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Locally Engineered Detachment System Rescuing Aneurysm Coiling when Regular Balt Coil Release Device Used to Detach Balt Coils Had a Technical Error

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ABSTRACT: While performing posterior communicating aneurysm coiling, the framing of the aneurysm was performed but the coil detachment device was having an error which was only known when the coil was released into the aneurysm. The biomedical engineer within the operating room created a twelve voltage power supply circuit which was used to detach all the coils, thus rescuing the situation and saving the patient.

KEY WORD: Aneurysm, Coils, Coil Detachment, Coil Release Device, Twelve Voltage Power Supply.

INTRODUCTION

Annapurna Neurological Institute and Allied Science (ANIAS), is among the pioneer institutes to start neuro-interventional procedures in Nepal.(1) Our team comprises neurosurgeons and radiologists who were trained in neuro-intervention. Biomedical engineers are the part of the team who ensure the smooth functioning of Cath lab machines and all other technical services required during the case. The devices for neuro intervention such as coils, balloons, catheters, etc. are imported from India where the company's staff brings it along with him for the procedure.

Aneurysm coiling is a technically sophisticated surgery which requires a lot of instruments and devices. The imaging is one of the major part of this surgery which is performed under continuous fluoroscopic image guidance of C-arm. Further-more coils, catheters, balloons, dilators and detachment system are the major instruments used during aneurysm coiling.(2)

CASE REPORT

36 years old female presented to the Emergency with a sudden severe headache, multiple episodes of vomiting, and ptosis of the left eye for 10 days. On examination, the patient was well orientated to time, place, and person with GCS 15. Ptosis was present on left eye with the eyeball turned outward and downward. The pupil on the left side was 4 mm Dilated and non-reactive to light.



Figure 1: Pre-operative CT Angio showing aneurysm

CT Scan of the brain showed Subarachnoid Hemorrhage and the angiogram revealed a Left ICA Aneurysm at the communication segment measuring 6*5 mm with a neck measuring 3mm. The patient was planned for an aneurysm coiling. The right femoral artery was accessed with a 5F femoral sheath and diagnostic angiography was performed and then changed to a 7F large sheath, whose tip

was placed in the left ICA with the help of a 0.035 Terumo guidewire and 5F vertebral diagnostic catheter. Fargomax was introduced to the left segment of the ICA. Vasco-microcatheter was introduced to the aneurysm with the help of a micro guidewire. 6 aneurysm coils were introduced using repeated fluoro and DSA protecting the PCOM Aneurysm coiling for the neck.

After releasing the first coil into the aneurysm, we realized the detaching device was misplaced and was not present in time. The biomedical engineer thought of creating a 12 voltage power supply, which was then used to detach the coil. As the current was sent the ECG changes were noticed and detachment was confirmed. Barricade complex finish coils- 3mm 8 6mm, 2.5mm*4cm, 2mm*4cm, 2mm*2cm, 1.5mm*2cm, 1.5mm*2cm. Altogether 6 coils were used.

After coiling DSA was done which showed no vascular compromise. The 7F long sheath was enlarged to 8F short Sheath and the patient was shifted to ICU. Her postoperative stay was uneventful and she gradually improved and was discharged.

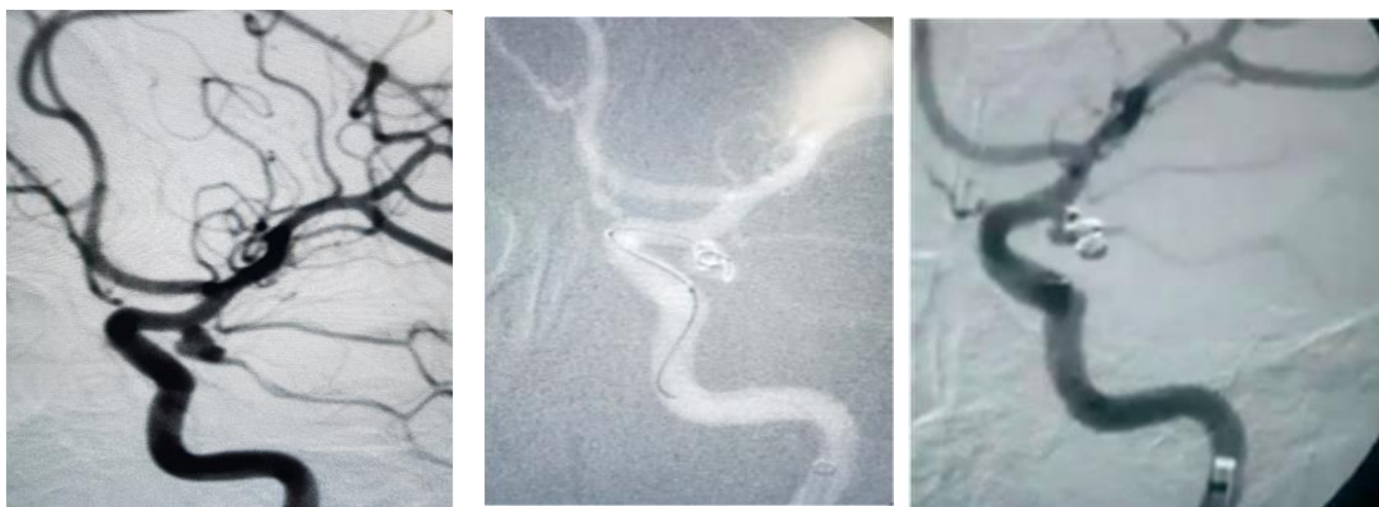


Figure 2: Intra-operative images showing the process of coiling.

DISCUSSION

Normal operation of a coil release device:

After the microcatheter carrying coil on its tip is deployed to this target and ready to be detached, it is fed with a small charge from the other end, through a coil release device. The microcatheter is double lumen in structure and carries the charge up to the breaking point. There is a small breaking point between the microcatheter and coil which breaks to release the coil in the target when the current is passed i.e. 9v in our case. The coil release device has two parts: a coil detachment cable and a power supply. The former part is the detachment cable, which is attached to the microcatheter and is connected to the power supply on the other end. The power supply provides all the necessary power required for coil release.(3)

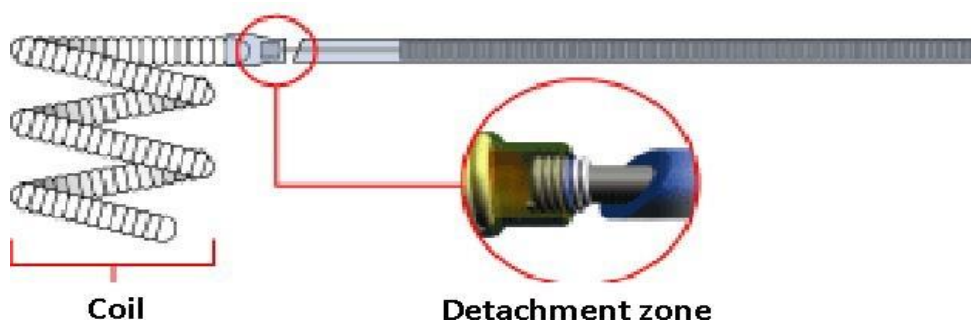


Figure 3: Typical coil detachment system

The solution to our problem:

In our case, all of the required parts were available except for the technical error with the power supply box. The voltage required for the coil release was 9v or higher. The negative and positive parts of the coil detachment cable were identified and cut, to expose the wire. The negative wire of the detachment cable was connected to the positive part of our self-built power supply and the positive part to our negative - as per the configuration provided by the company's technician. The exposed wires were soldered together by a soldering rod and insulated to ensure a safe work environment inside the operation room.

The power supply we built was 12v (due to limited supplies during an emergency), while the required was 9v or higher. 9v was supplied in the first place through 9v battery power but no action was seen. So, we opted for a 12v power supply.

12v Power Supply:

The mains line with 220V 50 Hz AC signal is first connected to the stepdown transformer. The transformer brings down the voltage to a 12V AC signal. The downgraded AC voltage is fed to a bridge rectifier consisting of four PN junction diodes, which converts the AC signal to a DC signal. However, thus obtained DC is not constant 12V but is fluctuating and has ripples. A 470 μ f capacitor acts as a filter to eliminate the ripples and produce a steady voltage. To ensure the voltage to be exactly 12V, the LM7812 voltage regulator is used. The output from the LM7812 is the required 12V DC.

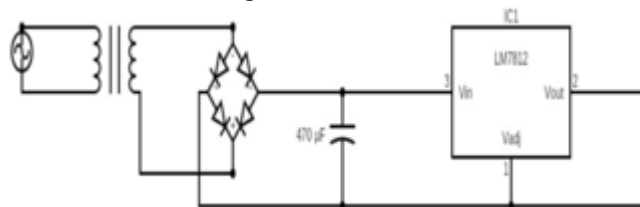


Figure 4: 12V power supply schematic diagram

CONCLUSION

Though the company provided detachment system had a technical error, based on its working principle, biomedical engineers working alongside the surgical team designed a system that was able to detach the coil from the catheter. The locally and promptly designed system helped to rescue the patient from any sort of emergency.

ACKNOWLEDGMENT

The coiling surgery is always performed in team and teamwork is most important during the operation. Besides Doctors, Radiologist, Interventionist and Biomedical Engineers, there are Operation theatre nurses, anesthesiologist and medical assistant working with the team in ANIAS. We would like to appreciate everyone's contribution during this surgery.

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