

# The Value of Sequential Computed Tomography Scanning in Anticoagulated Patients Suffering From Minor Head Injury

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**Background:** Since 1999, the Italian guidelines have been used at our department for the management of patients with mild head injury (MHI). According to these guidelines, a computed tomography (CT) scan should be obtained in all patients with coagulopathy and these should routinely undergo strict observation during the first 24 hours after injury; in addition they should have a control CT scan before discharge. With the increased use of anticoagulant therapy in the elderly population, admitting patients in such treatment with a MHI to the emergency rooms has become very common. The aim of our study was to evaluate the need of performing a control CT scan in patients on anticoagulation treatment who showed neither intracranial pathology on the first CT-scan nor neurologic worsening during the observation period.

**Methods:** We prospectively analyzed the course of all patients on anticoagulation treatment consecutively admitted to our unit between October 2005 and December 2006 who suffered from a MHI and showed a normal initial CT scan. All patients underwent strict observation during the first 24 hours after admission and had a control CT scan performed before discharge.

**Results:** One hundred thirty-seven patients were included in this study. Only two patients (1.4%) showed hemorrhagic changes. However, neither of them developed concomitant neurologic worsening nor needed admitting or surgery.

**Conclusion:** According with our data, patients on anticoagulation treatment suffering from MHI could be managed with strict neurologic observation without routinely performing a control CT scan that can be reserved for the rare patients showing new clinical symptoms.

**Key Words:** Traumatic brain injury, Anticoagulation, Outcome, Mild head trauma.

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More than 1.5 million people are treated for head injuries annually in the United States. A majority of injuries are minor, but the optimal evaluation and treatment protocol of this large group of patients remain controversial.<sup>1</sup>

Computed tomography (CT) of the head is frequently ordered for patients receiving anticoagulation who have a history of either fall or trauma. Determining what patients with mild head injury (MHI) require emergency CT scan

while they are in the emergency department is still controversial.<sup>2</sup> This controversy is based on the need to identify immediately those patients who are at risk of developing posttraumatic intracranial hemorrhage while balancing the need to decrease medical costs by reducing unnecessary imaging studies.

Warfarin anticoagulation is prescribed with increasing frequency to prevent extracranial vascular disease and thromboembolic complications of atrial fibrillation, deep venous thrombosis, and cardiac valves surgery.<sup>3</sup> Because most of these medical problems are found in the elderly, as the aging population increases, the use of anticoagulation also does.

The risk of spontaneous intracranial hemorrhage in association with anticoagulation has been well documented. In addition, it has been held for a long time that mortality and morbidity from traumatic brain injury are significantly increased in anticoagulated patients.<sup>4</sup> However, the role played by pre-morbid anticoagulation in the outcome of patients with head injuries remains undetermined. In any case, considering that head injury is the fifth leading cause of death due to neurologic disorders in the elderly and that this is a large and growing population, it must be recognized that we are dealing with a serious clinical problem.

Since 1999, the Italian guidelines have been used in our department for the management of patients with MHI.<sup>5</sup> Accordingly, a CT scan is obtained in all patients with coagulopathy, who after being placed under close observation during the first 24 hours after head injury, should also have a control CT scan before discharge. Taking into account the rapidly increasing number of elderly patients exposed to anticoagulation who are admitted to the emergency departments, we designed this study to evaluate whether it is useful to perform a control CT scan before discharge in anticoagulated patients with a MHI showing no clinical deterioration during the observation period.

## PATIENTS AND METHODS

We prospectively included in this study a total group of 137 patients consecutively admitted to our unit between October 2005 and December 2006 who suffered from a MHI while being on anticoagulation treatment. Other eligibility criteria were age older than 16 years, suffering from trauma within the last 48 hours before admission to the hospital, and showing a normal initial CT scan. MHI could be associated or

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not with a documented loss of consciousness or evidence of posttraumatic amnesia, but the patients had to score 14 to 15 in the Glasgow Coma Scale (GCS) at emergency department. Anticoagulation therapy, present in all cases, was defined as current treatment with heparin or warfarin and three patients were also antiaggregated with aspirin. Demographic data and all initial and subsequent hematologic and neurologic examinations (GCS score, mechanism of injury, reason for anticoagulation, the presence of symptoms as headache, vomiting, loss of consciousness and posttraumatic amnesia, and sensory or motor deficits) were collected by neurosurgery residents.

Eligible patients underwent a noncontrast cranial CT scan using a helical CT scanner following a standardized protocol. The results were interpreted by the radiology or neurosurgery staff. The presence of any CT scan abnormality other than the presence of extracranial injury was an exclusion criterion.

After the CT study, patients were admitted for a 24-hour period of close neurologic observation. All usual coagulation tests were performed (i.e., prothrombin time, international normalized ratio [INR], and partial thromboplastin time). Serial neurologic examinations were performed every 4 hours to 6 hours until a control CT scan was performed in all patients 20 hours to 24 hours after the initial CT scan. Anticoagulation treatment was not withdrawn in any patient.

We planned to separate our patients into two subgroups, i.e., one including those showing a normal neurologic status and other formed by patients developing neurologic deterioration during their stay in the hospital, defined as any change in the initial GCS score with or without focal deficits, persistent vomiting, or severe headache.

Findings on the second cranial CT were compared with the initial CT scans and categorized as worsened or unchanged by the neurosurgical team. Worsened CT scan was defined as the presence of any sign of intracranial bleeding.

Descriptive analyses were performed. We planned to record the baseline frequencies of the findings on both the neurologic examinations and the two CT scans, and then, analyze the correlations between the incidence of clinical changes, and the presence of intracranial posttraumatic lesions in the control CT scans using  $\chi^2$  and Fisher's exact tests.

## RESULTS

The average age of our 137 patients was 76 years  $\pm$  9 years, and 45 (33%) were men. Falls were the most common mechanism (89%) of head injury (Table 1). Atrial fibrillation was the most frequent reason for anticoagulation treatment, and the mean INR was  $3.8 \pm 1.2$  (Table 2). Median interval from trauma to initial CT scan was 3.2 hours. A repeat CT scan was performed in all patients with a mean interval of 20 hours  $\pm$  1 hour after injury (Fig. 1).

One hundred thirty five patients (98.6%) had no evidence of intracranial lesions on the control CT scans, and none developed subsequent neurologic deterioration or needed neurosurgical intervention during the observational period. Only two patients (1.4%) presented hemorrhagic lesions on the control CT scan; one was a 67-year-old man

**TABLE 1.** Demographic Characteristics of the Study Population

Characteristic	Value
Total population	137
Median age ( $\pm$ SD)	76 ( $\pm$ 9)
Male (%)	45 (33)
GCS score at arrival (%)	
15	122 (89)
14	15 (11)
Risk factors for intracranial complications (%)	
Severe headache	34 (25)
Vomiting	27 (20)
Loss of consciousness	14 (10)
Posttraumatic amnesia	6 (4.3)
Seizure	2 (1.7)
Scalp	38 (28)
Mechanism of injury (%)	
Traffic injury	7 (5)
Fall	122 (89)
Assault	4 (3)
Direct impact	2 (1.7)
Pedestrian struck	2 (1.7)
Associated injury	29 (21)

**TABLE 2.** Indications for Anticoagulation

	Number of Patients (%)	
	Warfarin	Aspirin
Atrial fibrillation	73 (53)	1
Valve replacement surgery	23 (17)	2
Stroke/TIA	22 (16)	—
Deep venous thrombosis	11 (8)	—
Other	8 (6)	—

TIA, transient ischemic attack.

arriving to the emergency department after suffering from a fall from his chair, which caused an impact on the head followed by loss of consciousness lasting about 6 minutes. The GCS score at admission was 15. He was anticoagulated and antiaggregated due to atrial fibrillation, and his INR was 3.10. The initial CT scan performed 2.5 hours after trauma was normal, and the control CT scan 22 hours after injury showed minimal intraventricular hemorrhage. However, the patient did not show neurologic deterioration, so that anticoagulation therapy was not withdrawn, and the CT scan repeated 24 hours later showed no changes. Thus, the patient was discharged 48 hours after injury. The other patient was a 74-year-old man anticoagulated and antiaggregated due to mitral valve replacement who was admitted after suffering from a fall while walking, which caused transient loss of consciousness. His neurologic examination was normal. The INR was 2.88 and the initial CT scan performed 3.4 hours after injury showed no abnormalities. Twenty-four hours after trauma, a control CT scan showed discrete subarachnoid hemorrhage over the convexity of the right cerebral hemi-

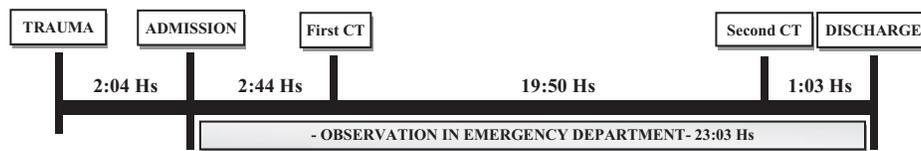


Figure 1. Median time between different stages of the study.

sphere. Anticoagulation was not stopped and a new CT scan performed just before discharge showed no changes.

These two patients showing intracranial bleeding on the second CT scan were among the three in our series who were both anticoagulated and antiaggregated; the difference in the incidence of bleeding in these two cases when compared with those who were only anticoagulated was statistically significant ( $p = 0.01$ ). Likewise, these two patients were among the 14 (10%) who suffered loss of consciousness in our series; the difference in the frequency of bleeding when compared with the 123 (90%) patients remaining fully alert after injury was also statistically significant ( $p = 0.004$ ).

## DISCUSSION

Many studies have documented that anticoagulation treatment is associated with an increasing risk of intracranial hemorrhage in patients with severe head injury.<sup>2,6-12</sup> Although there are clear-cut recommendations for the management of patients attending the emergency department after suffering from a MHI,<sup>4,13-18</sup> few authors have addressed how to deal with these patients when they are on anticoagulation treatment.<sup>3,19,20</sup>

Different reports described that anticoagulation consistently influence the final outcome after a MHI. Karni et al.<sup>8</sup> reported that ~7.5% of these patients present intraparenchymal bleeding on the admission CT scan. In 2002, Mina et al.<sup>11</sup> reported that the risk of patients with MHI for showing hemorrhagic lesions in the admission CT scan rises by 9.7% if they are anticoagulated. In Reynolds series,<sup>21</sup> 25% of patients with MHI older than 65 years who were anticoagulated had intracerebral bleeding. Ibanez et al.<sup>15</sup> estimated that to be under anticoagulation increases the risk of bleeding by a factor of 3.1 in patients with MHI. Thus, it is clear that all these patients should have a CT scan immediately after admission to the hospital.

Although there is a general agreement that because of the increased risk of bleeding all these patients should be admitted for observation during 24 hours after injury, it remains to be determined whether it is necessary to perform control scans on a routine basis before discharge when they do not develop neurologic changes during the observation period.<sup>16</sup> In fact, supporting evidence is weak and recommendations are contradictory. In 1996, Saab et al.<sup>22</sup> reported on two MHI anticoagulated patients aged older than 65 years, one of whom died because of an intracerebral hematoma after he deteriorated from 15 to 5 in the GCS; on the basis of this single observation, he recommended admitting for observation all patients with MHI on anticoagulation treatment. In 1998, Volans<sup>20</sup> added three personal cases to another eight collected from the literature in an attempt to establish the

relationship between intracranial hemorrhage and anticoagulation treatment in patients with MHI aged older than 65 years; although he did not perform statistical analyses, concluded that being on anticoagulation carries, a 10-fold increase in the risk for developing delayed intracranial bleeding. In the same year, Garra et al.<sup>19</sup> studied 65 MHI anticoagulated patients who did not suffer loss of consciousness; the observation that the CT scan, performed in only 60% of the cases, was normal led these authors to conclude that because these patients are not at risk for developing delayed intracranial bleeding they do not need control scans. Thus, taking into account the scarce and contradictory scientific evidence available up to now, a definite policy for control CT scanning in this clinical situation cannot be recommended.

Regarding the occurrence of neurologic deterioration of patients with MHI during the observation period, there are also contradictory results, but it should be noted that when occurring, it usually takes place within the first hours after injury. Sifri et al.<sup>1</sup> reported deterioration to occur ~2 hours to 3 hours after MHI in a series of patients who were not anticoagulated. In comparison, Reynold et al.,<sup>21</sup> who included only anticoagulated patients, observed that neurologic deterioration occurred within the first 6 hours after the injury. Finally, Itshayek et al.<sup>23</sup> reported on four patients with MHI under anticoagulation who developed delayed subdural hematoma, two of whom presented neurologic deterioration within the first 24 hours after trauma. These isolated observations support the widely adopted strategy of admitting all patients with MHI with any risk factors for delayed deterioration, anticoagulation treatment among them, for close neurologic observation during at least 24 hours after injury.

The main finding of this study, i.e., the combination of an advanced age and anticoagulation do not necessarily increases the risk of intracranial bleeding in patients with MHI with a normal admission CT scan, is relevant. Although the study has the limitation of being observational and non-randomized and did not considered a control group, it prospectively included a large series of consecutive patients with well-defined characteristics, namely to suffer from a MHI and to be under anticoagulation, which in few cases was combined with antiaggregation. Consequently, we think that our findings argue against the policy of performing control CT scanning before discharge on a routine basis in these patients who are better managed with 24 hours observation. However, when the patient is not only anticoagulated but also antiaggregated and suffers a loss of consciousness, then the risk for delayed intracranial bleeding increases and a control CT scan should be performed at the end of the period of observation (24 hours in most instances). Finally, the rare patients show-

ing minor bleedings in the control CT scan should have an additional CT scan before discharge.

Withholding control CT scanning in patients with MHI on anticoagulation showing a normal initial CT scan would have significant economic and clinical implications as it could save resources while maintaining an efficient patient care. Eliminating scans performed on a routine basis would decrease hospital costs, radiation exposure, and minimize transportation and delays in CT scanning in patients with higher priorities in busy trauma centers.

## CONCLUSION

According to our study, in which only 2 of 137 (1.4%) patients suffering from a MHI while being under anticoagulation showed delayed intracranial bleeding in the control CT scan, which was unaccompanied by neurologic deterioration and did not require surgical intervention, we do not recommend control CT scanning on a routine basis in this population of patients. Although a larger number of patients are needed to establish definite conclusions, it seems that close neurologic observation during a period of 24 hours may suffice to rule out potential surgical complications. An exception are patients anticoagulated exposed to loss of consciousness or antiaggregation treatments who could be at significantly higher risk for developing posttraumatic intracranial bleeding.

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