

Hypodense area within epidural hematoma in brain CT scan; Prediction of active bleeding in epidural hematoma

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Abstract: Background: One of the most important factors in management of patients with epidural hematoma is the existence of hypodense area within the hematoma (SWIRL sign) in brain CT scan. This finding can be the sign of active bleeding and developing the hematoma. Purpose: Study the value of brain CT scan of the patients with epidural hematoma in order to predict the possibility of expansion of the hematoma because of active bleeding. Method: 49 patients with traumatic epidural hematoma entered the study and divided in to 2 groups. Group A was those with epidural hematoma who had indications for immediate craniotomy such as significant midline shift, large size of hematoma, epidural hematoma due to hydrocephalus and etc, and group B was that small or moderate size of epidural hematomas that were kept under close observation without surgery.

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1. Introduction

Epidural hematoma, one of the most life threatening events, presents in 1-2% of the head trauma patients (Mishra and Mobanty, 2001). Bleeding is usually from vessels near the fractures, especially the arteries, which an appropriate homeostasis will result in a good prognosis for the patient. Over all, epidural hematoma has a fatal rate of 15-20% (Sandres and Mckenna, 2001). One of the major reasons of mortality following the epidural hematoma is its development and speed of expansion (Singh and Stack, 2006). Expanding of the epidural hematoma is reported in the first 24 hrs in 90% of the patients (Hardman, 1979).

To estimate the amount of expanding of hematoma there are some factors including: source of hematoma (artery or vein), spasm in the ruptured vessel, Walled off vessel by packed bloods, decompression of the hematoma by the fractured bone (Zimmerman and Bilanuk, 1982).

All the clinical and para-clinical findings which help to understand, the possibility of expanding of the hematoma earlier would be a benefit in the management of the patients. Computed Tomographic CT scan is a valuable imaging method in order to evaluate the head trauma patients with epidural hematoma. CT results vary depending on the source of bleeding (artery or vein), time interval between injuries and doing CT, bleeding's rate, formation of clots and active bleeding (Nizar and Al-

Nakshabandi, 2001). Active bleeding and fresh blood in the clotted area in brain CT (Swirl Sign) will manifest as a lower density area regarding to the density of the clotted hematoma (Picture 1) (Nizar and Al-Nakshabandi, 2001). This formation is predictor of continuous bleeding, the possibility of expansion of hematoma and high pressure over parenchyma of the brain. The goal of this article is to see how much important is to care carefully about this sign in hematomas who had no indications of surgical evacuation; Also, we would like to estimate the existence of active bleeding vessel during surgery and the possibility of hematoma expansion in these 2 groups.

2. Material and Methods

a. Study Design

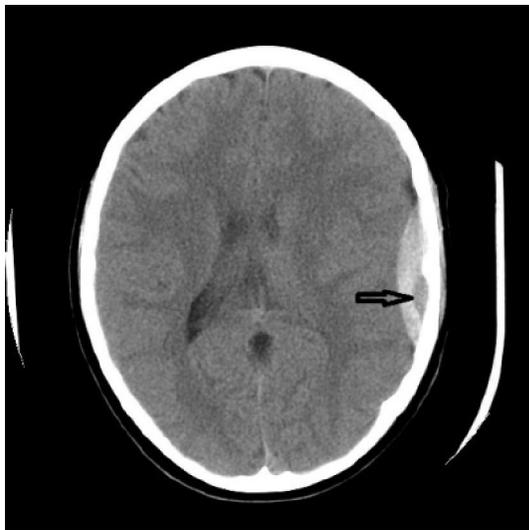
Trauma patients with epidural hematoma in their brain CT scan, who referred to Emergency Room, were studied. Patients with the past history of coagulopathy were excluded. Finally, forty-nine patients were classified in two groups, A and B. Group A, included all the patients transferred to OR and group B, included all the patients underwent close observation in the neurosurgical ICU. This selection was based on the patients Glasco Coma Scale (GCS), hematoma size, midline shift, hydrocephalus or indication of immediate operation in order to evacuate the hematoma and making homeostasis. All the patients in the operating room

were evaluated for any bleeding vessel following craniotomy. In group A patients with evidence of hypodense area in hyperdense epidural hematoma (SWIRL sign; indicating active intra hematoma bleeding) in primary brain CT Scan were compared to the patients without SWIRL sign in terms of presence or absence of active bleeding vessel following craniotomy.

In group B, the increase in epidural hematoma size in the second brain CT scan within 24 hours of patients with positive SWIRL sign was compared to that of the patients with negative SWIRL sign.

b. Outcome Measurements and Statistical analysis

The significance level was set at 0.05. Statistical analyses were conducted using SPSS15.0 (SPSS Inc, Illinois, and USA). Statistical analysis was conducted consisting of student's t-test. Correlation between bleeding mark in the CT and the need for surgery and other qualitative predictions was conducted using binary logistic regression.



Picture 1

3. Results

Totally forty-nine patients were included in this study. The mean age was 31.43 ± 15.79 years old. The mean of maximum diameter of hematoma in brain CT scan of patients with negative swirl sign was 11.95 (SD=8.40) and was 21.80 (SD=8.40) in the patients with positive swirl sign ($p < 0.05$).

Among the patients, 61.2% (30 patients) transferred to the OR for emergent craniotomy (Group A) and all of them had positive swirl sign in their brain CT scan and of these patients 90% (27 patients) had obvious active bleeding artery within the hematoma during craniotomy. There was

considerable correlation between transferring to the OR and existence of swirl sign. Patients that did not transferred to the OR underwent close observation in the ICU (38.8%; 19 patients) (Group B), and delayed CT scan was taken within 24 hrs. In group B with 19 patients, 21% had SWIRL sign. All the patients with positive swirl sign (4 patients) had increasing size of hematoma in their second brain CT scan and 3 patients of them transferred to the OR within 24 hrs of admission. 79% of patients in group B had epidural hematoma without SWIRL sign in primary brain CT scan. Of those with negative swirl sign, only 20% (3 patients) had increasing size of hematoma in their second controlled brain CT scan ($P < 0.05$).

4. Discussions

Epidural hematoma is one of the most important and significant emergencies which is treatable in the rapid diagnostic settings. Regarding to the arterial source of the bleeding under the skull bone, the continuous of bleeding leads to the high pressure over the parenchyma and ends in death. Estimation of the continuous or active bleeding in this group of patients is a key point to undergo surgery and make homeostasis. In the patients with epidural hematoma less than 15 mm and lack of any indication for immediate surgery, any sign of active bleeding in the hematoma and no packing sign of the bleeding vessel by the hematoma will necessitate evacuation of the hematoma and make homeostasis. Also, physicians should take care of the hospitalized patients in the ER or ICU precisely. The hypodense area in the hyperdense epidural hematoma (swirl sign) can be a predictive of active bleeding in the hematoma. Helmet et al. showed that active bleeding in the epidural hematoma makes an aneurismal sac or swirl sign. Similar to our study in which 56.5% of the hematomas had swirl sign, in Helmer and Zimmerman study, 58% and 57.7% of the hematomas had this sign, respectively (Zimmerman and Bilanuk, 1982; Nizar and Al-Nakshabandi, 2001). All the patients with the immediate surgical indication who transferred to the ER had the positive swirl sign. Of these patients, 90% had the obvious bleeding during craniotomy; this is in agreement with Al-Nakshabandi et al. who reported 84.6% in their study over 13 patients with epidural hematoma with hypodense area in the hyperdense clot (Nizar and Al-Nakshabandi, 2001).

Transferring the patients to the ER and take this image, meanwhile, the primary bleeding will be organized and the clot will be formed. Any hypodense area in the organized clot would be the mark of active bleeding or possibly, a bleeding vessel.

In patients with coagulopathy, there is the risk of developing hematoma and active bleeding.

Conclusion

In the CT of the patients with head trauma, hypodense area in the epidural hematoma is a serious caution of developing bleeding and existence of an active site of bleeding in the hematoma. Also, swirl sign can be placed as an immediate indication for surgery of epidural hematoma.

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