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Case Report

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Recruiting an Acute Coronary Team to Perform Emergent Mechanical Thrombectomy in Acute Ischemic Stroke Patients: A Successful Case and Team Model in a Local Hospital

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Stroke treatment has entered a new era after the publication of multiple randomized trials involving the use of a stent retriever since 2015. In Taiwan, the demand for interventional neuroradiologists to perform mechanical thrombectomy is high. For this reason, providing this standard care requires reshaping of the care model. Here, we report our experience in recruiting an acute coronary care team to perform emergent mechanical thrombectomy, which is essential in a patient with acute ischemic stroke.

Key Words: Basilar artery occlusion • Interventional cardiologist • Stent retriever • Stroke intervention

CASE REPORT

A 73-year-old man presented to the emergency department with a 30-minute history of acute deterioration in his consciousness. The patient experienced a sudden onset of dizziness while awaking from a nap and walked downstairs at home. The dizziness progressed into generalized weakness in all four limbs within 30 minutes. He had no trauma, convulsion, alcohol use, or recent recreational drug use. He was brought by a family member to the emergency department 90 minutes after the onset of dizziness. Upon arrival, he appeared comatose and exhibited a decerebrate posture in response to painful stimuli. He had a history of coronary artery disease (three-vessel disease), a previous myocardial infarction with apical akinesia, hypertension, and dyslipidemia. He had undergone coronary stenting to left anterior descending artery, left circumflex artery, and right coronary artery five years prior. His rhythm was sinus rhythm on multiple occasions. His regular medications included aspirin, clopidogrel, valsartan, and atorvastatin. He was right-handed. He had never smoked and the family denied use of alcohol. His pre-morbid modified Rankin scale was 0.

At the emergency department, his Glasgow coma scale was E2V2M3. His body temperature was 35.8 °C, his pulse rate was 82 and regular, his respiratory rate was 22, and his blood pressure was 128/60 mmHg. The pupils were initially 4 mm and 3 mm with light reflexes in both eyes. The pupillary reflex was then lost in the right eye. His eyes remained neutral in position. The oculocephalic and corneal reflexes were undetectable. His cough reflex remained intact during urgent orotracheal intubation for his coma. There was a symmetrical decrease in bilateral upper and lower limb muscle powers (3 on a scale of 5). The National Institute of Health Stroke Scale (NIHSS) was 31. The patient presented with acute locked-in syndrome. Systemic thrombolysis was contraindicated because of high NIHSS.

Emergent non-contrast computed tomography (CT),

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CT angiography, and CT perfusion imaging confirmed basilar artery occlusion. There was no intracranial hemorrhage. The CT perfusion imaging was considered not interpretable because of multiple artifacts. The acute stroke team and two interventional cardiologists were recruited according to our new acute ischemic stroke intra-arterial (IA) therapy protocol (Figure 1).

Endovascular intervention

At 60 minutes after CT evaluation, the patient was brought to the catheterization room. A puncture was made at the right common femoral artery with a micro-puncture set (Cook, 0.018-inch wire, and a 4-Fr sheath). After confirmation of the puncture location (at common femoral artery and safe for later use of AngioSeal vascular closure device), the micro-puncture sheath was changed to a 9-Fr 15 cm sheath. Angiography was performed using a 5-Fr 100 cm Judkin Right (JR4) catheter with a soft 0.035-inch hydrophilic wire (GlideWire, soft 260 cm, Terumo, Japan). The invasive angiography confirmed a sluggish flow through the right vertebral artery (VA) and occlusion at tip of the basilar artery. The pre-operative CT angiography was repeatedly evaluated to determine intervention strategy. Because the left VA was smaller than the right side, we chose the right VA to place the guiding sheath. The basilar artery size was measured around 3 mm based on CT angiography, so a stent retriever of size 4 × 20 mm was chosen.

We used NeuroMax 088 (90 cm, straight tip, 6 Fr, Penumbra, CA, USA) as the guiding sheath. The NeuroMax 088 is a dedicated neurointervention sheath, with a 9 Fr base and a 6 Fr tip. We then used intracranial support catheter Navien (6 Fr, straight tip, 125 cm, Covidien/Medtronic, Paris, France) and microcatheter Marksman (2.8 Fr, 150 cm, Covidien/Medtronic, Paris, France) to enter the basilar artery. A 300 cm 0.014-inch wire (PT2, Boston-Scientific) was used to traverse the clot. We chose Solitaire FR 4 × 20 mm (Covidien/Medtronic, Paris, France) to retrieve the thromboemboli. The procedure required no heparin bolus injection. We used three bags of heparinized solution (normal saline 1000 ml with 5000 units of heparin) and connected each bag to each catheter, which we placed in the target vessel to provide continuous flushing during the procedure.

We used a direct aspiration first past technique in addition to a stent retriever to facilitate clot removal.[1] The distal true lumen was confirmed with injection via the microcatheter. The stent retriever was deployed through the microcatheter and was allowed to integrate with the clot for five minutes. Then, the aspiration pump (Penumbra system) was activated. The distal access catheter (Navien) was then gradually advanced until the flow stopped. The system was allowed to stay in place for 90 seconds to facilitate aspiration and integration by the stent retriever and the distal access catheter. Then, the whole stent retriever and aspiration catheter were pulled out. After a total of three passes of the Solitaire stent retriever combined with aspiration, a large amount of thromboemboli was retrieved (Figure 2). The flow was restored from thrombolysis in cerebral infarction (TICI) perfusion scale 0 to TICI 3 (Figure 2, panels A and B). The pupil sizes and light reflexes both returned to normal when the patient left the catheterization room. His muscle power dropped to 1 in the left upper and lower limbs during the procedure and returned to 3 at the end of the procedure.

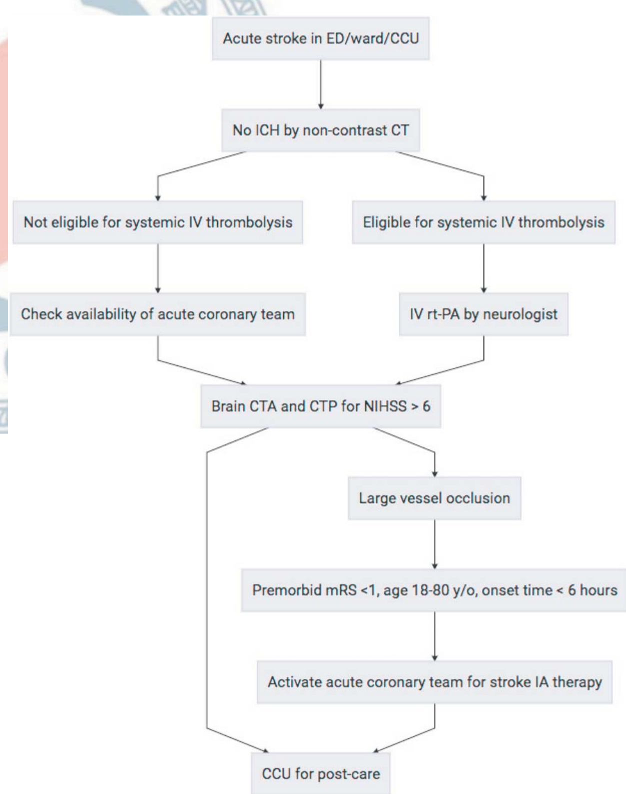

Figure 1. *The Hsinchu stroke team protocol. CCU, cardiac care unit; ED, emergency department; IA, intra-arterial; ICH, intracranial hemorrhage; IV, intravenous; mRS, modified Rankin scale; NIHSS, National Institute of Health Stroke Scale; rt-PA, recombinant plasminogen activator.*

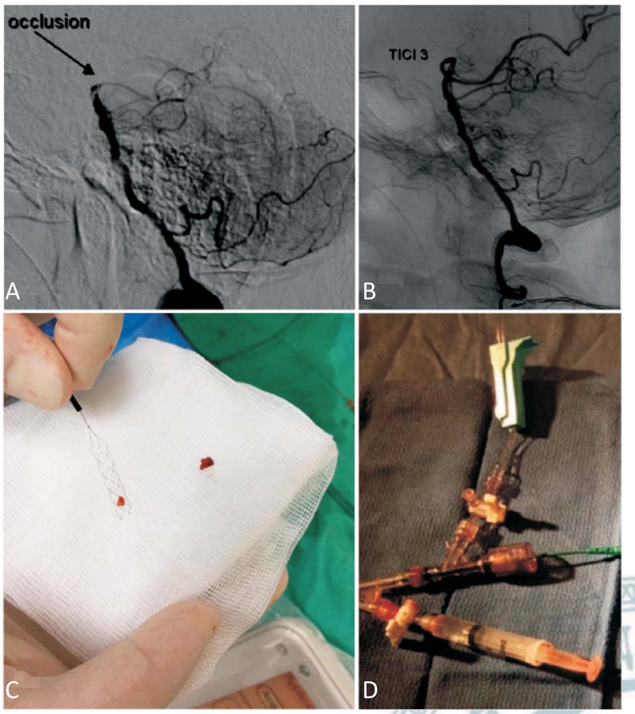

Figure 2. *(A) Before mechanical thrombectomy; (B) After mechanical thrombectomy; (C) Multiple thrombi was retrieved after a total of three passes of the stent retriever combined with aspiration; (D) A dedicated flushing system was connected to each catheter used during intervention.*

Post-catheterization course

The protocol mandates serial studies with non-contrast CT at 0 hour, non-contrast CT at 6 hours, and CT angiography (CTA)/CT perfusion (CTP) at 24 hours. Because the patient had a significant and stable improvement in all elements calculated in the NIHSS, the 0 hour non-contrast CT was skipped. The non-contrast CT at 6 hours showed contrast stasis or asymptomatic intracerebral hemorrhage at brainstem. Aspirin was stopped. The clopidogrel was continued because of the presence of coronary stents. He had a steady improvement despite the worrisome findings on CT follow-up. A magnetic resonance imaging confirmed patent basilar artery at the third day. The bilateral posterior cerebral arteries were also patent. His NIHSS improved from 31 to 10 at 24 hours. He was extubated at 48 hours and was transferred to the ward at day three. The post-intervention course was smooth and he received rehabilitation from day 3. At 14 days, he could get off the bed by himself and was able to walk with assistance from a cane. The modified Rankin scale at 2 weeks was 2.

DISCUSSION

We present a case presented with acute lock-in syndrome due to basilar artery occlusion. Instead of emergent transfer to a tertiary center, the patient benefited from our new care model.

Current evidence to support primary thrombectomy to treat acute ischemic stroke

Since Zeumer reported the first intra-arterial intervention for acute stroke in 1983, there have been tremendous improvements in acute ischemic stroke treatment.[2] In 2015, five reports demonstrated the benefits of mechanical thrombectomy in addition to systemic thrombolysis to treat acute ischemic stroke due to large vessel occlusion.[3-7] Now, clinicians must determine the best strategy to provide efficient care to all eligible patients.

Reasons to recruit an acute coronary team

In Hsinchu, Taiwan, there is no available interventional neuroradiologist. After successfully treating a patient with acute ischemic stroke due to severe left internal carotid artery stenosis in 2014, our cardiovascular team realized that forming a new neurovascular team in a local hospital would be impossible. Furthermore, over the next three years, we anticipated no new neuroradiologist servicing in the Hsinchu city. Therefore, utilizing mechanical thrombectomy to treat acute ischemic stroke, according to current guidelines, would be limited by staff availability. The most cost-effective way to build an acute stroke team would be utilizing the already available acute coronary team. Before this team modeling, there was a case series describing the performance of acute neurosalvage during carotid stenting by interventional cardiologists. As Lin reported in 2010, interventional cardiologists with adequate training could accomplish acute neurosalvage following an appropriate step-by-step protocol.[8] The acute coronary team had already established a response time goal, activation protocol, stable team maintenance budgets, and efficient methods for shortening the activation time. The acute coronary team in the NTUH Hsinchu branch has been providing services since 2006 continuously. The door-to-balloon time is now less than 90 minutes in 90% of cases. Based on the above reasons, we proceed with the following preparation.

Team preparation and the structure of teamwork

A cardiologist was sent to the Toshiba Stroke Center in New York, USA for training. The complete report is available on the web for open access (http://report.nat.gov.tw/). After returning from the United States, he initiated a training program with the cardiology catheterization room staffs. All cardiologists in Hsinchu branch received training to perform selective cerebral angiography. The principal operator has to be familiar with intracranial vascular anatomy including middle cerebral arteries, vertebral arteries, and basilar artery.[9] Every case performed was reviewed with multi-disciplinary team approach.

In our team model, the neurologist activates the team. When an acute stroke is identified, non-contrast enhanced CT is ordered. Systemic thrombolysis is performed by current standard by the decision of neurologists (patients without intracranial hemorrhage (ICH) and presented within 4.5 hours of onset). If the NIHSS is higher than 6, brain CTA and CTP are also ordered as judged appropriate by the neurologists. When large vessel occlusion is identified in the internal carotid artery, middle cerebral artery M1 segment, vertebral artery, or basilar artery (BA), the neurologists may contact the acute coronary team if the patient is eligible by current treatment guideline. Emergent IA mechanical thrombectomy is considered when the patient meets all the following eligibility criteria: premorbid modified Rankin scale < 1, age 18-80 years old, and onset time to estimated puncture time within 6 hours.[10] After the procedure, the neurologist and the cardiologist share the care responsibility in the cardiac care unit (CCU). The team shares a common meeting room and nursing facility. Results of echocardiography, electrocardiography, neurological examinations, and CT image findings are discussed at the bedside.

Caveats of the procedure

Since the procedure is often conducted after systemic thrombolysis, additional heparin is prohibited. We adopt the setup learned from the Toshiba Stroke Center. By using a continuous flushing system we can provide constant flow within all three catheters during the procedure (Figure 2, panel D). Each catheter is connected to one bag of 1000 ml heparinized normal saline (5000 units in each bag). During the procedure, the assistant needs to adjust the flow of flushing solution before and after each new catheter manipulations (either inserting or retrieving any new catheter). To facilitate clot removal, we combined aspiration technique and a stent retriever. Although the trials that have resulted in favorable outcomes all used a stent retriever, the protocols allow the operator to combine it with an aspiration system. There is an in vitro model that supports the use of an aspiration system in addition to a stent retriever to facilitate clot removal and reduce the chance of distal embolization.[11] There are also other reported techniques to facilitate clot removal.[12-14]

Differences between interventional neuroradiology team and cardiology team

We wish to emphasize that endovascular intervention to acute ischemic stroke is an actively developing science and requires more staffs to provide state-of-art care. To fill the clinical demand, interventional cardiologists may be a quick learner for the techniques involved in acute stroke mechanical thrombectomy. Good knowledge about intracranial vessels is very important. Because of different training background, cardiologists have to work in parallel with neurologists or neuroradiologists to identify patients who will benefit from mechanical thrombectomy. In contrast, interventional neuroradiologists can decide the treatment strategy and perform the procedure without assistance or approval from other discipline. The role of interventional neuroradiologists is irreplaceable in tertiary centers. And with a dedicated training process, interventional cardiologists may fill the gap in other resource poor areas. Widimsky and et al. discussed about the differences and similarities of acute ischemic stroke and acute myocardial infarction before the era of stentriever.[15] For interventional cardiologists who are interested in acute stroke therapy, they should be aware that reperfusion injury and reperfusion bleeding are real threats even when the procedure ended successfully by angiography.

CONCLUSIONS

Our case demonstrates that interventional cardiologists and an acute coronary team can be developed from pre-existing staffs to provide time-efficient revascularization in patients with acute ischemic stroke. Further study concerning the efficiency, quality, complications, and outcomes of acute stroke endovascular intervention performed by interventional cardiologists is required.

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No.

CONFLICTING OF INTEREST

None.

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