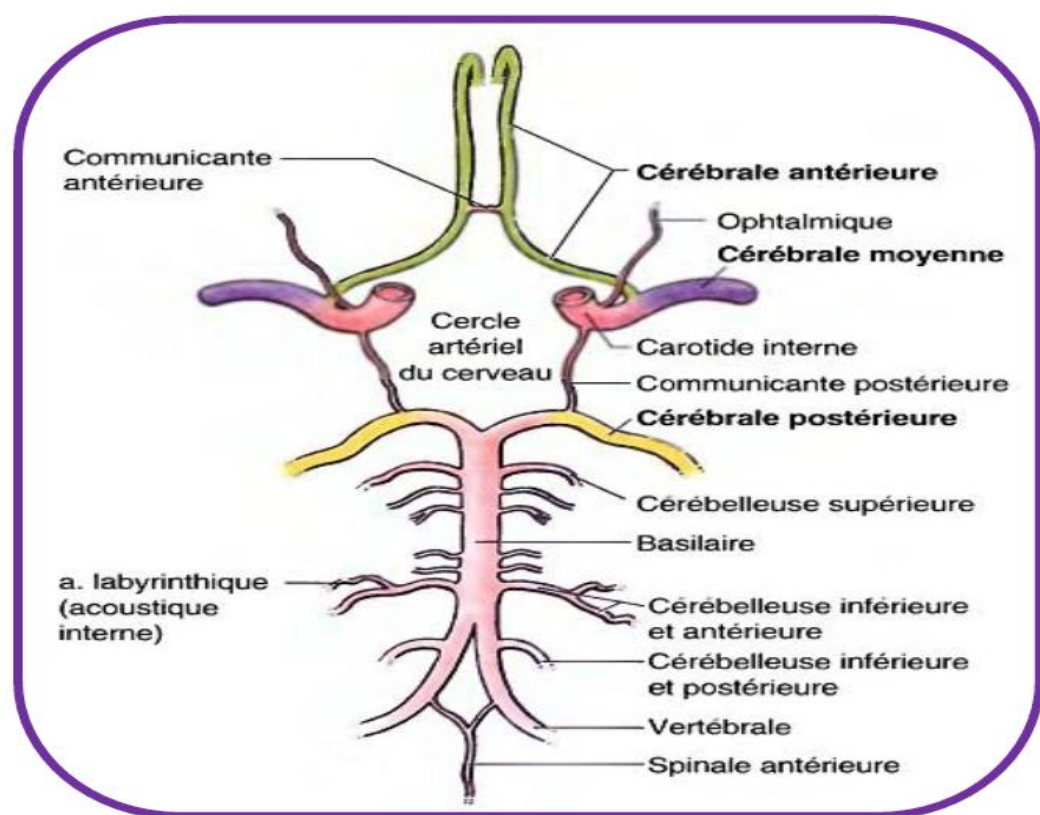# Predictors and ICU outcomes of neurogenic pulmonary edema in aneurysmal subarachnoid hemorrhage.

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Polygone of Willis

	Neurogenic pulmonary edema (n=17)	No neurogenic pulmonary edema (n=176)	Valeur de P
PaO2/FiO2 J2 (average, STDEV)	270(11)	306(30)	NS
PaO2/FiO2 J7 (average, STDEV)	267(13)	236(39)	NS
VasospasmJ2 (n, %)	4(23,5%)	25(14,2%)	NS
Vasospasm J7 (n, %)	3(17,65%)	23(13%)	NS
Natremia J2	142(32)	142(21)	NS
Natremia J7	139(39)	139(22)	NS

	Neurogenic pulmonary edema (n=17)	No neurogenic pulmonary edema (n=176)
Death (n, %)	6 (35,3%)	37 (21%)
Length of stay, in days (average,STDEV)	15,4(20,3)	11,4(11,2)
Glasgow score at the exit of ICU (n, %)		
Glasgow 15	7	102
Glasgow 13-14	3	26
Glasgow 10-12	0	4
Glasgow 7-9	0	3
Glasgow 3-6	1	4

Background and goal of study: Aneurysmal subarachnoid hemorrhage (ASH) could be complicated with neurogenic pulmonary edema (NPE). The incidence of this pathology is between 2 and 20% in an acute pathology of the central nervous system. NPE post ASH occurs most often between J0 and J7, concomitantly with initial cerebral (hemorrhage) or secondary (vasospasm, ischemia). For years, a poor grade ASH was considered as the main factor the occurrence of NPE. However, the location of aneurysm (posterior circulation) has been proposed as predictive of NPE with no role for patient factors or clinical features of ASH. The objectives were to determine predictive factors for the occurrence of early NPE in patients with ASH and outcomes of patients with or without NPE in intensive care unit (ICU) .

Materials and methods: We carried out a retrospective and monocentric descriptive observational study at the University Hospital Center in Strasbourg between 2010 and 2014. We analyzed records of patients who were admitted at University Hospital for ASH during a 5 years period. In Strasbourg, patients are systematically admitted to the ICU for the management of subarachnoid hemorrhage linked to a ruptured aneurysm documented by a cerebral scan. The data studied in the patients included are respectively: demography (age, sex, incidence of body mass) and medical history clinical features of ASH, aneurysm characteristics, ICU parameters at Day 2 and Day 7 and ICU outcomes. Diagnostic of NPE was set up by clinical and preclinical criteria (transthoracic heart ultrasound, electrocardiogram, type B natriuretic peptide, troponin, PaO2 / FiO2 ratio). Thus, in order to determine the possible risk factors for the occurrence of neurogenic pulmonary edema (presence or absence), a logistic regression analysis made it possible to retain the incriminated factors (alpha <0.05) for the multivariate analysis. A multivariable logistic regression model included all independent variables with P < 0.25 in the univariate analysis.

Results and discussion: Cases files of 193 patients were analyzed; NPE observed in 17 patients.8.8% of patients had a NPE (16 female/1 male, average age 58 years). The type B natriuretic peptide and troponin levels (average, STDEV) were 1504 (131) and 8.07 (1.76) respectively. In the group with NPE, Left Ventricular Ejection Fraction was 31.25% associated with dilation of the left ventricular in 17.6% of cases and alteration of segmental kinetics in 47% of cases. On stepwise logistic regression, sex, hypertension, vascular pathology, WFNS grade, aneurysm location (grouped as anterior or posterior; posterior location defined as any aneurysm of the vertebral or basilar segment) were found to be relevant factors. On multivariate logistic regression modeling, the occurrence of NPE, sex, hypertension, vascular pathology, aneurysm locations were found to be independent predictors. We identified five risk factors for NPE (posterior aneurysm, vascular risk factor, female sex, arterial hypertension, posterior aneurysm and WFNS(III, IV,V).

Source	Log Worth (-log 10)	P Value
Aneurysm location (posterior)	3,920	0,00012
Vascular pathology (presence)	2,784	0,00164
Sex (female)	2,659	0,00220
Arterial hypertension (presence)	1,638	0,02302
Aneurysm location (posterior) ×WFNS (III,IV,V)	1,319	0,04794
WFNS (III,IV,V)	0,411	0,38809

Comparing the two groups of patients with or without NPE, we did not observe any statistical differences in terms of mortality, length of stay and neurological status at discharge from ICU. In addition, no statistical differences were observed as regards to natremia, or presence of vasospasm and PaO2 / FiO2 ratio.

Conclusion(s): In our series of patients, an incidence of clinical NPE of 8.8 % was observed. For patients with ruptured aneurysm, both patient specified factors (female, vascular pathology) an aneurysm specified factors (posterior location, particularly with bad neurological status) need to be carefully considered as high risk factors of developing NPE.

1. Prunet and al. Critical Care 2014 18:R131
2. Inamasu and al. Neurol Med Chir 2012 52:49-55.

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