Clinical and Experimental Hypertension

ISSN: 1064-1963 (Print) 1525-6006 (Online) Journal homepage: www.tandfonline.com/journals/iceh20

The Effect of Admission Blood Pressure on the Prognosis of Patients with Intracerebral Hemorrhage That Occurred during Treatment with Aspirin, Warfarin, or No Drugs

Kemal Balci, Ufuk Utku, Talip Asil, Yahya Celik, Ilkay Tekinaslan, Nasif Ir & Ercument Unlu

To cite this article: Kemal Balci, Ufuk Utku, Talip Asil, Yahya Celik, Ilkay Tekinaslan, Nasif Ir & Ercument Unlu (2012) The Effect of Admission Blood Pressure on the Prognosis of Patients with Intracerebral Hemorrhage That Occurred during Treatment with Aspirin, Warfarin, or No Drugs, Clinical and Experimental Hypertension, 34:2, 118-124, DOI: 10.3109/10641963.2011.601380

To link to this article: https://doi.org/10.3109/10641963.2011.601380

Published online: 03 Oct 2011.

Clinical and Experimental Hypertension, 2012; 34(2): 118–124

ISSN 1064-1963 print /1525-6006 online
DOI: 10.3109/10641963.2011.601380

informa
healthcare

The Effect of Admission Blood Pressure on the Prognosis of Patients with Intracerebral Hemorrhage That Occurred during Treatment with Aspirin, Warfarin, or No Drugs

Kemal Balci,[1] Ufuk Utku,[2] Talip Asil,[2] Yahya Celik,[2] Ilkay Tekinaslan,[2] Nasif Ir,[2] Ercument Unlu[3]

[1]*Department of Neurology, School of Medicine, University of Ondokuz Mayis, Samsun, Turkey*, [2]*Department of Neurology, School of Medicine, University of Trakya, Edirne, Turkey*, [3]*Department of Radiology, School of Medicine, University of Trakya, Edirne, Turkey*

Abstract

Background. Hypertension is the most important modifiable risk factor for intracerebral hemorrhage (ICH), but blood pressure (BP) management during the acute phase of ICH is still controversial. Approximately one-fourth of ICHs occur during treatment with warfarin or aspirin. *Aim*. This study was designed to determine the effect of admission BP on the early prognosis of ICH patients by dividing them into three groups (warfarin, aspirin, and no drugs). *Methods*. Three hundred and sixty-nine patients with supratentorial ICH were divided into three groups according to medication. Each group was evaluated in terms of prognosis and the risk for mortality based on the modified Rankin Scale (mRS) score at discharge (good prognosis: mRS $\leq$ 3; poor prognosis: mRS $>$ 3). The effect of admission BP on prognosis was evaluated for each group. *Results*. The inhospital mortality rate was 72% for ICH patients treated with warfarin, 41.6% for ICH patients treated with aspirin, and 35% for ICH patients treated with no drugs. Admission mean arterial blood pressure (MABP) values were higher in patients with poor prognosis compared with patients with good prognosis for the aspirin ($P = .002$) and no-drug ($P = .001$) groups, but not in the warfarin ($P = .067$) group. *Conclusion*. A high MABP at admission was found to be an independent predictor of poor prognosis for ICH patients treated with aspirin or with no drugs, but not for ICH patients treated with warfarin.

Keywords: intracerebral hemorrhage, blood pressure, prognosis, mortality

INTRODUCTION

Intracerebral hemorrhage (ICH) is a life-threatening condition associated with substantial morbidity and mortality. The annual incidence of ICH varies between 10 and 20 cases per 100 000 people in the general population and up to 200 cases per 100 000 people in the elderly population (1,2). Although hypertension is the most important modifiable risk factor for ICH, blood pressure (BP) management during the acute phase of ICH is still controversial (3,4). High BP at admission has been reported to be associated with poor outcome in some, but not all, studies (5–8). High admission BP has also been reported as a risk factor for hematoma enlargement (9). For this reason, BP is often lowered in patients with ICH. However, in some ICH studies, it is reported that reducing BP could lead to neurological deterioration due to ischemia in hypoperfused brain regions adjacent to the hematoma (10).

Aspirin-associated ICH (AAICH) or warfarin-associated ICH (WAICH) constitutes approximately one-fourth of all cases of ICH. Aspirin is widely used to decrease the risk of occlusive arterial events in patients with atherosclerosis. Although the benefits of aspirin outweigh its hemorrhagic risks for patients at high risk of vascular diseases, the prolonged use of aspirin is associated with an increased risk of ICH (11). Warfarin sodium therapy is frequently used for patients with cardiac arrhythmias, pulmonary embolism, artificial heart valves, or deep vein thrombosis to prevent thromboembolic complications. Warfarin-associated ICH is becoming more common with the increased use of this medication in the aging population (12). The incidence of ICH in patients treated with warfarin is reportedly 7–10 times higher than in those not receiving warfarin (13). The risk of WAICH may reach 1%–2% per year. Warfarin use increases the risk of death from

Address correspondence to Kemal Balci, Department of Neurology, School of Medicine, University of Ondokuz Mayis, Samsun, Turkey. E-mail: kemalbalcidr@yahoo.com

Received 1 February 2011; *revised 21 February 2011*; *accepted 21 February 2011.*

ICH (14,15). Although it has been reported that taking aspirin or warfarin may increase the incidence of ICH and may result in a poorer outcome, recent studies reported conflicting results about the effects of warfarin and aspirin on the prognosis of ICH (12,15–17).

The aim of this study is to estimate the effect of aspirin or warfarin treatment on the prognosis of ICH and to evaluate the impact of admission BP on the short-term prognosis of ICH patients treated with aspirin, warfarin, or no drugs. This study is the first to investigate and compare the effect of initial BP on the prognosis of ICH patients by dividing them into three groups (aspirin, warfarin, and no drugs) according to their previous medications.

MATERIALS AND METHODS

Patients

The study series comprised of 424 patients with ICH admitted to the Department of Neurology, School of Medicine, University of Trakya in Turkey between January 2004 and January 2010. Patients who had ICH due to brain tumors, aneurysms, vascular malformations, hematological malignancies, coagulation disorders, head trauma, thrombolytic therapy, or hemorrhagic transformations of cerebral infarctions were excluded. In pontine and cerebellar hemorrhages, the outcome is highly dependent on the size and location of the hemorrhage in a very confined space. Therefore, patients with these types of hemorrhages (10 patients with brainstem hemorrhages and 24 patients with cerebellar hemorrhages) were excluded from the study because it is not accurate to compare hematoma volumes located in infra- and supratentorial regions. Twenty-one patients were excluded due to late admission after ICH (>12 h of onset) and surgical hematoma evacuation.

The hospital records of the remaining 369 patients were reviewed for details about age, gender, medications, initial mean arterial blood pressure (MABP) values, hematoma enlargement, extension to the ventricular system, comorbid conditions (ischemic heart disease, previous stroke, diabetes mellitus, hypertension, atrial fibrillation, heart failure), reasons for anticoagulation and antiplatelet medication, and the international normalized ratio (INR) at first presentation. Warfarin and aspirin use by patients at the time of bleeding was recorded. Initial BP values were obtained during transfer or immediately after the patients' arrival in the emergency room by a trained nurse using a calibrated sphygmomanometer. For almost all patients, at least six BP readings during the first 12 h after ICH onset were available. Of these, the highest one was chosen as the admission BP. The MABP was calculated by adding one-third of the pulse pressure (systolic–diastolic) to the diastolic pressure. The patients were considered to be hypertensive if their BP readings preceding the ICH had at least twice exceeded 160/95 mm Hg in accordance with the World Health Organisation/International Society of Hypertension (WHO/ISH) statement or if they were taking antihypertensive medication (18). Additional antihypertensive medication was considered only if the MABP exceeded 140–145 mm Hg. The patients were recorded as having diabetes mellitus if they were taking oral hypoglycemic agents or insulin at ICH onset. The patients were divided into three groups according to the medication being taken at the time of ICH: group 1 — AAICH; group 2 — WAICH; and group 3 — no-drug-associated ICH (NDAICH).

Neuroradiological Methods

Intracerebral hemorrhage was verified by computed tomography (CT) for all patients within an hour after admission and this was repeated if sudden clinical deterioration occurred. All CT scans were analyzed and reanalyzed, and the locations of the hematoma, hematoma volumes, and extensions into the ventricular system were measured. Follow-up CT and/or magnetic resonance imaging were used to search for secondary structural abnormalities when necessary. Angiography was performed if arteriovenous malformation or aneurysmal bleeding was suspected. The volume of ICH was measured manually using the previously described AxBxC/2 method (19). Hematoma locations were classified as follows: (i) basal ganglionic, (ii) lobar, (iii) thalamic, (iv) cerebellar, and (v) brainstem.

The three groups (AAICH, WAICH, and NDAICH) were compared for the prognosis of ICH within the duration of hospital stay and the effect of BP on the prognosis was evaluated for each group. Functional outcomes were assessed using the modified Rankin Scale (mRS) and accepted as good (score of 0–3) or poor (score of 4–6) at discharge.

Treatment

The patients with admission MABP >140–145 mm Hg received BP-lowering therapy with labetalol, nifedipine, furosemide, or metoprolol. Some patients received more than one drug. Mannitol (20%) was used to lower intracranial pressure, if necessary. Reversal of INR was achieved by administration of vitamin K and fresh frozen plasma, if necessary.

Statistical Analysis

Statistical analysis was performed using the SPSS 11.0 statistical software package (SPSS Inc., Chicago, IL, USA). Descriptive statistics are reported as frequencies and percentages for categorical variables and as median and range for continuous variables. Comparison of the parameters between groups was performed using χ^2 tests for categorical variables and using analysis of variance (ANOVA) for continuous variables. To identify the relationship between admission MABP and the outcome at discharge for the AAICH, WAICH, and

NDAICH groups, the patients were divided into two groups according to mRS scores (mRS: 0–3 and mRS: 4–6). For univariate analysis, associations between prognosis and various continuous variables were assessed using the Wilcoxon rank-sum test. Further multivariate linear regression was used to assess predictors of poor prognosis. Continuous values are expressed as mean ± SD. P value <.05 was accepted as statistically significant.

RESULTS

Of the 369 patients (168 women, 201 men) reviewed, 32 (8.7%) were being managed with warfarin and 48 (13%) were being managed with aspirin. The mean age of the patients was 67.5 ± 11.1 years (range: 34–93) and no significant difference was found for age or gender between the three groups (Table 1). The mean INR value of the 32 patients being managed with warfarin was 3.62 ± 2.1 (ranging from 1.46 to 10.7), and the INR values of 13 (40%) of the patients taking warfarin were in the therapeutic or infra-therapeutic range. The hematoma was located in the basal ganglia in 157 (42.5%) patients, in the thalamus in 141 (38.2%) patients, and in the lobar region in 71 (19.3%) patients. Basal ganglia and thalamic hematomas were more common in the AAICH and NDAICH groups, respectively. However, the hematoma was more likely to be located in the lobar region (47%) and intraventricular hemorrhage was most frequent in the WAICH group (69%) compared with the AAICH ($P = .042$) and NDAICH ($P = .02$) groups (Table 1).

The most common indications for warfarin use were previous cardioembolic strokes with or without atrial fibrillation (15 patients); atrial fibrillation with no previous stroke (seven patients); mechanical heart valves (three patients); pulmonary embolism (one patient); and deep venous thrombosis (two patients). The indication of warfarin use could not be determined for four patients. The most common indications for aspirin use were previous atherothrombotic stroke (13 patients); coronary artery disease (18 patients); and transient ischemic attacks (nine patients). The indication of aspirin use could not be determined for eight patients.

Hypertension (88.6%) was the most prevalent comorbid disease according to patients' medical histories, followed by diabetes mellitus (17.3%), cerebrovascular disease (16%), coronary artery disease (12.5%), congestive heart failure (7.8%), and chronic renal failure (4.3%). A history of cardiac disease ($P < .001$) or stroke ($P < .001$) was significantly more common in the AAICH and WAICH groups than in the NDAICH group (Table 1).

The WAICH (40.4 ± 25.4 mL) group had significantly larger hematoma volumes than the AAICH (25.0 ± 21.4 mL; $P = .003$) and NDAICH (26.9 ± 18.2 mL; $P = .004$) groups. However, no significant difference was found for hematoma volume between the AAICH and NDAICH groups ($P = .193$).

No significant difference was found for MABP between the AAICH and NDAICH groups ($P = .857$). The MABP was significantly higher among patients in the AAICH (131.2 ± 16.1 mm Hg) and NDAICH (131.6 ± 16.4 mm Hg) groups than among those in the

Table 1. Clinical characteristics and outcomes of 369 patients with ICH according to the medication (aspirin, warfarin, and no drugs)

Characteristics	AAICH group ($n = 48$)	WAICH group ($n = 32$)	NDAICH group ($n = 289$)
Age	70.1 ± 10.9	69.6 ± 10.6	67.2 ± 11.2
Male gender	20 (42%)	15 (46%)	130 (45%)
MABP (mm Hg)	131.2 ± 16.0	99.9 ± 13.3	131.6 ± 16.4
Volume of hematoma (mL)	25.0 ± 21.4	40.4 ± 25.4	26.9 ± 18.2
Intraventricular hemorrhage	25 (52%)	22 (69%)	136 (47%)
Localization of ICH			
Basal ganglia	20 (42%)	9 (28%)	128 (44%)
Thalamus	21 (44%)	8 (25%)	112 (39%)
Lobar	7 (14%)	15 (47%)	49 (17%)
Poor prognosis (mRS >3)	30 (62.5%)	28 (87.5%)	199 (69%)
Mortality	20 (41.6%)	23 (72%)	103 (35%)
Inhospital stay (days)	11.0 ± 5.4	10.2 ± 6.6	12.5 ± 6.5
Previous diseases			
Hypertension	40 (8.3%)	20 (62%)	267 (92%)
Diabetes mellitus	11 (23%)	7 (22%)	46 (16%)
Heart failure	3 (6.2%)	6 (19%)	20 (7%)
Coronary artery disease	13 (27%)	8 (25%)	25 (8%)
Previous stroke	13 (27%)	15 (47%)	31 (11%)
Chronic renal failure	0	1 (3%)	15 (5%)

Abbreviations: ICH – intracerebral hemorrhage; AAICH – aspirin-associated intracerebral hemorrhage; WAICH – warfarin-associated intracerebral hemorrhage; NDAICH – no-drug-associated intracerebral hemorrhage; MABP – mean arterial blood pressure; mRS – modified Rankin Scale.

WAICH group (99.9 ± 13.3 mm Hg) ($P < .001$). The clinical severity (mRS scores: 0–6) of the patients and admission MABP values had a linear relationship in the AAICH and NDAICH groups, but not in the WAICH group (Figure 1).

The mean duration of inhospital stay was 12.2 ± 6.3 days for the 369 patients. The mean duration of inhospital stay was significantly shorter for the patients who died (8.4 ± 5.8 days) than for those who survived (14.7 ± 6.1 days) ($P < .001$). Inhospital mortality was 39% and the groups differed significantly in terms of prognosis at discharge ($P = .01$). Mortality was most common in the WAICH group (72%), followed by the AAICH (41.6%) and NDAICH groups (35%). The mortality rate of patients within the first 24 h was 12.4% (46 patients). Twenty-eight patients (7.5%) had clinical deterioration due to hematoma enlargement after admission (7 [22%] of WAICH patients, 6 (12.5%) of AAICH patients, and 15 [5%] of NDAICH patients).

When the patients in each group were divided into two groups according to good mRS scores (mRS: 0–3) and poor mRS scores (mRS: 4–6), univariate analysis showed a significant association between the prognosis at hospital discharge and hematoma volume ($P < .001$), intraventricular extension ($P = .001$), and MABP ($P = .002$) in the AAICH group. Univariate analysis indicated a significant association between the prognosis and hematoma volume ($P = .001$) and intraventricular extension ($P = .019$) in the WAICH group, and a significant association between the prognosis and hematoma volume ($P < .001$), intraventricular extension ($P < .001$), MABP ($P < .001$), and history of hypertension ($P = .002$) in the NDAICH group. Admission MABP values were higher in patients with poor prognosis compared with those with good prognosis in the AAICH (136.3 ± 16.6 mm Hg vs. 122.7 ± 11.2 mm Hg, $P = .002$) and NDAICH (135.7 ± 16.2 mm Hg vs. 121.7 ± 12.1 mm Hg, $P < .001$) groups. However, no significant difference was found for MABP values between the patients with good and poor prognosis in the WAICH group (101.1 ± 5.0 mm Hg vs. 95.7 ± 6.7 mm Hg, $P = .067$) (Table 2).

Multivariate logistic regression analysis, including variables significant in univariate analysis, showed a significant association between prognosis and hematoma volume ($P < .001$) and MABP ($P = .029$) in the AAICH group. Multivariate logistic regression analysis indicated a significant association between prognosis at discharge and hematoma volume ($P = .014$) and intraventricular extension ($P = .048$) in the WAICH group, and a significant association between prognosis and hematoma volume ($P < .001$), intraventricular extension ($P < .001$), MABP ($P = .038$), and history of hypertension ($P = .009$) in the NDAICH group.

DISCUSSION

Blood pressure management during the acute phase of ICH is controversial (7,9,10,20). Admission MABP was found to be a prognostic factor in most previous ICH studies (21). Some previous investigations showed that high BP at admission predicts high mortality and poor neurological outcome (22,23). Ohwaki et al. (9) reported that a systolic BP of at least 160 mm Hg was frequently associated with poor prognosis. In another study, high admission MABP (>127 mm Hg) was found to be significantly associated with death within the first 2 days after ICH (5). However, some studies did not confirm the predictive association between high

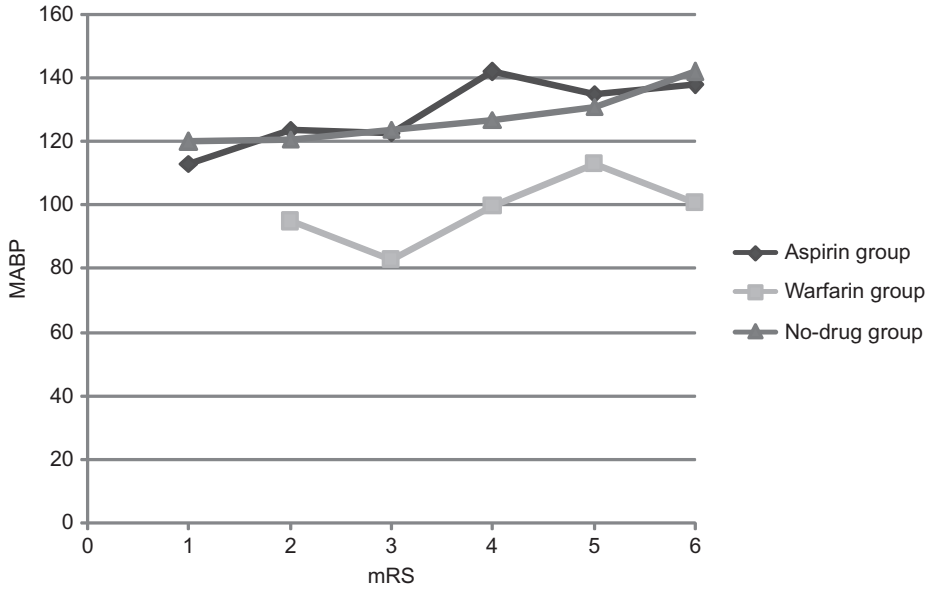

Figure 1. The relationship between clinical severity at hospital discharge and MABP at admission. Abbreviations: MABP – mean arterial blood pressure; mRS – modified Rankin Scale.

Table 2. The comparison of MABP and volume of hematoma between the patients with good and poor prognosis

	Good prognosis mRS (0–3)	Poor prognosis mRS (4–6)	Univariate analysis *P* value	MLRA *P* value
AAICH group ($n = 48$)	$n = 18$	$n = 30$		
MABP (mm Hg)	122.7 ± 11.2	136.3 ± 16.6	.002	.029
Volume of hematoma (mL)	9.8 ± 6.5	34.1 ± 22.1	<.001	<.001
WAICH group ($n = 32$)	$n = 4$	$n = 28$		
MABP (mm Hg)	95.7 ± 6.7	101.1 ± 13.7	.06	
Volume of hematoma (mL)	17.0 ± 12.2	43.8 ± 25.1	.001	.014
NDAICH group ($n = 289$)	$n = 117$	$n = 172$		
MABP (mm Hg)	121.7 ± 12.1	135.7 ± 16.2	<.001	.038
Volume of hematoma (mL)	8.9 ± 5.0	34.3 ± 16.4	<.001	<.001

Abbreviations: MLRA – multivariate logistic regression analysis; AAICH – aspirin-associated intracerebral hemorrhage; WAICH – warfarin-associated intracerebral hemorrhage; NDAICH – no-drug-associated intracerebral hemorrhage; MABP – mean arterial blood pressure; mRS – modified Rankin Scale.

admission BP and poor prognosis (24). In these studies, it is reported that most of the patients with ICH had chronic hypertension that increased the lower limit of cerebral blood flow autoregulation, and a sudden BP decline after ICH was reported to be associated with poor prognosis and high mortality rates, particularly as a result of hemodynamic infarctions (20). Tetri et al. (25) reported that patients with untreated hypertension had the best outcome, although they had the highest MABP values at admission. In a recent study, Ohwaki et al. (26) reported that both high and extremely low BP values were likely to adversely affect neurological status, and they demonstrated a "U"-shaped relationship between minimum systolic BP at admission and poor prognosis in patients with acute ICH, with the lowest risk for early neurological deterioration occurring at a minimum systolic BP of 123 mm Hg. In most of these studies, the effect of hypertension was analyzed in patients with spontaneous ICH, but not by dividing the patients according to their medication at the time of hemorrhage onset. This study aimed to look separately at the effect of BP on the prognosis of patients with ICH by dividing them into three groups according to their previous medications (warfarin, aspirin, and no drugs).

Increasing age, location and volume of hematoma, intraventricular extension, and comorbid diseases such as ischemic heart disease, atrial fibrillation, and diabetes mellitus were previously reported to be independent risk factors for the poor outcome of ICH patients (5,13,27,28). Tetri et al. (5) investigated the role of a high admission MABP and plasma glucose level, together with other predictors of early death for 379 patients with spontaneous ICH. They reported that diabetes mellitus, cardiac disease, advanced age, and the use of warfarin or aspirin were significantly more common among the patients who died within 3 months. In our study, no statistically significant difference was found for age and gender between the patients with good and poor prognosis in each subgroup. However, aspirin and warfarin users were more likely to have ischemic heart disease or to have had a previous stroke, as reported in the study by Hanger et al. (29). Hematomas were more commonly found in the lobar region (47%) and hematoma volume was greater (40.4 ± 25.4 mL) in the WAICH group compared with the other two groups. We demonstrated a significant association between poor prognosis (mRS > 3), hematoma volume, and intraventricular extension in all three groups. We also found an association between poor prognosis and initial MABP in the AAICH and NDAICH groups, but not in the WAICH group. Finally, we demonstrated a significant association between poor prognosis and a history of hypertension in the NDAICH group only.

Mortality rates and poor prognosis were much higher in the WAICH group compared with the AAICH and NDAICH groups. The high mortality rate in the WAICH group (72%) was found to be consistent with previously reported studies (in which it ranged from 52% to 68%) (13,30). Saloheimo et al. (31) investigated mortality in ICH patients and found an overall mortality rate of 32.7% within 3 months. The mortality rates of warfarin users in their study were inconsistent with our study (73.1% vs. 72%), but their follow-up period was significantly longer. Hanger et al. (29) studied the effect of aspirin and warfarin on early survival after ICH in 253 patients; the mortality rates at days 7, 14, and 28 were 34.8%, 38.7%, and 42.3%, respectively. In our study, mortality rates at hospital discharge (39%) were in accordance with the study by Hanger et al. In their study, the mortality rates of aspirin users, warfarin users, and non-users of aspirin or warfarin were 38%, 50%, and 36%, respectively, at day 14. In our study, the inhospital mortality rates of the AAICH (41.6%) and NDAICH (35%) groups were similar to those in the study by Hanger et al., but the mortality rates in the WAICH (72%) group were significantly higher.

Fric-Shamji et al. (32) examined the effect of admission MABP on prognosis in anticoagulated patients and they reported that MABP was an independent and modifiable risk factor for prognosis. However, in our study, the MABP was significantly lower in the WAICH group compared with the other two groups. In a recent study by Zubkov et al. (14), clinical and radiological

information for 88 patients with WAICH was studied, and BP at admission was not found to be associated with functional outcome at discharge. Hanger et al. (29) reported the use of warfarin prior to ICH was independently associated with increased early mortality. However, Hanger et al. (29) and Flibotte et al. (15) could not explain this effect of warfarin on prognosis by the volume of hematoma. Contrary to these studies, the mortality and poor prognosis in WAICH patients were found to be associated with a larger hematoma volume in this study. Although the WAICH patients had poorer prognosis associated with larger hematoma volumes, we could not demonstrate a linear relationship between the level of INR and hematoma volume; however, higher INRs may increase the risk of ICH. Moreover, 13 patients (40%) in the WAICH group had INR values that were either in the therapeutic or infra-therapeutic range. This ratio was significantly lower than that reported by Fric-Shamji et al. (87.6%) (32).

Saloheimo et al. (31) reported that regular aspirin use before the onset of primary ICH was a significant independent predictor for death (2–3 times) within the first 3 months after acute ICH. We found there was poorer prognosis but not as poor as in the study by Saloheimo et al. for AAICH patients compared with NDAICH patients (mortality rates: 41.6% vs. 35%). Nilsson et al. (3) also reported a non-significant trend for aspirin to predict mortality may be seen after omitting warfarin users. Saloheimo et al. (31) explained the high mortality in AAICH patients was because of a predisposition to hematoma enlargement. However, in this study, the hematoma volumes in the AAICH group were the same as in the NDAICH group. Other studies have also reported that the hematoma volume in patients using aspirin is no greater than that in patients not using such drugs (15). This poor prognosis may be due to the factors causing aspirin use (comorbid diseases such as diabetes mellitus, previous ischemic stroke, and ischemic cardiac diseases), which were more common in the AAICH group.

The main limitations of our study are that it was retrospective, and was not a randomized controlled study. Although our follow-up period (approximately 2 wk) was sufficient to evaluate the early stage prognosis because early deaths following an ICH are thought to be due to neurological deterioration, the long-term outcome of patients was not assessed (31). We used the $A \times B \times C/2$ method which has been well validated, rather than more precise computerized planimetry techniques for measuring hematoma volumes.

In conclusion, a strong relationship between hypertension and poor prognosis was confirmed in AAICH and NDAICH patients but not in WAICH patients. However, in WAICH patients who had the worst prognosis, hematoma volume had no association with admission BP. Patients who are placed on warfarin or aspirin treatment tend to have closer BP control because of the threat of ICH. Controlled trials are needed to determine the effect of BP on ICH that occurs during treatment with aspirin, warfarin, or no drugs.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

REFERENCES

[1] Qureshi AI, Tuhrim S, Broderick JP, et al. Spontaneous intracerebral hemorrhage. N Eng J Med 2001; 344:1450–1460.

[2] Nilsson OG, Lindgren A, Stahl N, Brandt L, Saveland H. Incidence of intracerebral and subarachnoid hemorrhage in southern Sweden. J Neurol Neurosurg 2000; 69:601–607.

[3] Nilsson OG, Lindgren A, Brandt L, Saveland H. Prediction of death in patients with primary intracerebral hemorrhage: a prospective study of a defined population. J Neurosurg 2002; 97:531–536.

[4] Bath P, Chalmers J, Powers W, et al. International Society of Hypertension (ISH): statement on the management of blood pressure in acute stroke. J Hypertens 2003; 21:665–672.

[5] Tetri S, Juvela S, Saloheimo P, Pyhtinen J, Hillbom M. Hypertension and diabetes as predictors of early death after spontaneous intracerebral hemorrhage. J Neurosurg 2009; 110:411–417.

[6] Fogelholm R, Avikainen S, Murros K. Prognostic value and determinants of first day mean arterial pressure in spontaneous supratentorial intracerebral hemorrhage. Stroke 1997; 28(7):1396–1400.

[7] Powers WJ, Zazulia AR, VideenTO, et al. Autoregulation of cerebral blood flow surrounding acute (6 to 22 h) intracerebral hemorrhage. Neurology 2001; 57:18–24.

[8] Qureshi AI, Mohammed YM, Yahia AM, et al. A prospective multicenter study to evaluate the feasibility and safety of aggressive antihypertensive treatment in patients with acute intracerebral hemorrhage. J Intensive Care Med 2005; 20: 34–42.

[9] Ohwaki K, Yano E, Nagashima H, et al. Blood pressure management in acute intracerebral hemorrhage: relationship between elevated blood pressure and hematoma enlargement. Stroke 2004; 35:1364–1367.

[10] Broderick J, Connolly S, Feldmann E, et al. Guidelines for the management of spontaneous intracerebral hemorrhage in adults: 2007 update: a guideline from the American Heart Association/American Stroke Association Stroke Council, High Blood Pressure Research Council, and the Quality of Care and Outcomes in Research Interdisciplinary Working Group. Stroke 2007; 38:2001–2023.

[11] He J, Whelton PK, Vu B, Klag MJ. Aspirin and risk of hemorrhagic stroke: a meta-analysis of randomized controlled trials. JAMA 1998; 280:1930–1935.

[12] Steiner T, Rosand J, Diringer M. Intracerebral hemorrhage associated with oral anticoagulant therapy. Stroke 2006; 37:256–262.

[13] Rosand J, Eckman MH, Knudsen KA, Singer DE, Greenberg SM. The effect of warfarin and intensity of anticoagulation on outcome of intracerebral hemorrhage. Arch Intern Med 2004; 164:880–884.

[14] Zubkov AY, Mandrekar JN, Claassen DO, et al. Predictors of outcome in warfarin related intracerebral hemorrhage. Arch Neurol 2008; 65:1320–1325.

[15] Flibotte JJ, Hagan N, O'Donnell J, Greenberg SM, Rosand J. Warfarin, hematoma expansion and outcome of intracerebral hemorrhage. Neurology 2004; 63:1059–1064.

[16] Foerch C, Sitzer M, Steinmetz H, Neuman-Haefelin T. Pretreatment with antiplatelet agents is not independently associated with an unfavourable outcome in intracerebral hemorrhage. Stroke 2006; 37:2165–2167.
[17] Tuhrim S. Aspirin use before ICH: a potentially treatable iatrogenic coagulopathy? Stroke 2006; 37:4–5.
[18] Whitworth JA. 2003 World Health Organisation (WHO)/ International Society of Hypertension (ISH) statement on management of hypertension. J Hypertens 2003; 21: 1983–1992.
[19] Broderick JP, Brott TG, Duldner JE, Tomsick T, Huster G. Volume of intracerebral hemorrhage: a powerful and easy to use predictor of 30 day mortality. Stroke 1993; 24: 987–993.
[20] Qureshi AI, Biliwise DL, Biliwise NG, et al. Rate of 24-h blood pressure decline and mortality after spontaneous intracerebral hemorrhage: a retrospective analysis with a random effects regression model. Crit Care Med 1999; 27:480–485.
[21] Carlberg B, Asplund K, Hagg E. The prognostic value of admission blood pressure in patients with acute stroke. Stroke 1993; 24:1372–1375.
[22] Leira R, Davalos A, Silva Y, et al. Cerebrovascular Diseases Group of the Spanish Neurological Society. Early neurologic deterioration in intracerebral hemorrhage: predictors and associated factors. Neurology 2004; 63:461–467.
[23] Willmot M, Leonardi-Bee J, Bath PM. High blood pressure in acute stroke and subsequent outcome: a systematic review. Hypertension 2004; 43:18–24.
[24] Davis SM, Broderick J, Hennerici M, et al. Recombinant activated factor VII intracerebral hemorrhage trial investigators. Hematoma growth is a determinant of mortality and poor outcome after intracerebral hemorrhage. Neurology 2006; 25: 1175–1181.
[25] Tetri S, Huhtakangas J, Juvela S, et al. Better than expected survival after primary intracerebral hemorrhage in patients with untreated hypertension despite high admission blood pressure. Eur J Neurol 2010; 17:708–714.
[26] Ohwaki K, Yano E, Nagashima H, et al. Blood pressure management in acute intracerebral hemorrhage: low blood pressure and early neurological deterioration. Br J Neurosurg 2010; 24:410–414.
[27] Roquer J, Rodriguez Campello A, Gomis M, et al. Previous antiplatelet therapy is an independent predictor of 30 day mortality after spontaneous supratentorial intracerebral hemorrhage. J Neurol 2005; 252:412–416.
[28] Mayer SA, Rincon F. Treatment of intracerebral haemorrhage. Lancet Neurol 2005; 4:662–672.
[29] Hanger HC, Fletcher VJ, Wilkinson TJ, et al. Effect of aspirin and warfarin on early survival after intracerebral hemorrhage. J Neurol 2008; 255:347–352.
[30] Hart RG, Boop BS, Anderson DC. Oral anticoagulants and intracerebral haemorrhage. Facts and hypotheses. Stroke 1995; 26:1471–1477.
[31] Saloheimo P, Ahonen M, Juvela S, et al. Regular aspirin-use preceding the onset of primary intracerebral hemorrhage is an independent predictor for death. Stroke 2006; 37:129–133.
[32] Fric-Shamji EC, Shamji MF, Cole J, Benoit BG. Modifiable risk factors for intracerebral hemorrhage. Study of anticoagulated patients. Can Fam Physician 2008; 54:1138–1139, 139.e1–4.