

Case reports

Transforming emergency care with Nexaris Angio-CT hybrid emergency rooms

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"With a CT scanner, a surgical table in a clean air environment, and angiographic imaging all available in the same HER, the necessary protocols and treatment steps could be performed without the need to move the patient."

"This case demonstrates that the HER can play a decisive role in the survival of patients with severe thoracic trauma. Without such a system, survival in this case would have been significantly more challenging."

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"The multimodality HER, which allows both CT-based diagnosis and angiography-guided treatment without patient movement, can contribute to reducing DIT, D2P, and P2R in acute ischemic stroke patients. A key advantage of the HER in this particular case was the ability to achieve short D2P without patient transfer, enabling seamless transition from diagnosis to treatment."

Motoo Fujita, MD, PhD

Abbreviations

CPR: cardiopulmonary resuscitation
D2P: door-to-puncture time
DIT: door-to-imaging time
ECMO: extracorporeal membrane oxygenation
ECPR: extracorporeal cardiopulmonary resuscitation
EMS: emergency medical services
HER: hybrid emergency room
P2R: puncture-to-recanalization time
V-A: veno-arterial
V-V: veno-venous

Case Report #1

Whole-body CT imaging, surgery, and ECMO in a single resuscitation bay



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Patient history

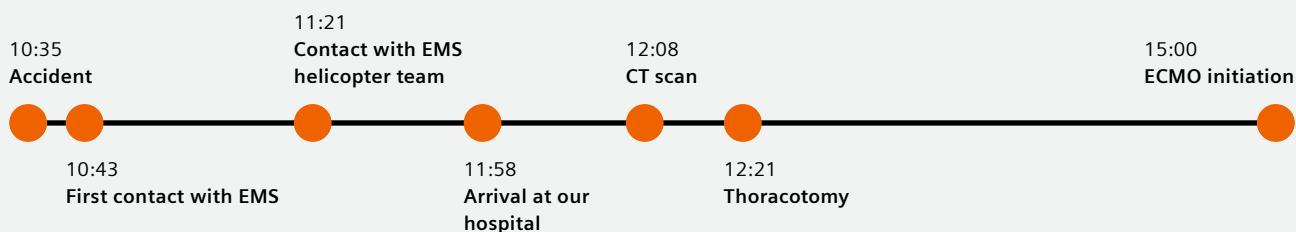
A teenage female patient presented to our emergency department via helicopter emergency medical service (EMS) after sustaining injuries in a fall from a height of approximately 30 meters. Upon arrival at our institution, approximately 1 hour after injury, her Glasgow Coma Score was 3 after drug-assisted intubation during prehospital care. Her respiratory rate was 40 breaths/min, heart rate was 157 bpm, and blood pressure was 68/26 mmHg. A chest tube had been inserted for a right open hemopneumothorax, presenting with 1500 mL of hemorrhage from the drainage tube at the time of arrival. The patient was directly transported from the helipad to the hybrid emergency room (HER), where whole-body computed tomography (CT) was performed concurrently with ongoing resuscitation and surgical preparation. The massive transfusion protocol was activated, and treatment was initiated.

Patient management in the HER

The HER, comprising a CT scanner on rails (SOMATOM Definition AS+, Siemens Healthineers AG, Germany) and an angiography system (ARTIS pheno, Siemens Healthineers AG, Germany), allowed for imaging with both modalities on the same surgical patient table (Maquet Magnus OR Table, Getinge AB, Sweden) without lifting or transferring the patient. The CT scan revealed extensive laceration and intraparenchymal hemorrhage of the right middle lobe, bilateral extensive lung contusions, right open hemopneumothorax, pneumopericardium, and multiple rib fractures (Figure 1).

We performed a right thoracotomy 23 minutes after the patient's arrival to control thoracic hemorrhage and relieve pneumopericardium (Figure 2-1). Due to the extensive laceration and intraparenchymal hemorrhage of the right middle lobe, preservation of the damaged lobe was considered unsuitable. Therefore, the right middle lobe was resected using a surgical stapler, and laceration and air leakage of the bronchus of the right upper lobe were repaired using the lateral suture technique (Figure 2-2). No significant cardio-pericardial injury was observed at the time of pericardiotomy, and pneumopericardium was assessed to be caused by a combination of minor pericardial tear and pneumothorax.

Timeline of events



Hemorrhage and air leakage in the right thorax were controlled. However, the blood gas analysis revealed a pH of 7.01, a PO₂ of 62.3 mmHg, and a PCO₂ of 89.1 mmHg under positive pressure mechanical ventilation with an FiO₂ of 1.0, and positive end-expiratory pressure of 20 cmH₂O. Therefore, veno-venous extracorporeal membrane oxygenation (V-V ECMO, venous return cannula [16 Fr] in the right internal jugular vein, and outflow cannula [21 Fr] in the right femoral vein using heparin-bonded catheters) was applied to maintain respiratory status without systemic heparinization in the HER before admitting the patient to the intensive care unit (Figure 3-1).

Despite extensive pulmonary contusions, the patient's oxygenation gradually improved, and she was successfully weaned from ECMO on Day 8. On Day 22, she was withdrawn from the ventilator. Finally, she was transferred to the rehabilitation hospital with no residual neurological deficits on Day 102.

Comments

With a CT scanner, a surgical table in a clean air environment, and angiographic imaging all available in the HER, the necessary protocols and treatment steps could be performed without the need to move the patient. In addition, the HER is equipped with a large display system that allows simultaneous visualization of vital signs, CT images, angiographic findings, and other patient information on a single screen. This facilitates real-time situational awareness for the trauma team (Figure 3-2). Although the patient was hemodynamically unstable, the availability of a CT scanner in the HER allowed for rapid and comprehensive assessment. The CT findings provided critical information (including the extent of thoracic injury and sources of hemorrhage) that directly informed the surgical strategy, enabling prompt and targeted operative intervention.

The patient's respiratory status was more severe than suggested by the CT findings alone. Progressive hypoxemia due to extensive pulmonary contusions was evident early, leading us to anticipate the need for V-V ECMO. This early recognition was critical for treatment planning.

After surgical control of thoracic hemorrhage, ECMO was introduced promptly and was safely initiated under fluoroscopic guidance. The ability to initiate ECMO immediately after surgery, without moving the patient, contributed to stable postoperative management and lung protection during the acute phase.

The patient was successfully treated through a seamless sequence of CT imaging, surgery, and ECMO. This coordinated management was possible because the HER is equipped to perform CT imaging, angiography, and surgery within the resuscitation area.

As a result of early diagnosis, timely surgery, and prompt initiation of ECMO in the HER, the patient achieved full recovery without neurological sequelae. This case demonstrates that the HER can play a decisive role in the survival of patients with severe thoracic trauma. Without such a system, survival in this case would have been significantly more challenging.

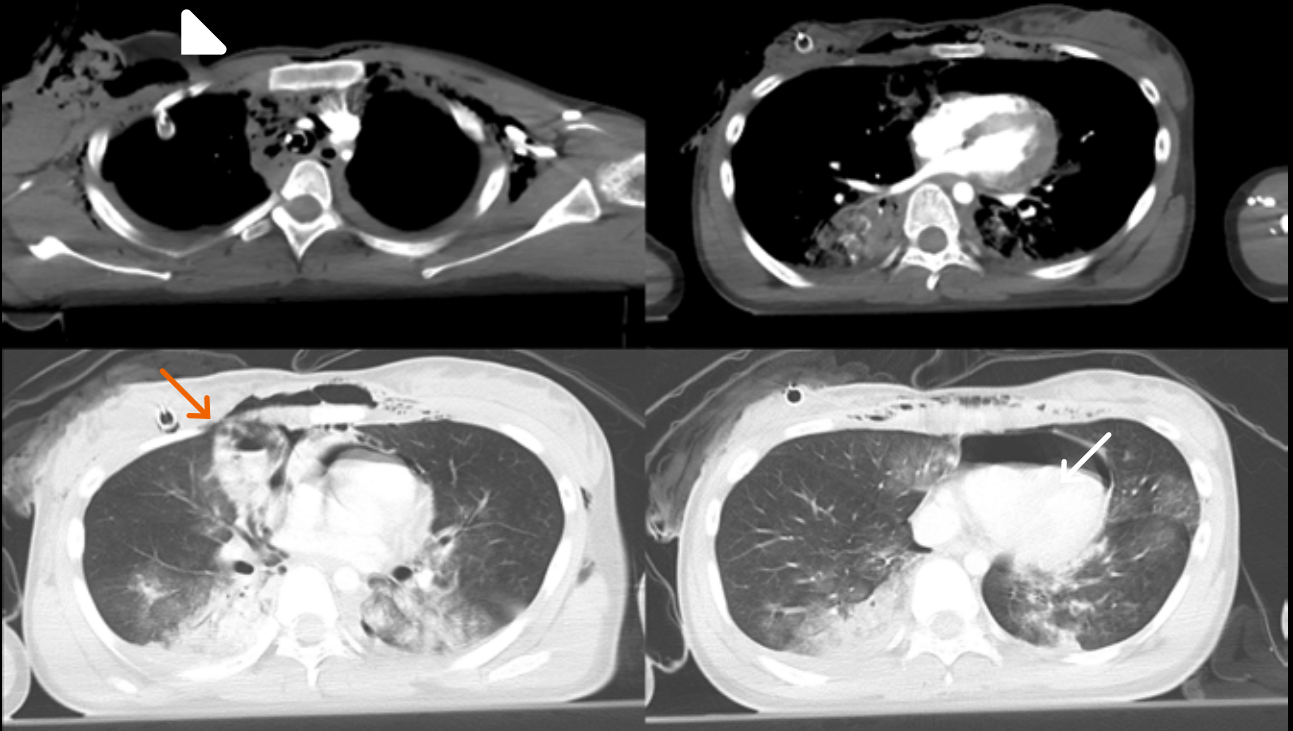


Figure 1

The CT scan showed a right open hemopneumothorax, subcutaneous emphysema (white arrowhead), an intraparenchymal laceration of the right middle lobe (orange arrow), and pericardial emphysema (white arrow).



Figure 2-1
Preparing for surgery after CT imaging, 23 minutes after arrival and 5 minutes after completion of the CT scan.



Figure 2-2
The right middle lobe was resected with a surgical stapler due to extensive laceration and intraparenchymal hemorrhage. Bronchial laceration with air leakage of the right upper lobe was repaired using a lateral suture technique.



Figure 3-1
Postoperatively, V-V ECMO was initiated to maintain respiratory status without systemic anticoagulation. A drainage cannula was inserted via the right internal jugular vein, and a return cannula was placed in the right femoral vein using heparin-bonded catheters.

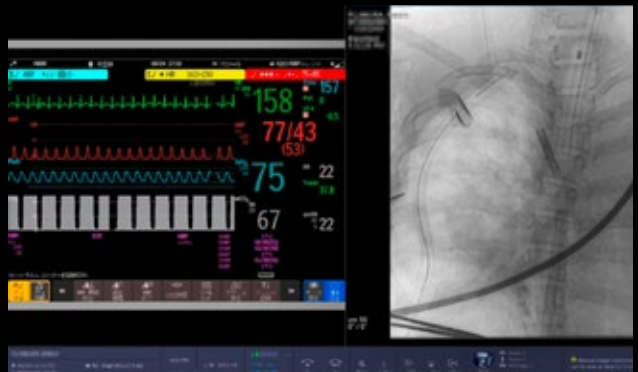


Figure 3-2
The HER is equipped with a large display monitor. This monitor can simultaneously display vital-sign monitoring, CT imaging, and angiographic findings.

Case Report #2

From cardiac arrest to recovery in one room: Integrated imaging and intervention enabling successful ECPR



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Patient history

A 45-year-old man suffered an out-of-hospital cardiac arrest with sustained ventricular fibrillation. The event was witnessed, and bystander cardiopulmonary resuscitation (CPR) was initiated promptly. Despite six defibrillation attempts in the prehospital setting, ventricular fibrillation persisted. The patient arrived at our institution approximately 50 minutes after collapse and was brought directly into the hybrid emergency room (HER) for the initiation of extracorporeal cardiopulmonary resuscitation (ECPR).

Patient management in the hybrid emergency room

While mechanical chest compression was ongoing, veno-arterial extracorporeal membrane oxygenation (V-A ECMO) was safely established via ultrasound- and fluoroscopy-guided cannulation, with a 16 Fr arterial cannula in the right femoral artery and a 20 Fr venous cannula in the right femoral vein. The arrival-to-puncture time was 2 minutes and the puncture-to-pump-on time was 9 minutes. After initiation of V-A ECMO, antiarrhythmic agents were administered, followed by defibrillation, which resulted in the return of spontaneous circulation. Electrocardiography showed no ST-segment elevation, and cardiac enzyme levels were only mildly elevated. Transthoracic echocardiography demonstrated no apparent regional wall motion abnormalities.

Based on these findings, the cause of cardiac arrest was determined to be idiopathic refractory ventricular fibrillation. The patient's hemodynamic condition gradually improved, allowing successful withdrawal from V-A ECMO on Hospital Day 3. The patient had no neurological sequelae and was discharged on Day 25 wearing a wearable cardioverter defibrillator.

Comments

The patient received bystander CPR, but ventricular fibrillation was refractory to prehospital defibrillation. Upon arrival at our institution, priority was given to rapid initiation of ECPR to restore systemic circulation and cerebral perfusion. The HER is equipped with a fluoroscopic imaging system, which enables safe and precise cannulation for V-A ECMO.

The HER is also equipped with a computed tomography (CT) scanner, allowing CT imaging to be performed immediately after V-A ECMO initiation without patient transfer. Prompt head CT imaging and CT angiography of the great vessels can therefore be obtained to evaluate potential causes of irreversible cardiac arrest. In this case, the HER enabled rapid and safe ECPR, resulting in survival without neurological sequelae.



Figure 1
The V-A ECMO drainage cannula (20 Fr) was inserted via the right femoral vein under fluoroscopic guidance.

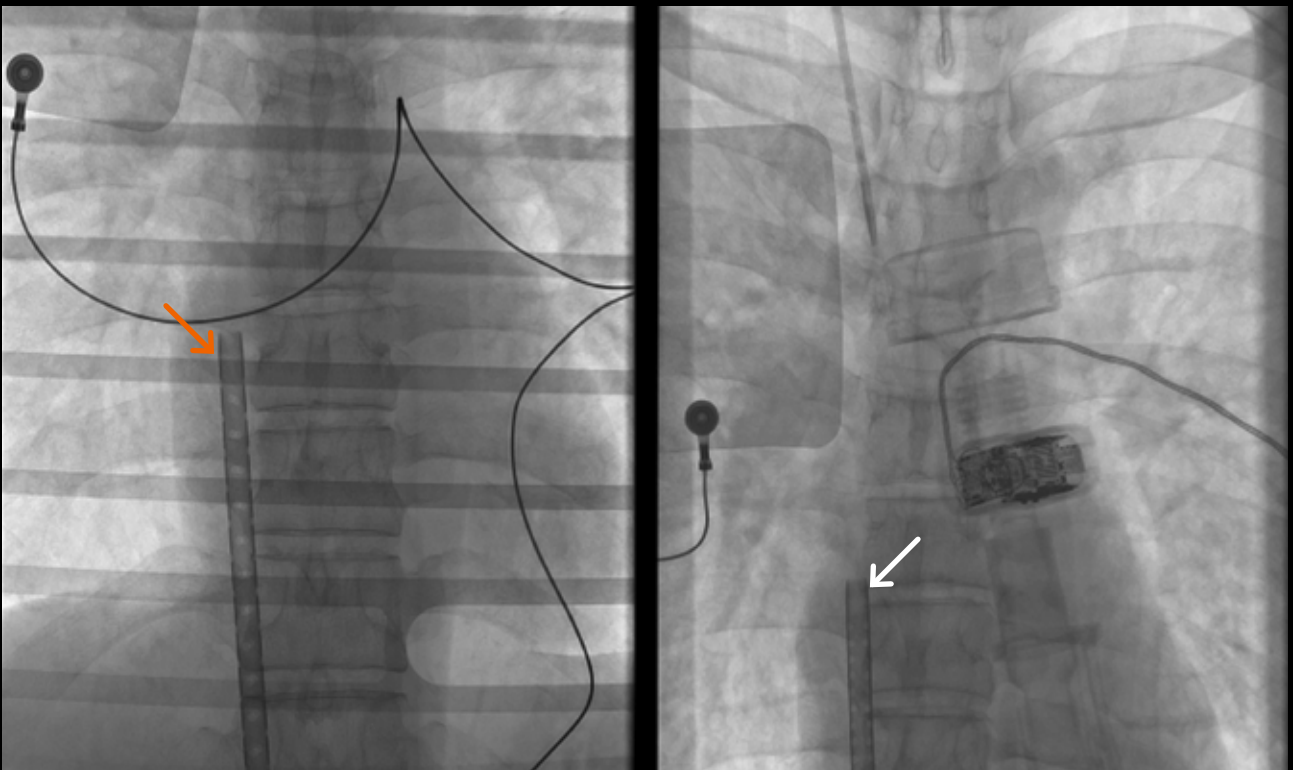


Figure 2
A drainage cannula was inserted via the right femoral vein (orange arrow) and a return cannula was inserted via the right femoral artery (white arrow).

Case Report #3

Thrombotic cerebral infarction

CT imaging, angiography, and endovascular treatment in the hybrid emergency room (HER)



Motoo Fujita, MD, PhD

Patient history

An 85-year-old man was transported to our hospital after experiencing cardiopulmonary arrest preceded by chest pain. Following resuscitation, a noncontrast head CT scan, a contrast-enhanced torso CT scan, electrocardiography, and transthoracic echocardiography were performed. However, no definitive cause directly accounting for the cardiac arrest was identified. In addition, no apparent complications attributable to the cardiac arrest were observed.

After undergoing targeted temperature management, the patient remained clinically stable without major complications and was subsequently monitored in the high care unit. Further evaluation of the preceding chest pain was planned.

Four days after cardiopulmonary resuscitation, although the patient was initially able to communicate verbally, he developed left-sided hemiplegia while under observation, and his level of consciousness deteriorated to a Glasgow Coma Scale (GCS) score of 8 (E2V1M5). The patient's respiratory rate was 19 breaths per minute, pulse rate was 83 beats per minute, and blood pressure was 104/65 mmHg, with no fever. His left upper and lower limbs became completely paralyzed, and his National Institutes of Health Stroke Scale score was 24.

Patient management in the hybrid emergency room

The patient was rushed to the HER, which comprises a CT scanner on rails (SOMATOM Definition AS+, Siemens Healthineers AG, Germany) and a robotic angiography system (ARTIS pheno, Siemens Healthineers AG, Germany), allowing for imaging with both modalities with the same patient table (Maquet Magnus OR Table, Getinge AB, Sweden). The patient was positioned on the operating table, and a diagnostic noncontrast head CT scan (0.75 mm slice thickness) and a contrast-enhanced torso CT scan (0.6 mm slice thickness) were acquired. The door-to-imaging time (DIT) was 2 minutes. CT images revealed a right internal carotid artery C7 segment occlusion. Immediate preparation for angiographic intervention was initiated within the same room, without additional patient movement or repositioning.

Twenty minutes after the diagnosis, a right femoral artery puncture was performed in the HER while the patient remained on the operating table. The door-to-puncture time (D2P) was 22 minutes. Right common carotid artery angiography confirmed occlusion of the internal carotid artery distal to the petrous (C2) segment. Thrombus retrieval by aspiration was performed from the M1 distal region in the first pass using a 4 x 40 mm Solitaire Platinum™ revascularization device (Medtronic, USA). Immediate angiographic imaging confirmed successful recanalization of the anterior and middle cerebral arteries.

The total time from arterial puncture to reperfusion (P2R) was 30 minutes. Immediately after the thrombectomy procedure, the patient regained the ability to move his left upper and lower limbs slightly in response to stimulation. The absence of hemorrhagic complications was confirmed on a follow-up CT scan while the patient was still in the HER. Three days after treatment, the patient's level of consciousness improved to GCS of 13 (E3V4M6), and his upper limb strength improved to a Manual Muscle Testing grade of 3/5.

Comments

The time to initiation of treatment is crucial for successful mechanical thrombectomy, as even small delays may increase the extent of irreversible brain injury and worsen functional outcomes. Therefore, minimizing treatment delays at each step of the treatment workflow is essential.

Several key time metrics have been proposed to evaluate and improve the efficiency of thrombectomy workflows. These include (1) onset-to-hospital arrival time, (2) DIT, (3) D2P, and (4) P2R.

Current stroke guidelines recommend rapid neuroimaging after hospital arrival, typically within 25-30 minutes. In addition, several workflow improvement initiatives have proposed target times such as a D2P of approximately 60 minutes and rapid recanalization after arterial puncture. Although these time thresholds are not uniformly defined in formal guidelines, they are widely used as practical benchmarks for optimizing thrombectomy systems of care. Some hospitals have reported significant reductions in DIT, D2P, and P2R by adapting their treatment system (e.g., by using imaging diagnostics that combine CT imaging and CT angiography).

The multimodality HER, which allows both CT-based diagnosis and angiography-guided treatment without patient movement, can contribute to reducing DIT, D2P, and P2R in acute ischemic stroke patients. A key advantage of the HER in this particular case was the ability to achieve a short D2P without patient transfer, enabling seamless transition from diagnosis to treatment.

Additionally, a well-coordinated multidisciplinary care team (including physicians, nurses, radiologists, and other medical professionals) and established in-hospital protocols are essential to achieve rapid diagnosis, timely treatment, and improved patient outcomes.



Figure 1

The patient's head was continuously moving, which affected the image quality and required stabilization. Noncontrast CT imaging revealed a hyperdense middle cerebral artery sign on the right side, suggesting acute embolic occlusion. CT angiography showed an occlusion in the C7 segment of the internal carotid artery.



Figure 2

No obvious intraparenchymal hemorrhage; the focal hyperdensity likely represents contrast enhancement/staining.



Figure 3
Right common carotid artery angiography confirmed occlusion of the internal carotid artery distal to C2.



Figure 4
Successful recanalization of the anterior and middle cerebral arteries

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