

Role of bioclimate conditions on cerebral aneurysm rupture in Brittany region

Grégoire Le Gac

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**THÈSE D'EXERCICE / UNIVERSITÉ DE RENNES 1
FACULTÉ DE MEDECINE**

Sous le sceau de l'Université Européenne de Bretagne

**THÈSE EN VUE DU
DIPLOME D'ÉTAT DE DOCTEUR EN MEDECINE**

Présentée par

Grégoire LE GAC

Né le 25 janvier 1985 à RENNES

**Role of bioclimate
conditions on cerebral
aneurysm rupture in
Brittany region**

**Thèse soutenue à RENNES
le 23/03/2016**

devant le jury composé de :

Philippe SEGUIN

Professeur, CHU Rennes / *président*

Xavier MORANDI

Professeur, CHU Rennes / *Juge*

Jean-Yves GAUVRIT

Professeur, CHU Rennes / *Juge*

Pierre-Jean LE RESTE

Docteur, CHU Rennes / *Juge*

Yoann LAUNEY

Docteur, CHU Rennes / *directeur de thèse*

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Role of bioclimate conditions on cerebral aneurysm rupture in Brittany region

Abstract

Introduction: Today, the subarachnoid haemorrhage (SAH) from ruptured intracranial aneurysm is an unpredictable event responsible for significant morbidity and mortality. Some studies suggest a potential role of climate conditions in SAH occurrence. The purpose of this study is to determine the impact of climatic factors and the moon influence on the new onset of SAH in an oceanic climate such as Brittany, France.

Methods: All adult with SAH hospitalized in the neurosurgery department and intensive care unit at the Rennes University Hospital between January 1st, 2011 and December 31st, 2012 were included. Meteorological variables, variations of these variables, moon phase and tidal coefficient were compared between days with SAH and days without SAH.

Results: We included 295 patients with SAH. The mean minimal temperature was significantly lower during days with SAH ($7,7\pm 4,7^{\circ}\text{C}$ vs $8,3\pm 4,6^{\circ}\text{C}$; $p = 0,039$); the fall of temperature between 2 days was significantly higher for days with SAH ($8,6\pm 4,1^{\circ}\text{C}$ vs $7,9\pm 3,8^{\circ}\text{C}$; $p = 0,0095$). Multivariate analysis showed that if the temperature fall between 2 days was greater than or equal to 8°C the SAH risk increased by 35% (odd ratio 1,35 [1,03 – 1,77]). There was no significant effect of other meteorological variables, neither the moon phase nor the tidal coefficient on SAH occurrence.

Conclusion: Low temperature and sudden temperature drop seemed to be associated with an increase of SAH occurrence in Brittany.

Introduction

Aneurysmal subarachnoid haemorrhage (SAH) is a common pathology with an incidence ranging from 6 to 9 per 100 000 inhabitant responsible for significant morbidity and mortality (1–6)(7). Individual risk factors of aneurysm rupture have been identified such as female sex, age over 50, excessive alcohol consumption, smoking and arterial hypertension (1,8,9). Despite the identification of these risk factors, the onset of aneurysmal SAH remains an unpredictable event often described as “a bolt from the blue”.

It is a common belief that the climate or the moon can influence humans, animals and various diseases (10,11).

Some studies suggest a potential role of climate conditions in intracerebral haemorrhage or SAH occurrence (12–22). These studies harbour however discordant results, several studies showing an association between the onset of SAH and the variations of atmosphere pressure (18,22,23), the season and low temperature (14,15). Conversely, other studies did not find any association between these severe brain injuries and the climate conditions (13,19,21,24). To explain these inconsistencies, we hypothesized that geographic location at the time of aneurysm rupture have an impact on aneurysm rupture according to the corresponding type of climate involved. In the geographic regions without significant meteorological variations, or with large enough area to depend of various climate types, several studies showed no association between SAH onset and climate conditions. Moreover, the statistical tools and analysis sometimes seem not optimal. Actually, these studies explored and mainly analysed climatic data as isolated variables without considering them as close intertwined values or as a climate profile.

Similarly, the different phases of the moon has been suggested to influence SAH onset. The new moon phase seems to be associated with an increase of SAH onset

(25) but few studies investigated the role of the moon and the results are discordant (24,26). These studies have considered only the phase of the illumination of the moon and have not integrate the effect of the moon on tidal coefficient.

The purpose of this study is to determine the impact of climatic factors and the moon influence on the new onset of SAH in an oceanic climate in the region Brittany, France.

Material and methods

We conducted a retrospective study in Rennes University Hospital, a tertiary hospital that bring together all SAH in Brittany. Brittany is a French region of 3,26 millions inhabitants in 2012. Its land area spread over 27,208km² where the climate is temperate, classified in oceanic climate (27). Rennes and Brest are the two main cities in Brittany and each one account for 318 127 and 314 844 inhabitants in 2012 respectively. This study was submitted to the local ethical committee of Rennes University Hospital, which stated that no patient consent was needed according to the French law.

Objectives

The primary objective of this study was to determine if atmospheric pressure change influence new onset of SAH on an overall analysis according to the weather of Rennes and Brest cities, by comparing days with or without SAH occurrence.

Secondary objectives was to identify the others climatics factors responsible for SAH occurrence (Temperature, Humidity rate, wind speed) on an overall analysis, to determine whether climatics factors had an impact on SAH severity according to the WFNS scale, the locations and the size of aneurysms based on an individual data analysis. Finally the influence of the moon and the tide on SAH occurrence was studied.

Patient Data

All adult (>18yo) patients with aneurysm or spontaneous non-aneurysmal SAH hospitalized in the neurosurgery department and intensive care unit at the Rennes University Hospital between January 1st, 2011 and December 31st, 2012 were

included. Patients with SAH due to trauma, ruptured arteriovenous malformations, vasculitis, and other structural lesions were excluded. For all patients, we collected age, gender, known risk factors of SAH (hypertension, smoking and alcohol consumption), the geographical location and the date of the SAH onset, defined as the day of headache or the date of hospitalization in case of coma, the hospitalization time and mortality. General and SAH specific severity scores were reported such as the Glasgow Coma Score, Severity Acute Physiological Score II (SAPS II)(28), Fisher and World Federation of Neurosurgical Societies (WFNS) score. The cerebral artery aneurysm was characterized by the determination of its location and matched according to 6 regions (anterior, medium, posterior, vertebrobasilar, carotid, and *sine materia* if no aneurysm were visualized on cerebral CT-scan). The aneurysm size in millimeters, the type of aneurysm treatment (surgery, embolization, abstention), and the consecutive potential complication (intracranial pressure, re-bleeding, cerebral vasospasm) were reported.

Meteorological data

For individual analysis, the season, the maximum, minimum and the change in barometric pressure, relative humidity rate and temperature, the maximum and the average wind speed during the day of SAH onset and the day before were collected. Data were collected on the website "<http://www.meteo-bretagne.fr>". In case of unavailable data on the exact geographical area of the SAH occurrence, data from the area closest were taken into account.

For overall analyses, the maximum value, the minimum value and the maximal variation (defined as maximum value minus minimum value over 24h) were used for the following parameters: the barometric pressure, the relative humidity rate and the

temperature. The maximum and the average speed of the wind every day between 1 January 2011 and 31 December 2012 for the cities of Rennes and Brest (both large cities of Brittany) were collected.

Moon and tide data

Each day was matched with the moon phase and the nearest port tidal coefficient (e.g. Saint-Malo port for Rennes). All data were collected on the website "<http://maree.info>". A moon cycle length is 29.5 days, which corresponds to the time required for one complete revolution of the moon around the earth. Consequently the cycle of the moon has been divided into 8 phases (New moon; Waxing crescent; First quarter; Waxing gibbous; Full moon; Waning gibbous; Last quarter; Waning crescent). The tidal coefficient in the morning and in the afternoon was collected, then the maximum of these 2 values have been classified into 9 categories (≤ 39 ; 40 – 49; 50 – 59; 60 – 69; 70 – 79; 80 – 89; 90 – 99; 100 – 109; ≥ 110).

Statistical analysis

Statistical analysis was performed with SAS software version 9.4. T-test was used for quantitative variables such as climatic variables (temperature, barometric pressure, humidity relative rate, the mean value and the maximum value of wind speed) and their climatic variations. Climatic variations were either a rise or a fall of a climatic variable over 2 days. A rise between 2 days was determined by subtracting the maximum of a day by the minimum of the day before and a fall between 2 days was defined as the maximum value of a day minus the minimum value of the day before.

Qualitative variable such as moon phase, tidal coefficient or patient characteristics were analysed using chi-square test. Multiclass variables were analysed by ANOVA method.

Tidal coefficient was analysed as a quantitative variable and a qualitative variable after being allocated into categories.

Multivariate analysis and ROC curves built from the logistic model were performed to determine the most relevant variable and to determine a threshold for SAH risk.

Multivariate analysis by ANOVA and logistic regression were performed to determine whether climate variations influenced the severity of SAH, assessed by WFNS score.

The other objective was to determine the effect of climate on aneurysm location.

Variables influencing the size of ruptured aneurysm were analysed by generalized linear model.

Results

Patient characteristics

We retrospectively included 295 patients hospitalized for SAH in our centre, 69 patients (23%) were from Brest city and its surrounding, 226 patients (77%) were from Rennes and its surrounding. Patient's characteristics and the distribution of risk factors for SAH are summarized in Table 1. The mean age of the population was 53 ± 13 years; the proportion of women was 64%, 46% of patients were tobacco users, 25% had arterial hypertension and 7% had excessive alcohol consumption. The severity was assessed with SAPS II, the mean score was 26 ± 13 , the mean Glasgow scale was 13 ± 4 , the mean Fisher score was 3 ± 1 and the WFNS score was 3 ± 2 . The main complications were hydrocephalus (30%) and vasospasm (24%) (summarized in Table 1). The overall mortality rate was 8%, the mean length of stay in ICU was 7.7 ± 8.2 days and the mean length of stay in hospital was 22.7 ± 24.9 days.

Aneurysm characteristics

The aneurysms were mostly localized in the anterior cerebral circulation (Anterior communicating artery; Anterior cerebral artery: 34%) and in the middle cerebral circulation (middle cerebral artery: 22%); the mean size was $5,8\pm 3,2$ mm. Most of intracranial aneurysms were treated by embolization (77%). The remaining aneurysms were treated by surveillance (16%) and surgery (7%). Aneurysm characteristics are summarized in table 2.

Monthly and seasonal SAH incidence

SAH occurred in 259 days out of the 731 days (26%) of the study. The month with the highest rate of SAH occurrence was July (n = 29 days; 47%) then January (n =

28 days; 45%) (figure 1). The month with the lowest rate of SAH occurrence was May and August (n = 16; 26%) (figure 1A). Winter was the season with the highest rate of SAH occurrence (n = 80; 27%) and Spring the one with the lowest rate (n = 65; 23%) (figure 1B). There was no significant statistical difference in SAH occurrence between each month ($p = 0,26$) or between each season ($p = 0,54$).

Overall analysis

The minimal temperature was significantly lower during days with SAH than days without SAH ($7.69 \pm 4.7^\circ\text{C}$ versus $8.3 \pm 4.7^\circ\text{C}$, $p=0.039$). There were no significant differences between days with SAH and days without SAH for maximal temperature, maximal and minimal barometric pressure, relative humidity rate, average or maximum wind speed (table 3). In addition, the fall of temperature between 2 days was significantly higher in days with SAH than days without SAH ($8.6 \pm 4.1^\circ\text{C}$ versus $7.9 \pm 3.8^\circ\text{C}$ $p = 0,0095$). There were no other significant differences between days with SAH and days without SAH for the other climatic variations (table 4).

The multivariate analysis showed that for the fall of one additional Celsius degree, the risk of aneurysmal SAH occurrence increases by 7% (1,07; 95%IC [1,03-1,10]). The higher the maximum temperature was, the higher the risk of SAH decreased (0,97; 95%IC [0,95-0,99]). According to the results of ROC curves from the logistic model, a threshold of 8°C seemed optimum. If the temperature falls between 2 days was greater than or equal to 8°C , the SAH risk increased by 35% (1,35; 95%IC [1,03 – 1,77]).

Individual analysis

There was no influence of climatic variable and variations on SAH severity (table 5). The variables that influence the WFNS score were age over 50yo (OR = 1,90 [1,21 – 2,99]), female sex (OR = 2,06 [1,25 – 3,39]) and alcohol consumption (OR = 2,41 [1,02 – 5,71]). The odd ratios (OR) were proportional e.g. the OR were the same to pass from class 1 to 2, from class 2 to 3 and so on.

There was no evidence of influence climatic variables and variations of SAH occurrence according to the location. Concerning of the aneurysm size, a gradient was observed with the season, $5,94 \pm 3,70$ mm in winter, $5,34 \pm 3,79$ mm in spring, $4,86 \pm 3,27$ mm in summer and $4,84 \pm 2,93$ mm in autumn ($p = 0,0092$). Tobacco use and diabetes also influenced the size of ruptured aneurysms, aneurysms sizes were larger in tobacco users $5,69 \pm 3,22$ mm versus $4,88 \pm 3,61$ mm ($p = 0,035$), aneurysm size were smaller in diabetic patient $2,00 \pm 2,83$ mm versus $5,32 \pm 3,43$ mm ($p = 0,036$). No effects were found for the other climatic variables or their variations.

Moon and tide data

There was no statistical evidence of the influence of the moon phase on the SAH onset ($p = 0.11$) (figure 2A). The mean tidal coefficient was 70.5 ± 19.2 for days with SAH and 72.2 ± 20.8 for days without SAH and no significant difference was found ($p = 0.21$). There was also no difference after having classified tidal coefficient as shown in figure 2B ($p = 0.12$).

Discussion

Our study do not find any associations between SAH onset and barometric pressure changes, it shows that low temperature and falling temperature between 2 days may be associated with a risk of SAH occurrence. There is no evidence that other meteorological variables and variations, such as barometric pressure, relative humidity rate and wind speed, are associated with an increased risk of SAH.

Moreover, a role of other meteorological variables has been suggested but in our observation we did not found any evidences supporting these findings. These studies mostly showed that a brutal change in barometric mean pressure more than 10hPa from the previous day of SAH onset, was associated with a significant risk of SAH occurrence odds ratio: 2.7 (1,027 [1 – 13], p = 0,035) (22,23,37,38). In our study we did not find any role of barometric pressure but an explanation could be the greater mean variation of barometric pressure observed in these studies.

Several studies showed that SAH occurrence increases in winter like in our study (16,23,29,30) but the nadir was in Summer. This result differs from our study in which the lowest SAH incidence was in Spring. No significant difference in SAH incidence according to the month or the season was observed, but the peak of incidence during Winter could be explain by the influence of temperature and its variations. Some studies seem to support the influence of temperature on SAH occurrence (15,16). Gill et al., on a cohort of 1175 adult patients in Maryland, showed that a decrease of 1°F was associated with a 0.6% increase in the risk of SAH (15). Rivera-Lara et al. (16) also showed that SAH occurred during colder days with daily maximal temperature inferior to 70°F. These latter results could be explain by an increase of blood pressure involving vasoconstriction or a modification of the blood coagulation (31–34). Cold weather also seems to increase risks of others vascular diseases such as

stroke or myocardial infarction based on the same pathophysiology (10,32,35,36). Finally, colder days induced changes in behaviour, physical activity, smoking or alcohol consumption that are known risks factors of aneurysmal SAH.

Moreover, a role of other meteorological variables has been suggested but in our observation we did not found any evidences supporting these findings. These studies mostly showed that a brutal change in barometric mean pressure more than 10hPa from the previous day of SAH onset, was associated with a significant risk of SAH occurrence odds ratio: 2.7 (1,027 [1 – 13], $p = 0,035$) (22,23,37,38). In our study we did not find any role of barometric pressure but an explanation could be the greater mean variation of barometric pressure observed in these studies.

Finally, several studies did not find any link between climate and SAH occurrence (13,19,21). These studies had limitations, the day of SAH onset was determined from national hospital databases in which the hospital admission day was assimilated to the day of SAH occurrence and the effects of microclimates within different zone also were not adequately addressed (19,21). Beseoglu et al. (13) in the Düsseldorf metropolitan area did not find any association between climate and SAH occurrence but the climatic changes of this area were limited, especially the absolute change in temperature between the day of SAH occurrence and the day before, was low and did not exceed 3°C. In our study, if the temperature fall between 2 days was greater than or equal to 8°C the SAH risk increased by 35%, and could explain the different conclusion.

Hughes et al. (39) found that anterior communicating artery aneurysmal SAH peaked in Summer whereas middle cerebral and posterior communicating artery aneurysmal SAH peaked in Spring and Autumn. Our study did not support these findings on aneurysm locations but we found an influence of season on ruptured aneurysms

according to their size: the largest aneurysms ruptured in Winter then in Spring and the smallest in Autumn then in Summer. This results could explain that we observed the aneurysmal SAH onset depending on season since aneurysm size is a risk of rupture (40). To the best of our knowledge, no study has investigated the effect of climate on aneurysm and patient characteristics and these finding supports the role of temperature in SAH occurrence. Tobacco use and diabetes also seemed to influence the aneurysm size; tobacco use seems to increase the aneurysm size as previously reported (41); but no previous study showed clearly a role of diabetes on aneurysm size. In this study we found that diabetes may be associated with a reduced aneurysm size.

Concerning of the moon cycle, its influence remains unclear. Ali et al (25) found an increase of SAH occurrence during new moon phase but the major limitation of this study lay in its retrospective design and limited sample size. On a larger cohort of 717 patients with SAH, Lahner et al. did not find any association (26). In an original way, we explored the impact of the tide on SAH onset, another aspect of the moon influence, but no influence of moon or tide were found. The influence of moon and tide on SAH occurrence remains more a myth than reality.

Nevertheless, our study has several limits. First, it is a retrospective study in which all patients hospitalized in the Rennes University Hospital between 2011 and 2012 were included. We managed to identify the place and the day of hospital admission but we failed to determine accurately the hour and the exact location of the SAH onset. Climatic data could be more accurate. For the overall analysis, we considered that Brittany climate was divided in 2 main zones with different superficies; the first area was defined as a climate close to Brest and the second as a climate close to Rennes.

Secondly, we do not manage to include all patients from Brest. During the period of the study, embolization procedure was not available in Brest university hospital, implicating that every patient who needed this treatment was transferred to Rennes university hospital. However, all patients who had *sine materia* SAH or underwent surgery, were kept in Brest hospital. Seventy percent of patients admitted to Rennes hospital, underwent embolization procedure, assuming the same proportion in Brest hospital, we could have failed to include 29 patients who stayed in Brest.

Thirdly, the SAH incidence varies between geographical area, ranging from 6/100,000 in Finland to 20/100,000 inhabitants in Japan (22,42,43). Moreover intracranial aneurysm incidence is unknown in the general population. Indeed, a part of the general population develops cerebral aneurysm without aneurysm rupture throughout their life (7,44). This issue could explain the difference between studies. In our study, SAH incidence in Brittany was around 7/100,000 person-years which is lesser than the previous studies (22,42,43). The mortality rate was lower than those reported previously which are close to 30% (1–6). More recent studies showed a decrease of the mortality rate of SAH to 25% (45–47). Moreover, in a nationwide american study where intra-arterial coiling rates were predominant, the mortality rate were 13% (20), which was closer to our mortality rate (8%). The changes in the treatment of SAH (e.g. intra-arterial coiling) could explain a part of these observations. In our study, we did not include fatal SAH before hospitalization; this bias could partially explain the differences observed between our results and those of the previous studies.

The influence of climate on SAH remains unclear. The investigation could be enhance by a prospective study in order to solve the limitation concerning the

accuracy of the place and the time of SAH onset, to warrant a more precise meteorological statement and consequently a more fine-tuned analysis. However, in clinical practice, time stamping the aneurysm rupture is tricky because of the initial coma or a frequent past history of headache.

Conclusion

Low temperature and sudden fall of temperature more than 8°C increase the risk of SAH occurrence of 35% in Brittany, a French region with temperate climate. There was no evidence that others meteorological variables could influence SAH occurrence. The effect of moon and tide seems to be more a myth than a reality. These findings might help physicians by adding an argument to evoke SAH occurrence in case of headache during cold weather and sudden change of temperature.

Despite the weak influence of climate found in our study, further investigations are needed to fully understand the pathophysiology and the real impact of climate on cerebral aneurysm rupture.

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List of abbreviations

SAH: subarachnoid haemorrhage

SAPS II: Simplified acute physiology score II

WFNS: World federation of neurosurgical societies

SD: Standard deviation

ICU: Intensive care unit

LOS: length of stay

Max: Maximum

Min: Minimum

OR: Odd ratios

Characteristics. N (%) or mean \pm SD	n = 295
Age (years)	53 \pm 13
Sex ratio (Female/Male)	1.76 (188/107)
<u>Center</u>	
• Rennes	226 (77%)
• Brest	69 (23%)
<u>Risks factors</u>	
• Arterial hypertension	74 (25%)
• Diabetes	6 (2%)
• Familial SAH history	12 (4%)
• Polycystic kidney disease	2 (1%)
• Tobacco use	137 (46%)
• Alcoholism	20 (7%)
SAPS II score	26 \pm 15
Glasgow coma scale	13 \pm 4
WFNS score	2 \pm 1
Fisher score	3 \pm 1
<u>Complications</u>	
• Intracranial Hypertension	33 (11%)
• Hematoma	38 (13%)
• Hydrocephalus	89 (30%)
• Vasospasm	71 (24%)
• Rebleeding	1 (0,3%)
• Ischemia	15 (5%)
• Infection	31 (11%)
Overall ICU Mortality	24 (8%)
Overall Hospital Mortality	24 (8%)
LOS in ICU (days)	7,7 \pm 8,2
LOS in hospital (days)	22,7 \pm 24,9

Table 1: Patients characteristics. ICU: Intensive Care Unit; SAPS II: Simplified acute physiology score; SAH: Subarachnoid haemorrhage; LOS: length of stay

Aneurysm characteristics. N (%) or mean \pm SD	n = 295
<u>Aneurysm location</u>	
• Anterior	100 (34%)
• Medium	65 (22%)
• Posterior	17 (6%)
• Carotid	50 (17%)
• Vertebro-basilar	25 (8%)
• <i>Sine materia</i>	38 (13%)
Aneurysm size (mm)	5,8 \pm 3,2
<u>Aneurysm treatment</u>	
• Embolization	226 (77%)
• Surgical	23 (7%)
• None	46 (16%)

Table 2: Aneurysm characteristics.

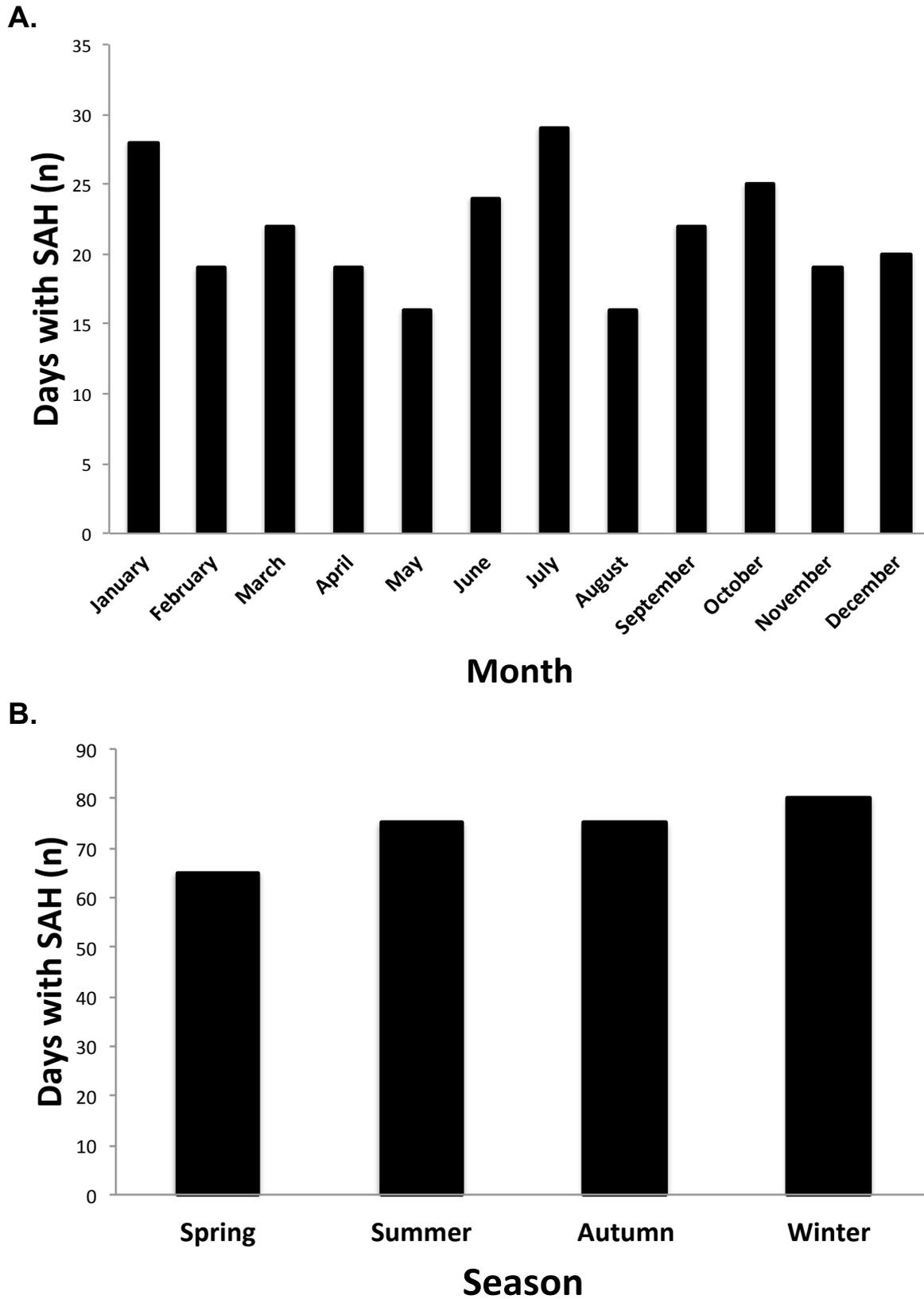


Figure 1: (A) Monthly ($p = 0,26$) and (B) Seasonal ($p = 0,54$) Subarachnoid haemorrhage incidence in Brittany between January 1st 2011 and December 31st 2012. SAH: subarachnoid haemorrhage

Climate variables. Mean \pm SD	Days with SAH (n=259)	Days without SAH (n= 1203)	p value
<u>Temperature ($^{\circ}$Celsius)</u>			
• Maximum temperature	16 \pm 5,8	16,3 \pm 16,3	0,41
• Minimum temperature	7,7 \pm 4,7	8,3 \pm 4,7	<0,05*
<u>Barometric pressure in hPa</u>			
• Maximum pressure	1021,3 \pm 8,5	1020,4 \pm 8,8	0,12
• Minimum pressure	1015,8 \pm 9,8	1014,7 \pm 10,1	0,1
<u>Humidity relative rate (%)</u>			
• Maximum rate	95,4 \pm 4,4	95,8 \pm 4	0,26
• Minimum rate	63,2 \pm 16,7	63,5 \pm 15,5	0,72
<u>Wind speed in Km.h⁻¹</u>			
• Average speed	13,8 \pm 6,4	14,5 \pm 6,6	0,14
• Max speed	41,2 \pm 15,4	40 \pm 14,4	0,22

Table 3: Effects of meteorological parameters on subarachnoid haemorrhage occurrence. Max: maximum; SAH: subarachnoid haemorrhage

Variations. Mean \pm SD	Days with SAH (n=259)	Days without SAH (n= 1203)	p value
<u>Temperature ($^{\circ}$Celsius)</u>			
• J0max - J0min	8,3 \pm 4,3	8 \pm 4	0,2
• J-1max - J0min	8,6 \pm 4,1	7,9 \pm 3,8	<0,05*
• J0max - J-1min	8,1 \pm 4,7	8 \pm 4,3	0,84
<u>Barometric pressure (hPa)</u>			
• J0max - J0min	5,5 \pm 3,6	5,7 \pm 3,8	0,31
• J-1max - J0min	5,7 \pm 5,8	5,7 \pm 5,7	0,99
• J0max - J-1min	5,5 \pm 5,8	5,7 \pm 6,2	0,75
<u>Humidity relative rate (%)</u>			
• J0max - J0min	32,3 \pm 15,8	32,2 \pm 14,7	0,95
• J-1max - J0min	32,3 \pm 16,5	32,3 \pm 15,5	0,99
• J0max - J-1min	32,8 \pm 15,9	32,1 \pm 15,7	0,52

Table 4: Effects of meteorological variations on subarachnoid haemorrhage occurrence. J0max – J0min: variations of the climatic variable within a day; J-1max – J0min: fall of a climatic variable between a day (J0) and the day before (J-1); J0max – J-1min: rise of a climatic variable between a day (J0) and the day before (J-1). max: maximum; min: minimum; SAH: subarachnoid haemorrhage.

NOM et Prénom : LE GAC Grégoire

TITRE DE LA THESE d'EXERCICE

(Ce document sera à insérer dans les thèses définitives)

Titre :

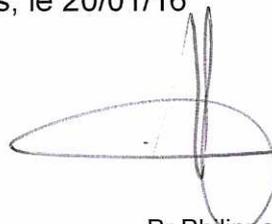
Role of bioclimate conditions on cerebral aneurysm rupture in Brittany region

Rennes, le 20/01/16



Dr Yoann LAUNEY
Directeur de thèse

Rennes, le 20/01/16



Pr Philippe SEGUIN
Président de jury

Vu et permis d'imprimer

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G. CATHELIN

U.F.R. DE MEDECINE DE RENNES		N°
LE GAC, Grégoire.- Role of bioclimate conditions on cerebral aneurysm rupture in Brittany region		
40 feuilles, 3 graphiques, 5 tableaux. 30 cm.- Thèse : Médecine; Rennes 1; 2016 ; N° .		
Résumé français		
<p>L'hémorragie sous-arachnoïdienne (HSA) par rupture d'anévrisme, est un événement imprévisible responsable d'une morbi-mortalité importante. Des études suggèrent un rôle du climat dans la survenue d'HSA. Le but de cette étude est de déterminer l'impact du climat et cycle lunaire sur la survenue d'HSA en Bretagne.</p> <p>Tous les patients adultes, hospitalisés pour HSA, entre 2011 et 2012, étaient inclus. Les variables météorologiques, les variations de ces variables, la phase de lune et le coefficient des marées ont été comparés entre les jours avec et les jours sans HSA.</p> <p>La température minimale était significativement plus faible pendant les jours avec HSA (7,7°C contre 8,3°C, $p = 0,039$) la chute de la température entre 2 jours était significativement plus élevée pendant des jours avec HSA (8,6°C contre 7,9°C, $p = 0,0095$). Si la température chutait de 8°C ou plus entre 2 jours, le risque d'HSA augmentait de 35%. Il n'y avait pas d'effets des autres variables.</p> <p>Les basses températures et la chute de température sont associées à la survenue de HSA.</p>		
Résumé anglais :		
<p>Aneurysmal subarachnoid hemorrhage (SAH) is a sudden event responsible of significant morbidity and mortality. Several studies suggest a role of climate in SAH occurrence. The aim of this study is to determine the impact of climate parameters and moon cycle on SAH occurrence in Brittany.</p> <p>All adult patients hospitalized for SAH, between 2011 and 2012, were included. The meteorological variables, changes in these variables, the moon phase and the tidal coefficient were compared between days with and without SAH.</p> <p>The minimum temperature was significantly lower on days with SAH (7.7°C vs 8.3°C, $p = 0,039$) and temperature drop between two days was significantly higher for days with SAH (8.6°C vs 7, 9°C, $p = 0,0095$). If the temperature dropped to 8°C or more between 2 days, the SAH risk increased by 35%. There was no effect of other variables.</p> <p>Low temperatures and the temperature drop are associated with SAH occurrence.</p>		
Rubrique de classement :	REANIMATION	
Mots-clés :	Hémorragie méningée, hémorragie sous-arachnoïdienne, anévrisme cérébral, climat, lune, coefficient des marées, température, facteurs de risques	
Mots-clés anglais MeSH :	Subarachnoid haemorrhage, cerebral aneurysm, intracranial haemorrhages, climate, moon, tidal coefficient, temperature, risk factors	
JURY:	Président :	Professeur Philippe SEGUIN
	Assesseurs :	Dr Yoann LAUNEY [directeur de thèse] Pr Xavier MORANDI Pr Jean-Yves GAUVRIT Dr Pierre- Jean LE RESTE