Anticoagulation-related intracranial extracerebral haemorrhage

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SUMMARY From January 1981 to June 1986 116 patients with anticoagulation-related intracranial haemorrhage were referred to hospital. Seventy six of these haemorrhages were extracerebral, 69 were in the subdural and seven in the subarachnoid space. No epidural haemorrhages were identified. Compared with non-anticoagulation-related haematomas, the risk of haemorrhage was calculated to be increased fourfold in men and thirteenfold in women. An acute subdural haematoma, mostly due to contusion, was more frequently accompanied by an additional intracerebral haematoma than a chronic subdural haematoma. Trauma was a more important factor in acute subdural haematomas than in chronic. Almost half of the patients (48%) had a history of hypertension, more than a third (35%) had heart disease and about one fifth (18%) were diabetic. Headache was the most frequent initial symptom. Later decreased level of consciousness and focal neurological signs exceeded the frequency of headache. Three patients with subarachnoid haemorrhage and nine patients with acute subdural haematomas died, while those with chronic subdural haematomas all survived and had at the most mild, non-disabling sequelae. Myocardial infarction (22%), pulmonary embolism (20%), and arterial disease (20%) were the most frequent reasons for anticoagulant treatment. Critical review based on established criteria for anticoagulation treatment suggests there was no medical reason to treat a third of these patients. The single most useful measure that could be taken to reduce the risk of anticoagulation-induced intracranial haemorrhage would be to identify patients who are being unnecessarily treated and to discontinue anticoagulants.

Subdural haematoma is a well known and potentially lethal complication of anticoagulant treatment. Since the first description in 1944¹ several reports concerning this topic have been published. Prior to 1970 these papers were primarily case reports.²⁻²⁰ Later series of up to 20 cases appeared,²¹⁻²⁴ and two recent reports analysed 27 and 46 cases respectively.^{25,26} All authors agree that there is increased risk of haemorrhage under anticoagulant treatment. However, data about additional risk factors such as age,^{18 21 24 25 27-29} sex,^{18 24-26} hypertension,^{18 23-26 28 30-32} interactive drugs,^{23 31 33} and quality of anticoagulation are often incomplete and divergent. Data about epidural bleeding and subarachnoid haemorrhage, the rarer manifestations of

intracranial extracerebral haemorrhages, are also scarce.^{22 24 25 30 31 34-36} Apart from mortality^{18 21 24-26 35} systematic analyses of the outcome of patients suffering such bleeds during anticoagulant treatment are lacking. The present study presents a description and analysis of a large group of intracranial, extracerebral bleeds related to anticoagulation. The aim of the study was to define groups at high risk and thus to contribute to prevention of this event in patients receiving anticoagulation treatment.

Methods

The following methods were used to identify patients who experienced anticoagulation related intracranial bleeds between January 1981 and June 1986.

(a) Review of all the CT reports of the Department of Neuroradiology for the corresponding time period. Usually the patients were admitted to the Department of Neurosurgery, and patients on anticoagulant treatment and relevant clinical data could be identified from the charts. Patients admitted to the Neurosurgical Department with a positive

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CT from outside of our hospital were not missed by this method, since they routinely had a second CT within a few days of admission.

(b) The diagnosis of anticoagulation-related haemorrhage is coded by numbers (VESKA-codes) and stored in a computer after discharge from the hospital. The names of these patients were easily tracked.

(c) The files of the Neurologic and Neurosurgical Clinics not stored in this computer were reviewed.

(d) Seventy six cases with anticoagulation-related intracranial extracerebral bleeds were identified. If the data in the charts were not sufficient to make a retrospective analysis, additional information was obtained from the charts of referring hospitals or the hospitals the patients were released to, or we called the family doctor. Fifty nine patients survived the stay at our hospital. Thirty three of these have been seen in follow up at the Neurology and Neurosurgery Outpatient Clinic. Information about the outcome of the remaining 26 was obtained from the hospitals the patients were released to or from the family doctor.

The diagnosis was made primarily by CT. Only a few of the patients had scintigraphy, angiography or surgery to confirm the diagnosis.

All the data were set up in cross correlation tables by computer. If there seemed to be a difference between two findings, its significance was tested by Chi square test.

Results

Frequency

In the Netherlands most of the orally anticoagulated patients are controlled by institutions run by the state.²⁶ However, in Switzerland anticoagulant therapy is supervised by the family doctors. Therefore it is difficult to get information about the precise number of Swiss on anticoagulants. It can only be estimated from the market volume of anticoagulants sold in Switzerland. Roughly 70,000 of the 6.5 million Swiss inhabitants are under anticoagulant treatment. Since most of the treated persons are 50 years and older and these represent 30% of the population, 3.6% of this older age group are receiving anticoagulants. In Leiden (NL) this figure was 4% on December 1974,²⁶ 6% of men and 2% of women.

From Jan 1 1985 to June 30 1986 155 patients with intracranial extracerebral bleeds (88 men, 66 women) were referred to our hospital. Twenty five (= 16%) of these (16 men, 9 women) occurred on anticoagulant treatment (Wintzen *et al*²⁶ 21%, Bret *et al*²³ 4.8%–14%). No epidural haematomas occurred among patients receiving anticoagulant treatment. These figures indicate a fourfold increased risk of extracerebral bleed with anticoagulation. Assuming the same sex distribution of anticoagulated persons in the Netherlands, the risk increases threefold in men and sixfold in women.

Considering only subdural haematomas the risk of anticoagulation related bleeding is even higher. Twenty three (24%) of 97 subdural collections

occurred with anticoagulation, 15 in men and 8 in women. Thus the risk was 6 times higher than without anticoagulation, 4 times higher for men, 13 times for women.

Age and sex

Of these 76 patients 51 were men, 25 women. The average age was 69 years (men 68.5, women 70.5). The age ranged from 47 to 86 years, and men and women did not show any significant difference in age range. Most of the patients (85%) were 60 years and older (fig 1). Only three patients were younger than 50 years. There was not any seasonally increased frequency of haemorrhage.

Type and location of the bleed

Table 1 gives an overview as to type and localisation of bleed. Ninety per cent occurred in the subdural, 10% in the subarachnoid space. Subdural haematomas occurred predominantly on the right side. Acute subdural bleeds were more frequently associated with an additional haematoma, usually contusional haematoma. In two of the seven subarachnoid haemorrhages angiography revealed a bleeding aneurysm, while in the remaining five no other predisposing factor than anticoagulation was found. There was no anticoagulation associated epidural haematoma.

Trauma

Table 2 gives the data about cranial trauma. Patients were divided into four groups according to the history: Group I: No history of trauma. Group II: Minor trauma without loss of consciousness. Group III: Cerebral concussion (loss of consciousness not longer than 15 minutes). Group IV: Cerebral contusion (loss of consciousness exceeding 15 minutes) and/or skull

Fig 1 Age of patients with anticoagulation-related intracranial extracerebral haemorrhage.

Anticoagulation-related intracranial extracerebral haemorrhage

Table 1 Localisation of intracranial extracerebral haemorrhage while on anticoagulant therapy

	Number of cases (%)	Location	Additional intracerebral haematoma
Subarachnoid haemorrhages	7 (9%)		2
Chronic subdural haematomas	45 (59%)	Right 22 Left 12 Bilateral 11	1
Acute subdural haematomas	24 (31%)	Right 12 Left 9 Bilateral 3	10

fracture. In four cases a history of trauma could not be obtained. One patient with a chronic and 9 patients with an acute subdural bleed had additional intracerebral haematomas. Thirty five of 43 patients with a chronic subdural collection (more than 80%) had no or only a minor cranial trauma (groups I and II). On the other hand, eight of 23 patients with acute collection (one third), especially if associated with intracerebral haematoma, had a severe head injury (groups III and IV). No role of trauma could be assessed for patients with subarachnoid haemorrhage, in part due to the small number of patients.

Type, duration, indication, and quality of anticoagulation

Drugs used; Forty five patients (59%) were taking acenocoumarol (Sintrom®), 29 (38%) phenprocoumon (Marcoumar®), and 2 (3%) were heparinised. The duration of anticoagulation until the first symptom or sign of bleeding is shown in fig 2. Most of the patients (42%) had been anticoagulated more than three years. Seven percent intracranial bleeds occurred within two weeks after start of anticoagulation (including two heparinized cases), 11% within the first month, 20% within two months, and 33% within six months. **Indications for anticoagulant medication** were as follows: myocardial infarction 17 cases (22%), pulmonary embolism 15 cases (20%), arterial disease 15 cases (20%), phlebothrombosis, usually of the lower extremities, nine cases (12%), postoperative immobilisation seven cases (9%), artificial heart valves seven cases (9%), cerebrovascular disease two cases (3%), ischemic heart disease without infarction, chronic atrial fibrillation, and aortic graft after

Fig 2 Duration of anticoagulation until occurrence of haemorrhage.

aneurysm one case each. Patients with myocardial infarction had been anticoagulated for the longest time followed by the group with artificial heart valves, phlebothrombosis, arterial disease and pulmonary embolism. **The quality of the oral anticoagulant treatment** is given in fig 3 as Quick value (prothrombin time) at admission to the hospital. More than half of the prothrombin time values (54%) were in the desired therapeutic range from 30% to 15%. Thirty four percent of the patients were overanticoagulated (prothrombin time value lower than the desired therapeutic range of 15 to 30%). On the other hand 13% had a value higher than the desired therapeutic range. One of the two heparinized patients was overtreated, the other one less than desired.

Drugs interacting with coumarins and alcohol consumption. Drugs interacting with coumarins the patients had been taking are given in table 3. Two thirds of the patients (66%) were taking at least one of the listed drugs at the time of haemorrhage, 26% two and 8% three or more. Six patients (9%) were under the influence of alcohol at the time of the first symptom or sign of intracranial haemorrhage. This figure might be too low, since it depends on the history and clinical impression and was never sought or confirmed by laboratory tests.

Table 2 History of cranial trauma in 72 patients. In 4 of the 76 patients no history was available

	No trauma	Minor trauma without loss of consciousness	Cerebral concussion	Cerebral contusion	Total
Subarachnoid haemorrhage	4	—	2	—	6
Chronic subdural haematomas	23	12	6	2	43
Acute subdural haematomas	6	9	4	4	23

Fig 3 Number of haemorrhages in relation to prothrombin time.

Past medical history

a) *Anticoagulation associated haemorrhage* in the past: There was a history of prior haemorrhage in five patients (7%) (one skin bleeding, two haematurias, and two gastrointestinal bleedings). b) *Disorders of the heart and vascular system*: Twenty nine patients (42% out of 69 patients; the data of seven patients were incomplete) suffered from *ischemic heart disease*. Twenty four (35%) had a history of myocardial infarction (44% of men, 16% of women), 19 (27%) of angina pectoris, and 30 (44%) had symptoms or signs of heart failure. Twenty one (31%) had *cardiac arrhythmia*, half of them atrial fibrillation or flutter, half of them extrasystoles. Twelve (16%) had *heart valve disease*, and seven patients (9%) had an artificial heart valve. A history of *arterial hypertension* was present in 37 (48%) patients. Patients with elevated blood pressure present only after the bleeding but with no history of hypertension were not classified as hypertensive, since an intracranial bleeding can cause reflex hypertension. There were *varicose veins* in 20 of 64 cases

Table 3 Medical treatment interacting with anticoagulation

	Type of medication	Number of cases
Drugs increasing anticoagulant effect	Amiodarone	3
	Chloralhydrate	1
	Cotrimoxazole	2
	Salicylate	5
	Thyroid hormone	1
Drugs probably increasing anticoagulant effect	Nonsteroidal antiinflammatory drugs	8
	Tricyclic antidepressants	1
Drugs decreasing anticoagulant effect	Phenytoine	1
Drugs probably decreasing anticoagulant effect	Cardiac glycosides	30
	Diuretics	24

(incomplete data in 12 cases), in 41% of women and 26% of men. Twenty four (31%) had a history of *venous thrombosis*, usually of the legs (32% of women, 19% of men), and 17 (22%) of *pulmonary embolism* (28% of women, 18% of men). Twenty one (27%) had signs of *arterial disease*, usually of the legs (24% of men, 32% of women). Twelve patients (15%) had a history of cerebrovascular disease, four transient ischemic attacks and eight cerebrovascular infarctions. Two patients had an aortic graft after surgical repair of *aortic aneurysms*. The frequency of all of these conditions did not show to be significantly different in men and women. c) *Diabetes mellitus*. Fourteen of the patients (18%) were diabetic, three of them insulin dependent. d) *Liver disease*. Eight patients (11%) showed signs of liver and biliary tract disease. One patient had cirrhosis, one cholelithiasis and the rest elevated transaminases. For at least three the liver disease was due to alcohol. e) *Neoplasia*. Three patients had a history of tumors, one breast cancer with spinal metastasis, one bladder and one tongue carcinoma without evidence of metastasis. Patients with bleeding into a primary or metastatic intracranial tumor were excluded from this study. f) *Headache*. Nine patients (12%) complained of chronic headache. If headache was a symptom of IEH, it was always of a different type than previous headache episodes. g) *Smoking, alcohol, and drugs*. Twenty eight patients (37%) were smokers. Twelve patients (16%) were chronic drinkers. There was no case of drug abuse or use of illicit drugs.

Symptoms and signs

The first symptoms or signs noticed by the patients, the family, or the attending physician were headache in 30 cases (39%), decreased level of consciousness in 11 (14%), personality disorders in 10 (13%), paresis and plegia in six (8%), nausea and vomiting in 5 (7%), word finding difficulties and aphasia in 4 (5%) and falls also in four cases (5%) (fig 4). Paraesthesias, epileptic fits, and an extracranial bleed occurred as the first symptom or sign once each. In three cases the first symptom could not be identified. Headache was most often the first symptom in all groups. *Symptoms and signs occurring later* are given in fig 5 (including the first symptom or sign) and were as follows: Decreased level of consciousness in 48 cases (63%), headache in 41 (54%), personality disorders in 32 (42%), paresis and plegia in 31 (41%), nausea and vomiting in 21 (28%), word finding difficulties in 11 (15%), falls and stiff neck in 9 (12%), and epileptic fits in five (7%).

Severity of symptoms and signs

The severity of symptoms and signs was classified according to Markwalder and coworkers³⁷ (table 4). Table 5 gives the most severe neurologic/neuropsych-

Fig 4 First symptoms or signs of the anticoagulation-related intracranial extracerebral haemorrhages.

chologic deficit before the decision to operate or not operate on a patient was taken. Patients with acute subdural bleeds seem to be in worst clinical condition prior to the operation; however, the figures are too small to reach statistical significance. Before surgery all the patients who died and all the surviving patients in grades 3 and 4 had decreased level of consciousness and motor deficits.

Computertomographic findings

All the patients had CT evaluation but two with a subarachnoid haemorrhage. After the end of 1983 all the patients were examined by a General Electric 9800 scanner. From these an analysis of the thickness and volume of the haematoma, displacement of midline structures, and signs of transtentorial herniation such as effacement of the basal cisterns and enlargement of the contralateral temporal horn could easily be estab-

Fig 5 Frequency of symptoms and signs occurring in the course of the anticoagulation-related intracranial extracerebral haemorrhages.

Table 4 Clinical grades of neurologic and neuropsychologic deficits (according to Markwalder et al³⁷)

Grade 0	No symptoms, or signs
Grade 1	Patient alert and oriented. Minor complaints such as headache. No or mild neurologic and/or neuropsychologic signs such as asymmetric reflexes, slight memory disturbances or word finding difficulties.
Grade 2	Patient sleepy and/or disoriented. Severe neurologic or neuropsychologic signs such as hemiparesis, aphasia, hemianopsia, or abnormal behaviour.
Grade 3	Patient stuporous. Reaction to painful stimuli. Severe focal deficits such as hemiplegia.
Grade 4	Patient comatose. No or bilateral abnormal reaction to painful stimuli. Decerebration.

lished. Prior to 1984 an EMI Scanner was used. Only a few of these films could be used for analysis. The average thickness of a subdural haematoma was 1.5–2 cm. With increasing thickness there was an increase in mortality. The correlation between *displacement of midline structures* and mortality as shown in figure 6 is even higher. Only two of four patients with displacements of the septum pellucidum of more than 20 mm and none of two with displacement of more than 25 mm survived. Mortality was highest in the patient group with the most signs of transtentorial herniation (fig 7). Thirty six patients (80%) showed none, four (9%) slight and five (11%) moderate brain atrophy. There was no significant correlation between atrophy and outcome.

Treatment

Forty of 45 chronic and 14 of 24 acute subdural collections were evacuated surgically by burr hole craniostomy. Four chronic collections were not operated because of few clinical signs and small size. One patient died of pulmonary edema before operation. In six patients with an acute bleed surgical intervention did not seem reasonable because of poor neurological status. Two patients could not be operated because of other medical problems, and two haematomas were not evacuated because of small size. Of the seven patients with subarachnoid haemorrhage the two with aneurysms had surgical and the remaining five medical treatment.

Table 5 Most severe clinical deficit of 76 anticoagulation related intracranial extracerebral haemorrhages. Grades according to definition in table 4

	Grade 1	Grade 2	Grade 3	Grade 4
Subarachnoid haemorrhage	2	3	1	1
Chronic subdural haematoma	4	27	10	4
Acute subdural haematoma	1	8	6	9
Total of patients	7	38	17	14

Fig 6 Graph showing correlation between displacement of midline structures and mortality.

Outcome

The outcome, expressed by the clinical findings at discharge from the hospital and at one to two months later is given in table 6. The classification was made again according to Markwalder *et al*³⁷ (table 4). Three of seven patients with subarachnoid haemorrhage died. All the patients with chronic subdural collections survived, whereas nine (37%) of the 24 patients with

Fig 7 Mortality was highest in the group with the highest grade of transtentorial herniation. The grade of transtentorial herniation was assessed by computerized tomography. Grade 0: No sign suggesting transtentorial herniation. Grade 1: Effacement of the basal cisterns ipsilateral to the haemorrhage. Grade 2: Effacement of the basal cisterns ipsilateral to the haemorrhage and dilatation of the inferior horn of the lateral ventricle on the opposite side. Grade 3: Effacement of the basal cisterns on both sides.

Table 6 Clinical follow-up. Grades as defined in table 4

Most severe clinical grade	Number of patients	Clinical grade 1 to 2 months after discharge from hospital	Number of patients
Grade 1	7	Grade 0	7
Grade 2	38	Grade 0	22
		Grade 1	13
		Died because of IEH	1
		Died of other reason	2
Grade 3	17	Grade 0	7
		Grade 1	6
		Died because of IEH	2
		Died of other reason	2
Grade 4	14	Grade 0	1
		Grade 1	2
		Died because of IEH	9
		Died of other reason	2

IEH = intra cranial haemorrhage.

acute subdural bleeds died, five of them with an additional intracerebral haematoma. Of the 14 patients who had no intracerebral haematoma in addition to the acute subdural bleed, four died (28%). None of the surviving patients had a neurologic/neuropsychologic deficit higher than grade 1, one to two months after haemorrhage. Two thirds of the patients with a chronic and half of the patients with an acute subdural collection did not show any symptoms or signs at the time of the final examination. Age, sex and past medical history did not influence the outcome. However, patients in the worst clinical condition, who usually also had midline shifts and signs of transtentorial herniation on CT, showed the highest mortality rate. There was a correlation between outcome and most severe clinical deficit (correlation coefficient $r = 0.89$).

Discussion

Intracranial extracerebral haemorrhage while on anticoagulation treatment has been described since the introduction and wide use of oral anticoagulants. In the present series of 76 anticoagulant associated bleeds, 69 (91%) were located in the subdural and seven (9%) in the subarachnoid space. One third of the subdural bleeds had an acute and two thirds a chronic course. There was no epidural haematoma in this series.

The first issue is, whether intracranial bleeds and anticoagulation treatment occur together by chance or if anticoagulants increase the risk. According to Wintzen *et al* the risk of suffering a subdural bleed while on anticoagulant treatment is increased seven times in men and 26 times in women. Using the same figures as Wintzen *et al*, this relative risk would be a factor four in men and a factor 13 in women in our series. Such an increased risk can hardly be explained by chance. Anticoagulation associated bilateral subdural bleeds were not more frequent than non-

anticoagulation-related bilateral haematomas, which is in agreement with Wintzen *et al*²⁶ and does not confirm the suspicion of Huguenin.¹⁸ Anticoagulation associated haemorrhage occurs significantly more often on the right side. The reason is unclear.

Wintzen *et al*²⁶ calculated the risk of suffering an intracranial bleed during anticoagulant treatment. They found one haemorrhage during 2000 treatment years. The absolute risk in our population can be estimated from the market volume of anticoagulants in Switzerland. Roughly 70,000 of the 6.5 million Swiss residents are anticoagulated and we estimate 10,800 to live in the catchment area to our neurosurgical department. In the 5.5 year period under study 76 patients were diagnosed of which 12 had a fatal outcome. This indicates an annual probability of 1.3 per thousand of an anticoagulation-related bleed. The annual chance of dying from anticoagulation-related intracranial extracerebral haematoma is 0.2 per thousand.

Some authors assume that the course of anticoagulant associated extracerebral bleeds is more severe than in non-anticoagulation-related bleeds.^{18 24 35} This assumption is corroborated neither by this study nor by the results of Wintzen *et al*.²⁶ Markwalder *et al*^{37 38} did not find a more severe course in anticoagulation associated subdural haematomas either. Acute subdural clots in this study had a mortality of 37.5%, whereas with purely traumatic lesions the mortality reaches 80%. Anticoagulant associated acute subdural bleeds occurred more often after relevant cranial trauma than chronic collections and were more frequently associated with an intracerebral haematoma.

Anticoagulation related subarachnoid haemorrhages are rare. Only seven of the 76 anticoagulation related bleedings were located in the subarachnoid space, and in two of them an aneurysm was identified. These subarachnoid hemorrhages may have happened by chance.

It is interesting to review conditions and diseases of the past medical history not leading to anticoagulation per se, for example hypertension. Its role in anticoagulation associated haemorrhage is controversial.^{18 23-26 30-32} Almost half of our patients (48%) had a history of hypertension. This percentage is high and favours the assumption of hypertension being a risk factor in spite of the lack of a control population. The same holds true for diabetes mellitus. A percentage of 19% seems to be high compared to the prevalence of two to 10% in a normal population. On the other hand diabetes causes vascular diseases and thus leads indirectly to anticoagulation. Our data do not allow any conclusion about drugs interacting with anticoagulants. However, the high percentage (66%) of patients taking one or more drug potentially

interacting with anticoagulants should alert the physician to recognize such a possible interaction early.^{23 31}

The role of head injury in pathogenesis of anticoagulation related intracranial bleeds is also controversial. Some authors favor it,^{21 23 35} others deny it.^{24 26} In our material, trauma had at most a minor role in chronic subdural bleeds. However, in acute bleeds, especially if associated with an intracerebral haematoma, there was often a history of severe head trauma.

Because the risk of bleeding and thus also of intracranial haemorrhage is increased while on anticoagulation, the first aim must be to reduce unnecessary use of anticoagulants. The National Conference on Antithrombotic Therapy summarized the most recent studies on the use and benefits of antithrombotic agents.³⁹ According to its recommendations, anticoagulants should not be used longer than three months after a myocardial infarction. However, this was the most frequent indication among our patients, and this was also the group with the longest duration of treatment as in other series.^{23-25 31 35} None of the patients with myocardial infarction as the indication for anticoagulation had been treated for less than three to six months. According to these recommendations in almost one quarter of our patients there was no longer an indication for anticoagulation. The situation with pulmonary embolism and venous thrombosis is similar. In these conditions the National Conference on Antithrombotic Therapy recommends anticoagulation for three months and longer duration of treatment only in recurring embolism or thrombosis. Only 12 of 24 cases fulfilled these criteria. Long term anticoagulation with artificial heart valves or atrial fibrillation due to cardiomyopathies is not called into question, and the recommendations given with peripheral arterial occlusive disease also are not firm about short or long term anticoagulation. To sum up, the indication for antithrombotic therapy was doubtful in 38% of the patients. If long term treatment had been used restrictively, almost every third case could have been avoided.

One third of cases occurred during the first six months of treatment. This might be the most dangerous period. However, not knowing the prevalence and average duration of anticoagulation in the Swiss population, no definite conclusion can be deduced from this fact. Kase *et al*, studying anticoagulation-associated intracerebral haemorrhage, found the highest risk of bleeding in the first months after start of anticoagulation,⁴⁰ whereas Levine and Hirsh³² considered this risk to be the same at any time of treatment.

In 34% of the patients a prothrombin time value was measured beyond the desired therapeutic range.

This favours the assumption that quality of anticoagulation is an important factor. However, the course of haemorrhage in overtreated patients was not more severe than in patients with prothrombin time values in the desired therapeutic range. Furthermore the prothrombin time value varies considerably upon the thromboplastin used for its assessment. It is recommended to give the result not in Quick percentage values but rather in international normalized ratios (INR).⁴¹

If a patient on anticoagulants develops symptoms such as unusual headache, a personality disorder, and/or focal neurological deficits, the clinician should suspect an anticoagulant-related haemorrhage. If the neuroradiological workup verifies an *acute subdural bleed*, the bleeding has to be stemmed aggressively. We use vitamin K and coagulation factors (fresh frozen plasma or isolated preparations of coagulation factors II, VII, IX, and X) to normalize coagulation. The goal is a prothrombin time of 1.2 or less (INR value; for conversion of Quick percentage to INR values see reference 41). As soon as prothrombin time has reached a value of 1.8 surgical drainage of the haematoma is started. Patients with a *chronic subdural collection* are managed in the same way. When only minor or no symptoms or signs are present (grades 0 and 1), we give only vitamin K and no coagulation factors and perform surgery several hours or up to one day later when prothrombin time is in the range of 1.8 or less. Anticoagulated patients with *subarachnoid haemorrhage* receive also vitamin K and coagulation factors and additionally Nimodipine.⁴² Aneurysms if present are clipped as early as possible, and surgery is delayed only in patients in Hunt and Hess grade IV and V.

An extracerebral haemorrhage is a severe complication of anticoagulation treatment. In this series the mortality was 16%. The most efficient way to reduce its occurrence is to check the indication for anticoagulant treatment over and over again. On the other hand, the fear of bleeding complications should not restrain the physician from antithrombotic therapy, and after haemorrhage it should not restrain the physician from restarting the anticoagulant medication following an appropriate time period either. Some of the patients do not die because of the intracranial bleed. They die after discontinuation of anticoagulation because of the disease for which the treatment was being given.

Mortality of anticoagulation associated extracerebral bleeds in this series is less than previously reported (48%).²⁶ This might be due to improved diagnostic tools (CT) and improvement of surgical techniques. Irrespective of the course of the haemorrhage and the severity of the clinical conditions, surviving patients were left with little or no residues.

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