



# Duret Hemorrhage after Extradural Hematoma Evacuation—A Rare Entity

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## Abstract

### Keywords

- ▶ Epidural hematoma
- ▶ extradural hematoma
- ▶ Duret hemorrhage
- ▶ craniotomy
- ▶ postoperative complications

Traumatic brainstem injury can be classified as primary or secondary. Secondary brainstem hemorrhage that evolves from raised intracranial pressure (ICP) and transtentorial herniation is referred to as Duret hemorrhage. We report a 25-year-old male who underwent emergency craniotomy, with evacuation of acute epidural hematoma, and postoperatively developed fatal Duret hemorrhage. Duret hemorrhage after acute epidural hematoma (EDH) evacuation is a very rare complication and the outcome is grave in most of the cases.

## Introduction

Brainstem hemorrhage is commonly reported from an autopsy series in severely head-injured patients. It can be primary or secondary. The former arises because of impact at the time of injury and the latter occurs due to raised intracranial pressure (ICP) and transtentorial herniation.<sup>1,2</sup> The latter type is known as Duret's hemorrhage after Henri Duret, a nineteenth-century French surgeon who worked in Charcot's laboratory in Salpêtrière Hospital in Paris.<sup>3</sup> The sudden downward movement of the brainstem against a relatively fixed and immobile basilar artery is a key step in the pathogenesis of a Duret hemorrhage.<sup>4,5</sup> Duret hemorrhage has been rarely reported in extradural hematoma (EDH). We report such a case in a patient whose EDH was evacuated.

## Case Description

A 25-year-old young adult presented to the surgical emergency department with an alleged history of fall from the rooftop approximately 12 feet in height. On neurological examination,

his Glasgow coma scale (GCS) score was E1V1M5 with right anisocoria. CT head showed right temporoparietal acute EDH with mass effect and midline shift (▶ **Fig. 1**). He underwent right temporoparietal craniotomy with evacuation of EDH. He was shifted to the intensive care unit (ICU). His anisocoria reverted to normal but his GCS did not improve. A postop check CT was done, which showed complete evacuation of EDH, but the patient had developed a right temporal small contusion with brainstem hemorrhage (▶ **Fig. 2**). The patient remained comatose and died 5 days later.

## Discussion

Traumatic brainstem injury can be classified as primary or secondary. Primary brainstem injury occurs at the time of injury, frequently identified on initial imaging, and the most common type is diffuse axonal injury from acceleration/deceleration inertial injury at the midbrain due to the impact by tentorium or clivus and sometimes also secondary to hyperextension of the cervical spine which contuses the lower brain stem.<sup>5-7</sup>

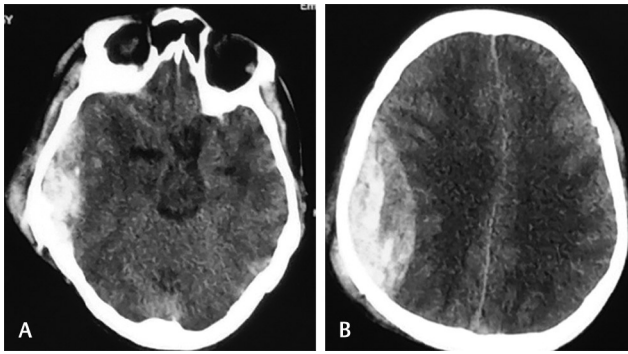
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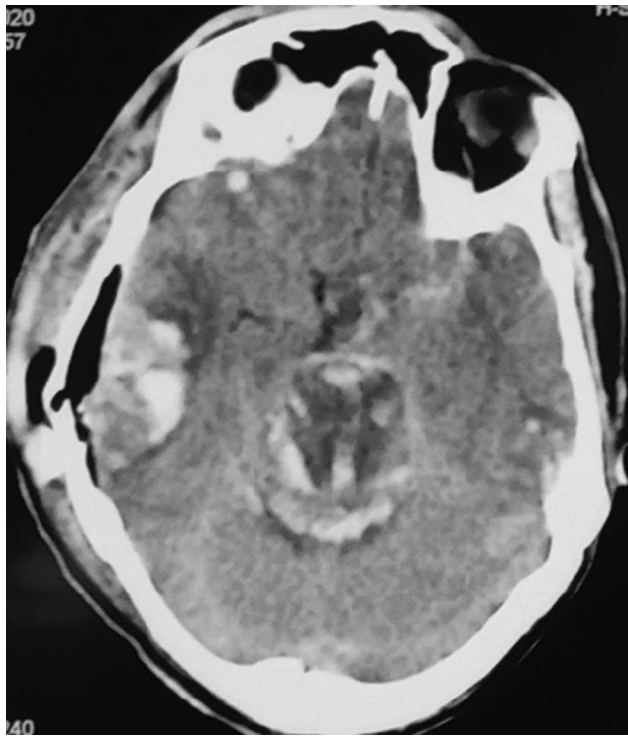
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**Fig. 1** CT head showing right mixed density temporoparietal extradural hematoma (A) with normal brainstem (B)



**Fig. 2** Postop CT head showing small right temporal contusion with brain stem bleed

Secondary brainstem injury can be hemorrhagic or ischemic.<sup>5</sup> The majority of primary brainstem injuries are located in the dorsal and dorsolateral aspect of the brainstem, whereas secondary brainstem hemorrhage, also known as Duret hemorrhage,

develops during downward cerebral herniation due to raised ICP from a mass lesion.<sup>4</sup> There is a predisposition for involvement in median rostral pons and ventral tegmentum of the midbrain in secondary brainstem hemorrhage.<sup>8</sup> Differentiation between primary and secondary brain stem hemorrhage may be challenging, since Duret hemorrhages may occur within half an hour of the initial trauma.<sup>4</sup> In our case, the brainstem hemorrhage was considered secondary, as it was not present on the initial CT scan, and the postoperative CT scan showed bleed in the midline and ventral aspect of the brainstem.

The possible pathogenesis of Duret hemorrhage has been controversial. When the brain stem is displaced inferiorly, the basilar artery and its paramedian pontine perforating vessels remain relatively fixed; this may cause the latter to shear and lead to hemorrhage.<sup>4,9,10</sup> This assertion is supported by studies of raised ICP induced by inflation of intracranial balloons in canine models. As the brainstem moves downward, stretching and disruption of paramedian pontine perforating arteries may directly lead to hemorrhage.<sup>11</sup> On the other hand, since veins are more compressible than arteries, a herniation may lead to venous congestion and subsequent hemorrhagic infarction at the rostral brain stem.<sup>9,10</sup> However, an element of hemorrhage may be linked to reperfusion injury also, as there have been reports of brain stem hemorrhages after surgical decompression.<sup>12</sup> We believe that in our patient, it was a reperfusion injury that led to Duret hemorrhage, as the initial CT scan done within 1 hour of injury was not showing brain stem bleed. We operated within one and a half-hour of injury, and his anisocoria got corrected and he got saved from tentorial herniation.

To the best of our knowledge, only two cases of Duret hemorrhage after the evacuation of EDH have been reported before, and ours is third in the literature (►Table 1). Duret hemorrhage has been considered an irreversible brain stem event with high morbidity and mortality, sometimes discouraging continuation of care.<sup>4</sup> However, early withdrawal of care eludes a true assessment of outcomes for such lesions. There have been rare instances in the literature that document good functional outcomes.<sup>11</sup> Primary parenchymal injury may also have a significant influence on the prognosis than Duret hemorrhage alone as suggested by Ishizaka et al.<sup>9</sup>

## Conclusion

Duret hemorrhage after the evacuation of acute EDH is a very rare complication. It is an ominous sign, as the outcome in most of the patients is grim.

**Table 1** Showing the profile of two previous cases of EDH with Duret hemorrhage

Case	Authors	Year	Age/Sex	Mechanism	Treatment	Outcome
1	Fujimoto et al <sup>6</sup>	2000	44/F	Craniotomy for CSF leak repair, followed by acute EDH	Craniotomy with evacuation of EDH	Discharged with only confusion, ocular bobbing, and bilateral internuclear ophthalmoplegia
2	Gregory et al <sup>12</sup>	2010	58/M	Hit by a motor bike	Craniotomy with evacuation of EDH	Brain dead
3	Present case	2020	21/M	Fall from a rooftop	Craniotomy with evacuation of EDH	Died

Abbreviations: CSF, cerebrospinal fluid; EDH, extradural hematoma.

**Conflict of Interest**

None declared.

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