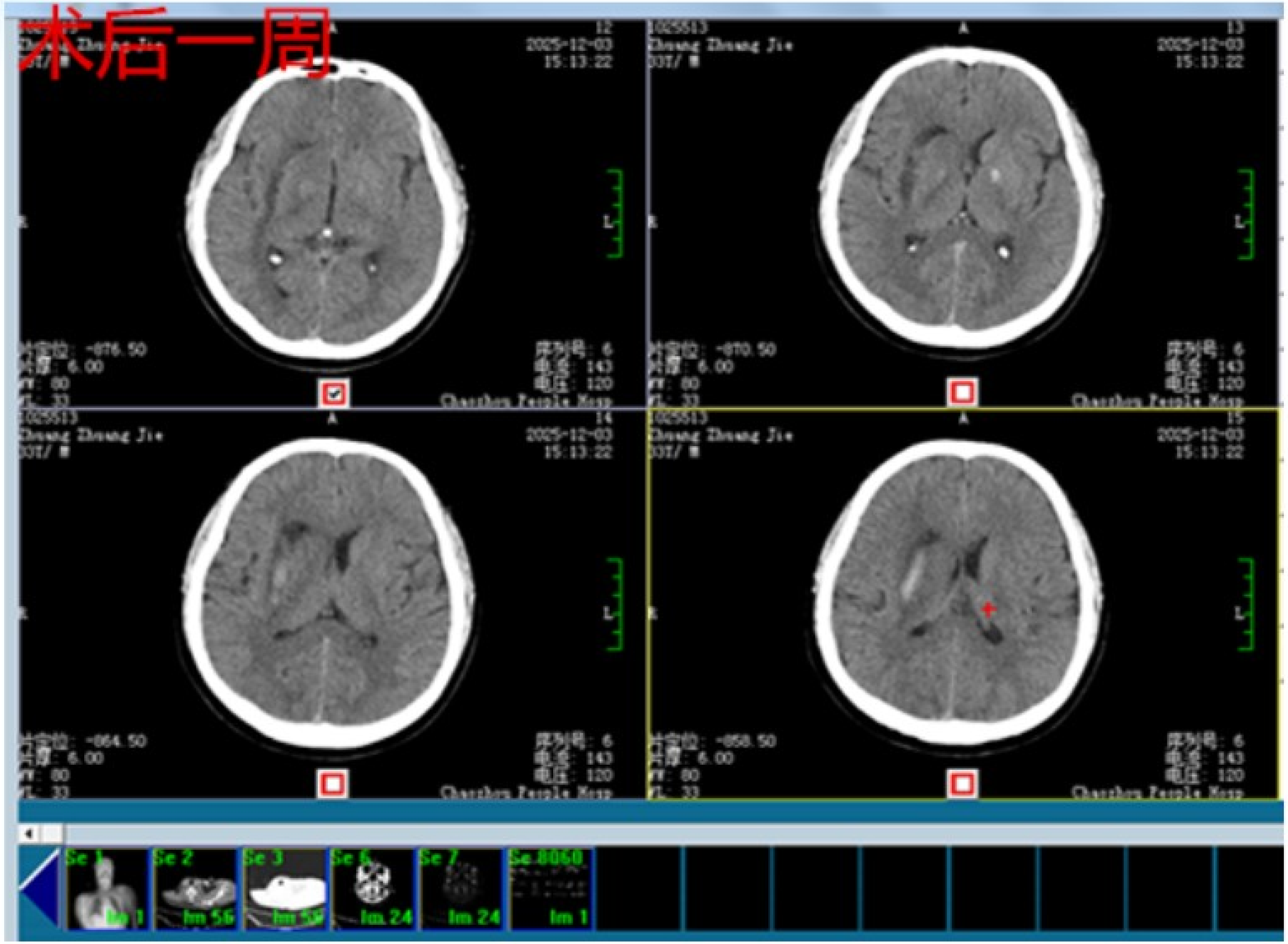
Emergency Admission Summary: A 39-year-old male presented to the ER 2 hours post-onset of sudden unconsciousness. On admission, he was hypertensive (BP: 210/105) and comatose with a GCS of 7 (E1V1M5), showing signs of psychomotor agitation to stimuli. Neurological examination was significant for right-hemispheric localization: the left limbs exhibited complete paralysis (Grade 0/5) with hypotonia (weakened muscle tension), while the right limbs showed intact strength (Grade 5/5) and normal tone. The left Babinski sign was prominent, and no pathological reflexes were elicited on the right.



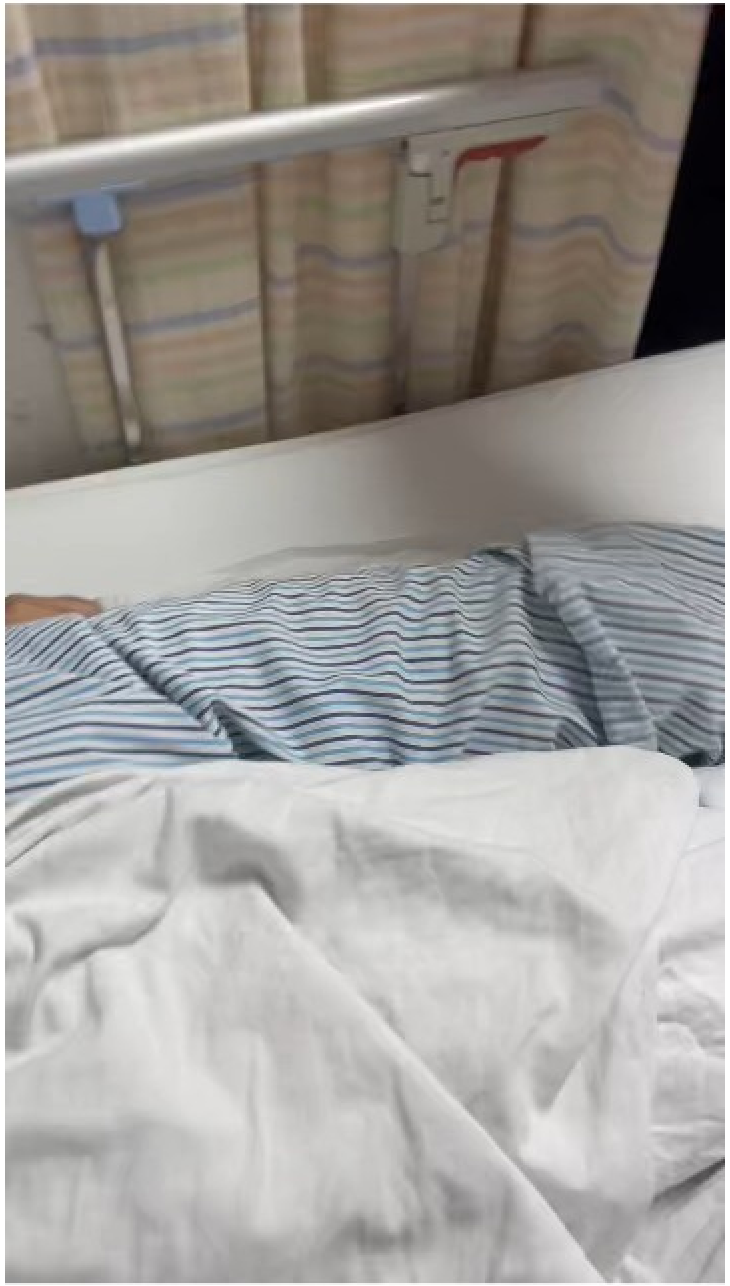

术后

Ward rounds on the second day after operation (eyes can be opened and actions can be coordinated)

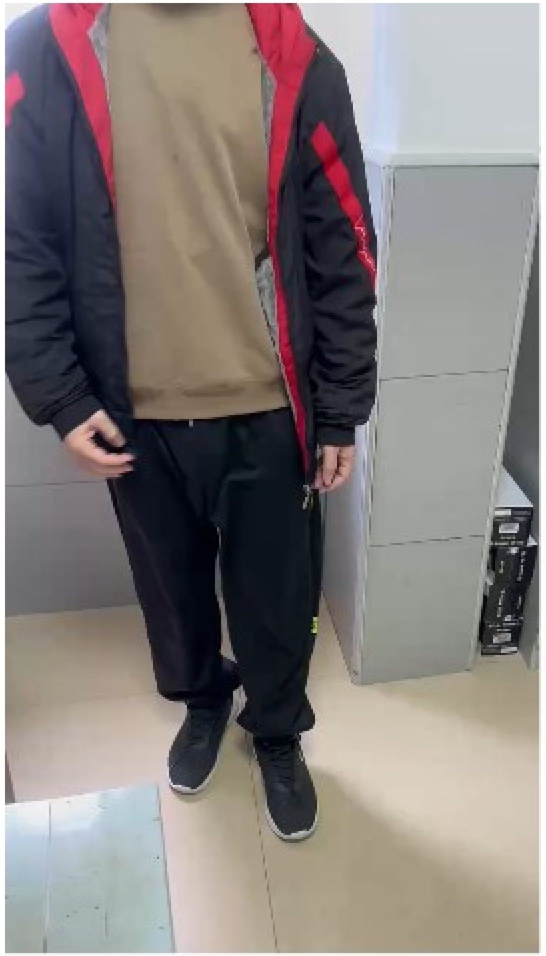

术后第三天


术后一周

At discharge (left upper limb muscle strength grade IV, left lower limb muscle strength grade V)



Return to the hospital for follow-up after one month.



THANKS

感谢观看