Novel Use of Dual-Lumen Catheter for Irrigation and Drainage After Evacuation of Chronic Subdural Hematoma

Diem Kieu Tran[1], Peter Tretiakov[1], Julia Brock[2], Jefferson Chen[1], Sumeet Vadera[1]

Key words
- Chronic
- Drain
- Evacuation
- Hematoma
- Subdural

Abbreviations and Acronyms
cSDH: Chronic subdural hematoma
CT: Computed tomography
POD: Postoperative day

From the [1]Department of Neurological Surgery, University of California, Irvine; and [2]Department of Neurological Surgery, University of California, Los Angeles, California, USA

To whom correspondence should be addressed:
Diem Kieu Tran, M.D.
[E-mail: diemkt@uci.edu]

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BACKGROUND: **Chronic subdural hematoma (cSDH) is an intracranial pathology most commonly affecting elderly patients. Patients may present with worsening headache, seizures, weakness, balance and gait problems, and memory deficits. Even in patients undergoing hematoma evacuation, there is a substantial risk for recurrence. The authors present the first use of an irrigating external ventricular drain in the United States in the perioperative management of a patient with cSDH treated with craniotomy (IRRAS, Stockholm, Sweden).**

CASE DESCRIPTION: **An 82-year-old male presented with right-sided weakness, confusion, and right-sided neglect with expressive aphasia. He was found to have a large 2.5-cm cSDH with a 9-mm left-to-right midline shift. The patient was treated with a minicraniotomy to evacuate the hematoma and placement of an irrigating drain in the subdural space. The patient was discharged home on postoperative day 3 without complication. He was at neurologic baseline 2 weeks later on follow-up.**

CONCLUSIONS: **The use of an irrigating drain for perioperative management of cSDH is a novel means to prevent recurrence and warrants further exploration.**

INTRODUCTION

Chronic subdural hematoma (cSDH) is a common pathology that affects 1–5 per 100,000 individuals annually.[1] After cSDH development, natural physiologic sequelae lead to a gradual enlargement of the cSDH, primarily through formation of a subdural neomembrane.[2] Patients may present with a multitude of different symptoms including headache, seizures, focal deficit, gait difficulty, and memory deficits. Traditionally, cSDH can be treated with surgical evacuation when symptomatic or close observation when minimal symptoms present, but optimal treatments remain a topic of debate. The standard treatment for cSDH is burr hole evacuation, which can be performed in the operating room or at the bedside.[3] The use of a subgaleal or subdural drain after burr hole evacuation has been shown to be safe and reduce recurrence rates of cSDH, with no difference in recurrence rates between the 2 types of drains.[4-9] In a separate study, the recommended treatment was burr hole drainage with irrigation of the fluid, followed by drainage with a closed-system drainage.[10] The use of subgaleal drains with external ventricular catheters has proven beneficial in preventing reaccumulation of subdural fluid.[11] Ou et al[12] recommend exhaustive drainage of a subgaleal drain with injection of urokinase as a method to minimize rates of recurrence.

The authors present the first use of the IRRAflow irrigating drainage system

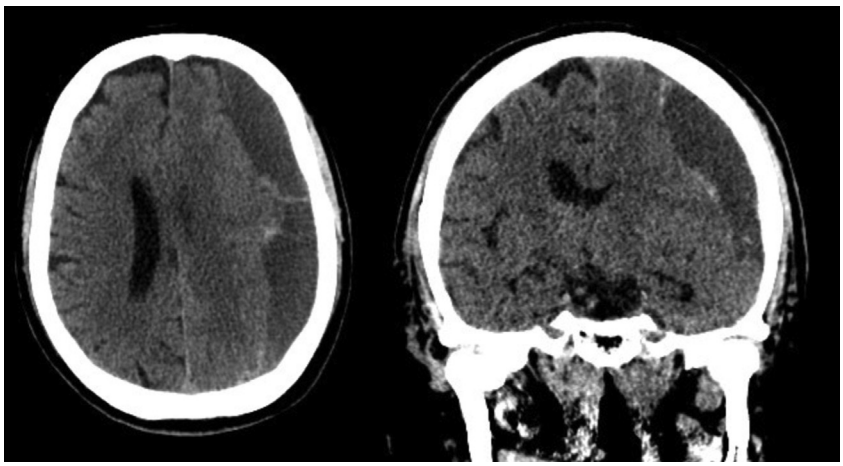

Figure 1. Preoperative axial and corona head computed tomography shows 25-mm thick mixed attenuating left extraaxial hematoma causing 9 mm rightward midline shift and subfalcine herniation.

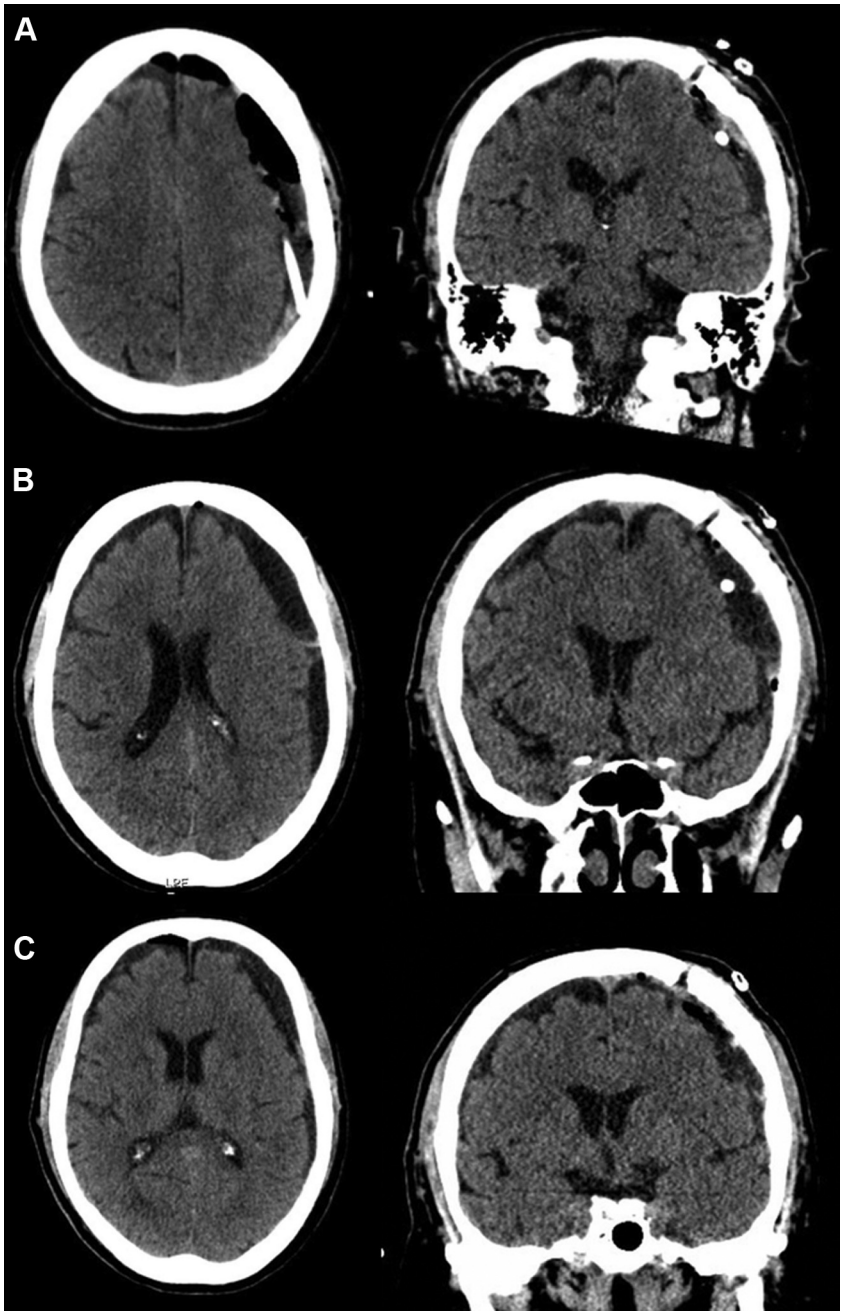

Figure 2. (**A**–**C**) Axial and coronal head computed tomography (CT). (**A**) Postoperative day 1 scan shows pneumocephalus measuring up to 20-mm thick along the left frontal convexity and 11-mm thick residual extraaxial fluid/hemorrhage along with persistent 9-mm rightward midline shift and subfalcine herniation. (**B**) Postoperative day 2 scan shows stable 11-mm thick residual extraaxial fluid/hemorrhage and decrease in rightward midline shift now measuring 5 mm with improvement of subfalcine herniation. (**C**) Postoperative day 3 axial and coronal head CT shows 5-mm thick residual extraaxial fluid collection with no midline shift.

(IRRAS, Stockholm, Sweden) for perioperative management of a chronic subdural in a patient who underwent craniotomy and hematoma evacuation.

CASE PRESENTATION

An 82-year-old male presented with confusion, right-sided weakness and neglect, and expressive aphasia. Physical examination revealed dysarthria, mild word-finding difficulties, and 4/5 strength throughout his right side with a right-sided pronator drift. The patient stated that he fell 2 months before presentation and was not taking any anticoagulants. Laboratory values were all within normal limits. Computed tomography (CT) of the brain showed a 2.5-cm left convexity mixed-density extraaxial hematoma causing 9-mm rightward midline shift and subfalcine herniation (Figure 1). The patient was treated with minicraniotomy for evacuation of the subdural hematoma due to the large cSDH size and because the patient was symptomatic. During surgical evacuation of the hematoma, it was noted that the brain did not reexpand significantly and therefore, the IRRAflow irrigating drain system was placed in the subdural space. The drain was set to drain at a pressure of 5 cm H_2O and irrigating at a rate of 10 mL/hour of normal saline. Computed tomography (CT) scan on postoperative day (POD) 1 showed extensive pneumocephalus and residual 11-mm subdural fluid collection along with a persistent 9-mm midline shift (Figure 2A). At this point, the decision was made to lower the drainage pressure to −5 cm H_2O and increase the irrigating rate to 90 mL/hour. CT scan on POD 2 showed improvement in subdural fluid collection now measuring 7 mm with a 2-mm midline shift (see Figure 2B). The drain was removed that afternoon, and the patient was discharged on POD 3. Head CT done before discharge showed continued improvement in subdural fluid collection and complete resolution of the midline shift (Figure 2C). The patient was seen on POD 14 with complete resolution of symptoms (Figure 3).

Operative Technique

The patient was positioned supine with the head turned toward the opposite side of the subdural hematoma. The epicenter of the subdural was located and marked. An incision was marked and a minicraniotomy ≈5 cm in size was created. Copious irrigation was performed until no further clot was identified. The inner membrane was opened, and edges were coagulated. At this point, it was noted that the brain was not reexpanding, so the IRRAflow (Figure 4) drain was inserted into the subdural space and connected to

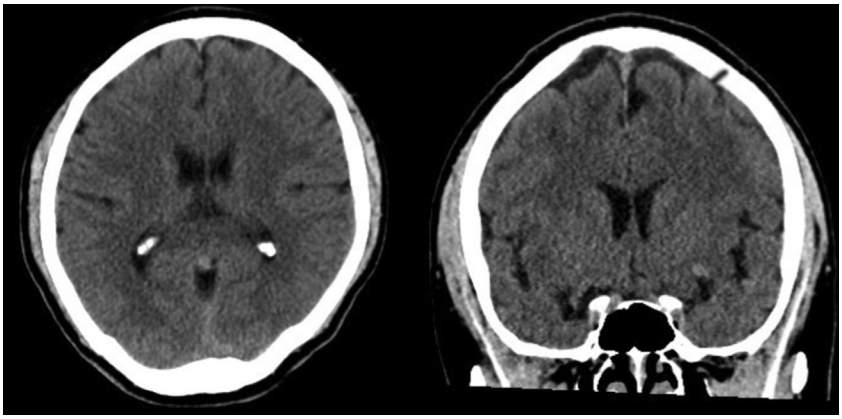

Figure 3. Postoperative day 14 axial and coronal head computed tomography shows complete resolution of subdural hematoma.

the pump system. The dura was loosely closed, and the bone flap was replaced. The drain was set to drain at 5 cm H_2O and an irrigation rate of 10 mL/hour of fluid.

DISCUSSION

Chronic subdural hematoma is a common neurosurgical condition; however, treatment paradigms are still a topic of much debate. There is no uniformity about which strategies are best, such as the role of burr hole, twist drill, or craniotomy, in cSDH among neurosurgeons. There is also no uniformity over use of irrigation or drains.[13,14] Although irrigation and drainage protocols have been developed and described, this is the first use of an IRRAflow irrigation and drainage system for cSDH described in the United States.

There has been considerable evidence supporting the use of external drains after the evacuation of subdural hematomas.[15-19] The drains significantly reduce the recurrence rate of subdural hematoma.[5] There are many benefits of a closed irrigation and drainage system when compared with other protocols that have been described. The main benefit is that because the device incorporates an irrgation port connected to a pump, there is no need for routine flushing of the drain, which can be a nidus for infection. There is also a theoretical benefit to continuous irrigation and drainage of the subdural space with small amounts of irrigation when compared with sporadic injections performed at varying time points. In this case, we found that increasing the rate of irrigation and drainage caused a radiologic decrease in the size of the residual SDH postoperatively. Having the ability to adjust the amount of irrigation provides additional control of the system and allows for custom treatments based on imaging studies and clinical symptoms.

This catheter is a new, intelligent, and automated fluid exchange system that allows for the active management of intracranial pressure and cerebrospinal fluid. IRRAflow is the first dual-lumen catheter design to be employed in fluid management and allows for the previously passive, gravity-driven process of drainage to become active. This new design allows for the immediate drainage of excess fluid, a step of paramount importance as it results in a lower risk of a subsequent stroke. Previously, external ventricular drains had to be monitored for possible occlusions and replaced or flushed manually, when necessary. The IRRAflow automates this process, allowing for more continuous treatment. The system follows an irrigation and aspiration cycle continuously, thereby ridding the system of possible occlusions before they can form fully. Replacement of the catheter is then no longer necessary, and this creates a closed system of treatment, which can reduce risk of infection.

There is obvious evidence that irrigation works in treatment of chronic subdural.[20,21] With the use of this external ventricular drain, there is continuous irrigation and drainage, which can help reduce the residual subdural fluid from surgery.

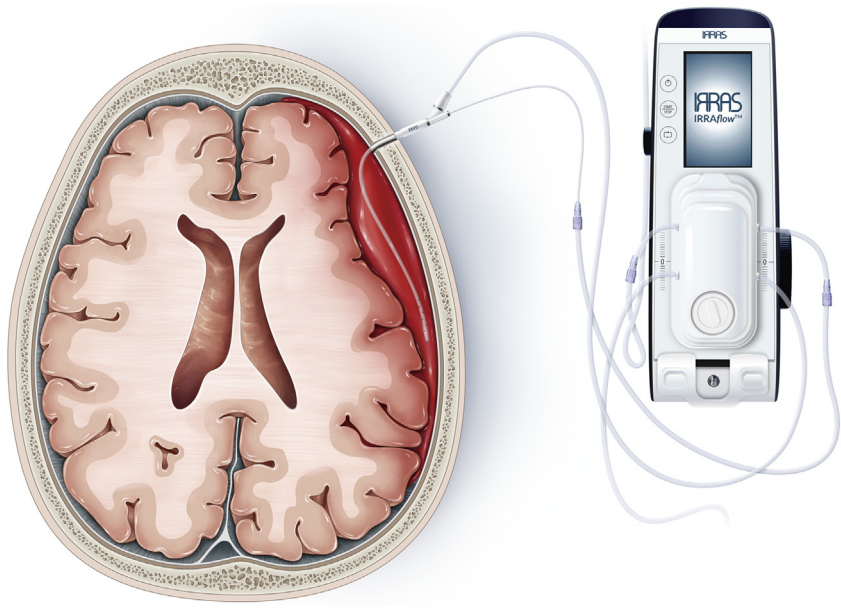

Figure 4. Schematic diagram of the IRRAflow drain and pump inside the brain.

CONCLUSION

Chronic subdural hematomas are one of the most common neurosurgical

pathologies but can be difficult to completely treat given the high recurrence rates. The use of a dual-lumen catheter with irrigation and drainage capabilities can effectively treat and prevent reaccumulation of the subdural fluid.

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