World Journal of Cardiovascular Diseases, 2014, 4, 1-4 **WJCD**
http://dx.doi.org/10.4236/wjcd.2014.41001 Published Online January 2014 (http://www.scirp.org/journal/wjcd/)

Spontaneous and iatrogenic dehydration in the elderly alone or in combination with antiplatelet/anticoagulation agents and risk of subdural hematoma

Elizabeth Wirkowski[1*], Jonas DeMuro[2], Adel Hanna[2], Jay Yasen[1], Rajiv Narain[1], Susan Elcin[1]

[1]Department of Neuroscience, Winthrop University Hospital, Mineola, USA
[2]Department of Surgery, Winthrop University Hospital, Mineola, USA
Email: [*]EWirkows@winthrop.org

Received 30 November 2013; revised 29 December 2013; accepted 9 January 2014

ABSTRACT

Background and Purpose: To evaluate the role of preadmission conditions, dehydration specifically, in the development of subdural hematoma in the elderly. Methods: Retrospective chart review. Results: The most prevalent pre-admission medical condition was hypertension, followed by atrial fibrillation, CAD, hyperlipidemia, diabetes, and cancer. Out of 95 patients, 69 (73%) had features of dehydration, 27% were on diuretics and 28% were on antiplatelet agents and anticoagulation. Conclusions: Elderly population is prone to dehydration. Overzealous use of diuretics especially in combination with anticoagulation or antiplatelet therapy can contribute to the development of subdural hematomas, both spontaneous and traumatic.

KEYWORDS

Subdural Hematoma; Diuretics; Aquaporins; Adverse Drug Events; Dehydration

1. INTRODUCTION

The origin of blood accumulation within the subdural space, subdural hematoma (SDH) can be traumatic or spontaneous. SDH contributes to significant morbidity and mortality in the elderly, especially when renal and cardiac comorbidities occur [1]. Traumatic SDH occurs due to acceleration injuries with tearing of the bridging veins, combined lesions of the cortex and pia-arachnoid, fractures of the skull as well as lacerations of the venous sinuses. Nontraumatic SDH may occur due to arteriovenous malformations, aneurysms, hemorrhagic diatheses, hepatic failure, anticoagulation, infections, brain metastases, brain tumors, especially convexity meningiomas [2], low ICP, CSF leak, iatrogenic or spontaneous dehydration, and alcoholism [3]. While the exact incidence of SDH is unknown, acute SDH complicates approximately 11% of head injuries that require hospitalization and approximately 20% of severe traumatic brain injuries [3]. In another study, acute SDH was reported in 30% of patients with traumatic brain injury, and was associated with poor outcomes and a high mortality rate of 40% - 60%. In the younger population, acute SDH is due to high-momentum impact, mainly traffic accidents or fall from heights; in the elderly population, acute SDH is due to low momentum falls (from bed or while walking) [4].

Elderly population is prone to dehydration because of decreased intake as well as multipharmacy, diuretics included. Although intellectually obvious, there are basically no studies that address role of dehydration, spontaneous or iatrogenic in the occurrence of subdural hematoma.

2. METHODS

We reviewed the records of 95 consecutive patients admitted to our institution with the diagnosis of SDH between September 2009 and September 2011. The patients were adults. They all suffered from spontaneous or traumatic isolated SDH. The cohort's age, preadmission use of diuretics, antiplatelet agents or anticoagulation, fluid status on admission, cardiac function and medical history were analyzed.

3. RESULTS

Out of 95 patients, 30 were classified as spontaneous

[*]Corresponding author.

SDH because there was no history of trauma. The rest of the patients with SDH were classified as traumatic with various levels of trauma severity.

The average age for patients with spontaneous SDH was 72, and the average for patients with traumatic SDH was 74.

The most prevalent pre-admission medical conditions were hypertension, followed by atrial fibrillation, CAD, hyperlipidemia, diabetes, and cancer. (**Figure 1**)

Out of 95 analyzed patients, 20 (21%) did not have any elevation in Bun/Cr (defined as ratio > 20:1), and were not on diuretics or on antiplatelet agents and/or anticoagulants (AP/AC). There were 69 patients (73%) who had an elevated Bun/Cr ratio, 26 patients (27%) on a diuretic, and 27 patients (28%) on antiplatelet agents and/or anticoagulants (AP/AC) (**Figure 2**).

Out of 30 patients with spontaneous subdural hematomas, 19 had elevated Bun/Cr levels, 9 patients were on diuretics, and 6 were on anti-platelets and/or anticoagulants (**Figure 3**).

Out of 65 patients with traumatic SDH, 50 had an elevated Bun/Cr, 18 were on diuretics, and 39 were on antiplatelets and/or anticoagulants. (**Figure 4**)

Only 5 patients out of 72 (7%) who had transthoracic echocardiography done had an ejection fraction of less than 40%.

4. DISCUSSION

Chronic SDH usually occurs in the later stages of life. Trauma, if recalled, is often trivial. In Ramachadran's series, 56% of patients with chronic SDH recalled a history of trauma. Of those, 78% experienced only minor trauma. There is usually several weeks between the initial insult and clinical deterioration. Age, neurological presentation on admission and associated comorbidities determine mortality. [5] Anticoagulation use is a factor in 5% - 20% of patients with chronic SDHs. Mortality can be higher in older patients receiving anticoagulation [1]. In one series of patients with chronic SDH following head trauma, patients had been treated with oral anticoagulants or aspirin at the time of hemorrhage in 21% and 13% of patients, respectively [6].

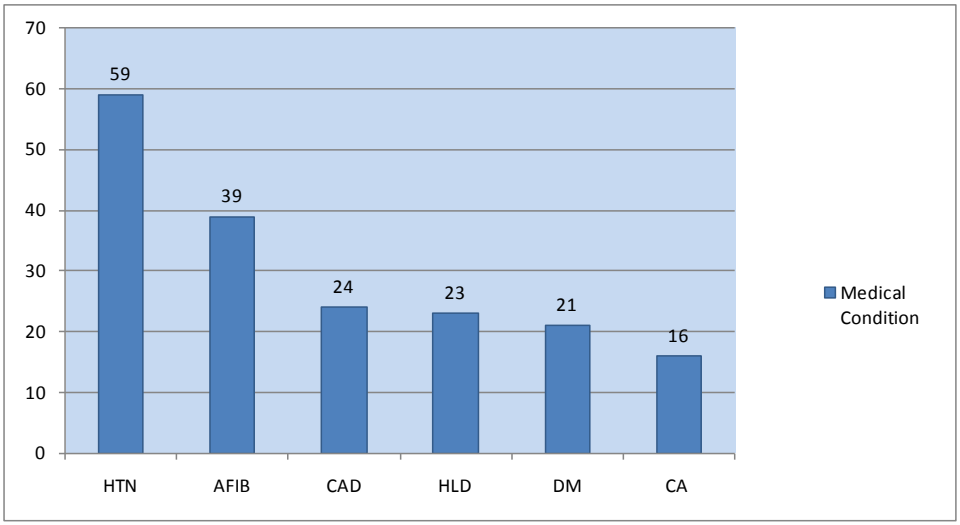

Figure 1. Frequency of preadmission medical conditions for the group.

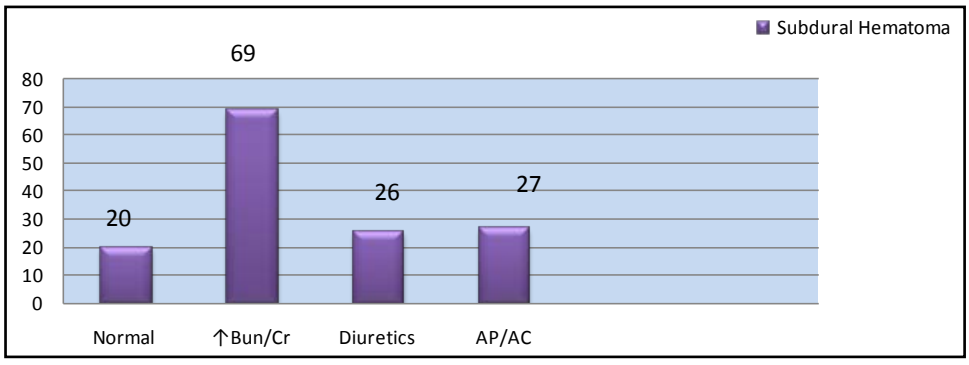

Figure 2. Subdural Hematoma (n = 95) – Selected Admission Information (BUN/Cr > 20), diuretics taken at home, antiplatelet agents or anticoagulation prior to admission).

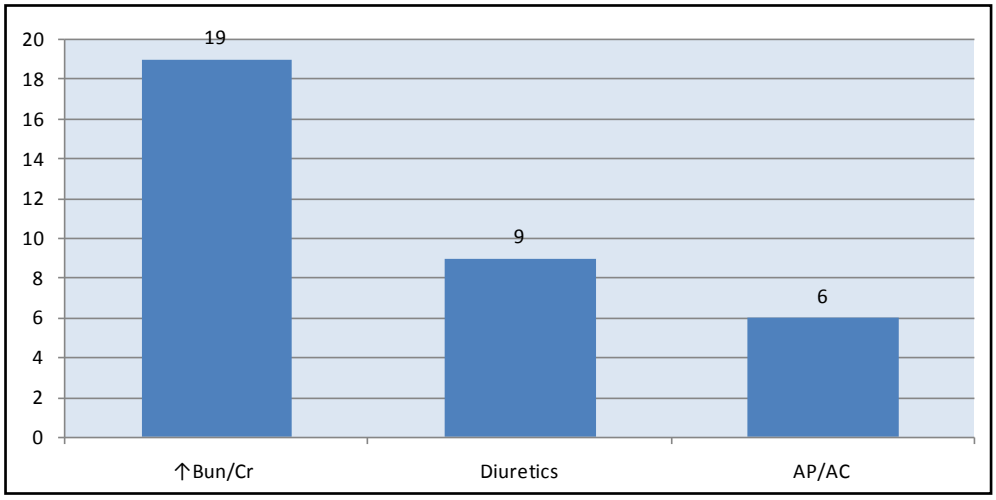

Figure 3. Admission Information –Spontaneous SDH (n = 30).

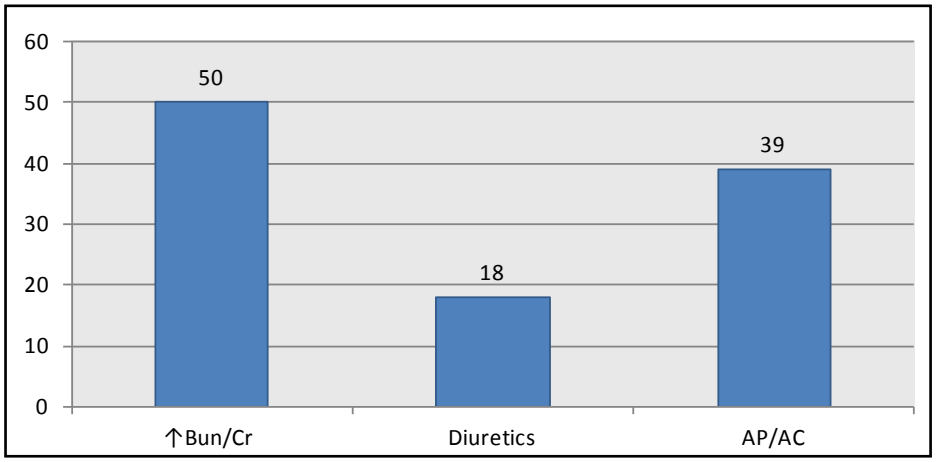

Figure 4. Admission Information- Traumatic SDH (n = 65).

In our cohort, 28% of SDH patients were on oral anticoagulants or antiplatelet agents.

The question arises, what leads to trauma in the elderly and what makes the brain so frail, even when the trauma is trivial? Another question is what leads to subdural hematoma expansion?

Dehydration can contribute in several ways to the formation of SDH. In adults, the cranium is a rigid vault of fixed size. As such, the intracranial volume is a constant - the sum of the brain, the CSF and the intracranial blood volume. The changes in ventricular volume caused by dehydration are much larger than those seen in day-to-day fluctuations in a normally hydrated healthy control subject. [7,8] Dehydration can lead to hypo or hypernatremia and contraction alkalosis, which can alter mental status, leading to falls. Sodium disorders can also increase the risk of seizures, especially hyponatremia. All above can contribute to head trauma and SDH.

The elderly patients with brain atrophy are more prone to falls and dehydration. There is also significant number of elderly patients who have cardiac condition and who are aggressively treated with anticoagulation and diuretics. The most prevalent diagnoses being HTN and atrial fibrillation.

Since our study was a retrospective chart review, we defined patients with volume depletion as having a Bun/Cr ratio above 20.73% of our patients showed volume depletion on admission. Out of this group, 39% received diuretics.

More and more research suggests that brain water status is regulated by aquaporin receptors, especially AQP 1 and 4. AQP 4 is expressed in astroglial cells lining the ependymal and pial surfaces that are in contact with CSF in the ventricular system and the subarachnoid space. [10] Aquaporin 1 has been found in the choroid plexus as well as the external membrane of subdural hematoma [11].

One of the mechanisms of subdural hematoma enlargement can be ongoing hemorrhage due to inhibition of thrombus formation by thrombomodulin, as well as

the inhibition of healing of damaged sinusoids [12]. Hyperfibrinolytic activity alone may not explain the progressive dilution that occurs in the chronic SDH. Aquaporin 1 expression in the outer membrane of a SDH can contribute to the increase in water flow and the growth of the hematoma [13]. Inhibition of aquaporin channels and water permeability can prevent edema formation in pathological states [14].

Although diuretics can inhibit aquaporin 1 and 4 water permeability, acting at an internal pore occluding binding site and potentially slow down the growth of subdural collections, they can also increase tonicity of the brain cells and reduce brain volume [15].

Reducing of brain volume may contribute to the subdural hematoma growth. It is interesting that almost 1/3 of our patients admitted with SDH were on diuretics, and more than 2/3 were volume depleted. Once patient develops a SDH, a change in mental status may lead to decreased oral intake, leading to further volume depletion.

5. SUMMARY

Preadmission volume depletion was prevalent in both spontaneous and more so in traumatic SDH. Dehydration is prevalent in the elderly. Overzealous use of diuretics can be dangerous, especially in combination with anticoagulation and antiplatelet agents. The elderly may not tolerate overzealous blood pressure control, especially if it is achieved through the use of diuretics. Even though cardiac conditions including congestive heart failure are prevalent in the elderly population, not all cases require aggressive diuretic therapy. Only 7% of patients in our group had an EF less than 40%. Diuretics not only lead to volume depletion, orthostasis and falls in the elderly, but also may cause an increase in brain tonicity and reduce production of CSF by affecting aquaporin channels in the brain; however, this theory requires further investigations.

SDH carries significant mortality and morbidity rates. Therefore, prevention of iatrogenic errors is extremely important [16].

REFERENCES

[1] Fiki, M.E. (2012) Acute traumatic SDH outcome in patients older than 65 years. *World Neurosurgery*, **78**, 228-230. http://dx.doi.org/10.1016/j.wneu.2012.02.049

[2] Chen, W. and Grafe, M. (1992) Unsuspected meningioma presenting as a subdural hematoma. *Journal of Neurology, Neurosurgery & Psychiatry*, **55**, 167-168. http://dx.doi.org/10.1136/jnnp.55.2.167-a

[3] Markwalder, T. (1981) Chronic subdural hematomas: A review. *Journal of Neurosurgery*, **54**, 637-645. http://dx.doi.org/10.3171/jns.1981.54.5.0637

[4] Cooper, D.J., Rosenfeld, J.V., Murray, L., Arabi, Y.M., Davies, A.R., D'Urso, P., *et al*. (2011) The DECRA trial decompressive craniectomy in diffuse traumatic brain injury. *NEJM*, **364**, 1493-1502.

[5] Ramachdran, R. and Hegde, T. (2007) Chronic subdural hematomas-causes of morbidity and mortality. *Surgical Neurology*, **67**, 367-372. http://dx.doi.org/10.1016/j.surneu.2006.07.022

[6] Reymond, M. and Marbet, G. (1992) Aspirin as a risk factor for hemorrhage in patients with head injuries. *Neurosurgical Review*, **15**, 21-25. http://dx.doi.org/10.1007/BF02352062

[7] Dickson, J. and Weavers, H. (2005) The effects of dehydration on brain volume-preliminary results. *International Sports Medicine*, **26**, 481-485. http://dx.doi.org/10.1055/s-2004-821318

[8] Marshall, S. and Hinman, F. (1962) Subdural hematoma following administration of urea for diagnosis of hypertension. *JAMA*, **182**, 813-814. http://dx.doi.org/10.1001/jama.1962.03050460105017

[9] Akioka, N., Fukuda, O., Takaba, M., Kameda, H., Saito, T. and Endo, S. (2007) Clinical investigation of acute spontaneous SDH cases. *Journal of Stroke and Cerebrovascular Disease*, **16**, 109-113. http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2006.11.007

[10] Nielsen, S., Nagelhus, E.A., Amiry-Moghaddam, M., Borque, C., Agre, P. and Ottersen, O.P. (1997) Specialized membrane domains for water transport in glial cells: High-resolution immunogold cytochemistry of aquaporin 4 in rat brain. *Journal of Neuroscience*, **17**, 171-180.

[11] de Groot, B.L. and Grumbmuller, H. (2001) Water permeation across biological membranes: Mechanism and dynamics of aquaporin 1. *Science*, **294**, 2353-2354. http://dx.doi.org/10.1126/science.1062459

[12] Murakami, H. and Hirose, Y. (2002) Why do chronic SDH continue to grow slowly and not coagulate? Role of thrombomodulin in the mechanism. *Journal of Neurosurgery*, **96**, 877-884. http://dx.doi.org/10.3171/jns.2002.96.5.0877

[13] Basaldella, L., Perin, A., Orvieto, E., Marton, E., Itskevich, D., Dei Tos, A.P., *et al*. (2010) A preliminary study of aquaporin 1 immunolocalization in chronic subdural hematoma membranes. *Journal of Clinical Neuroscience*, **17**, 905-907. http://dx.doi.org/10.1016/j.jocn.2009.11.010

[14] Manley, G.T. and Fujimura, M. (2000) Aquaporin-4 deletion in mice reduces brain edema after acute water intoxication and ischemic stroke. *Journal of Natural Medicines*, **6**, 159-163.

[15] Miglati, E., Meurice, N., DuBois, P., Fang, J.S., Somasekharan, S., Beckett, E., *et al*. (2009) Inhibition of AQP-1 and AQP-4 water permeability by derivative of the loop diuretic bumetamide acting at an internal pore occluding binding site. *Molecular Pharmacology*, **76**, 105-112.

[16] Miranda, L. and Braxton, E. (2011) Chronic subdural hematoma in the elderly: Not a benign disease. *Journal of Neurosurgery*, **114**, 72-76. http://dx.doi.org/10.3171/2010.8.JNS10298

