

## Nosocomial Infections are Associated with Delayed Cerebral Ischemia in Aneurysmal Subarachnoid Hemorrhage

Paul M Foreman MD; Michelle Hui Juan Chua BS; Mark R. Harrigan MD; Winfield S. Fisher MD; Nilesh A. Vyas MD; Robert Lipsky; Beverly C. Walters MD, MSc, FRCS(C), FACS; R. Shane Tubbs PhD, PA-C; Mohammadali Mohajel Shoja; Christoph Johannes Griessenauer MD



### Learning Objectives

By the conclusion of this session, participants should be able to: 1) identify clinical risk factors for DCI, 2) understand that nosocomial infection is associated with DCI, 3) contemplate possible pathophysiologic mechanisms to explain the association between infection and DCI.

### Introduction

Delayed cerebral ischemia (DCI) is a recognized complication of aneurysmal subarachnoid hemorrhage (aSAH) that contributes to poor outcome. This study seeks to determine the effect of nosocomial infection on the incidence of DCI and patient outcome.

### Methods

An exploratory analysis was performed on 156 aSAH patients enrolled in the Cerebral Aneurysm Renin Angiotensin System (CARAS) study. Clinical and radiographic data were analyzed with univariate analysis to detect risk factors for the development of DCI and poor outcome. Multivariate logistic regression was performed to identify independent predictors of DCI.

### Results

One hundred and fifty three patients with aSAH were included. Delayed cerebral ischemia was identified in 32 (20.9%) patients. Nosocomial infection, ventriculitis, aneurysm rerupture, and clinical vasospasm were independently associated with the development of DCI [3.5 (1.93 – 6.35),  $p < 0.00$ ; 25.3 (4.39 – 110.9),  $p = 0.03$ ; 7.55 (2.72 – 20.9),  $p = 0.05$ ; 43.4 (23.6 - 79.8),  $p < 0.00$ ; respectively]. Diagnosis of nosocomial infection preceded the diagnosis of DCI in 15 of 21 (71.4%) patients. Patients diagnosed with nosocomial infection experienced significantly worse outcomes as measured by mRS at discharge and 1 year ( $p < 0.00$  and  $p = 0.03$ , respectively).

Table 2. Independent predictors of DCI

Predictor	Multivariate coefficient	Standard error	Odds ratio	P value
Clinical vasospasm	3.77	0.61	43.4 (23.6-79.8)	<0.00
Nosocomial Infection	1.25	0.60	3.5 (1.93-6.35)	0.04
Rerupture	2.02	1.02	7.55 (2.72-20.9)	0.05
Ventriculitis	3.23	1.48	25.3 (4.39-110.9)	0.03

Table 3. Outcome with respect to nosocomial infection

Characteristic	No nosocomial infection N=90	Nosocomial infection N=63	P value
mRS at discharge			<0.00
mRS 0-2	61 (67.8%)	13 (20.6%)	
mRS 3-6	29 (32.2%)	50 (79.4%)	
mRS at 1 year*			0.03
mRS 0-2	55 (82.1%)	20 (52.6%)	
mRS 3-6	12 (17.9%)	18 (47.4%)	

\*Clinical follow-up was not available for 23 patients without infection and 25 patients with infection at 1 year.

### Conclusions

Nosocomial infection is independently associated with DCI. This association is hypothesized to be partly causative through the exacerbation of systemic inflammation leading to thrombosis and subsequent ischemia.