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ORIGINAL

Emergency transcranial Doppler ultrasound: Predictive value for the development of symptomatic vasospasm in spontaneous subarachnoid hemorrhage in patients in good neurological condition☆

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KEYWORDS
Transcranial Doppler ultrasound;
Vasospasm;
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Abstract
Purpose: To examine the predictive value of an early transcranial Doppler ultrasound (TCD), a study was performed in the emergency department for patients with spontaneous subarachoniod hemorrhage (SAH) in good neurological condition, in order to know which patients are at high risk of developing delayed cerebral ischemia (DCI).
Design: A descriptive observational study was carried out involving a period of 3 years.
Setting: Critical Care and Emergency Department.
Patients: The study consecutively included patients with SAH of grades I–III on the Hunt and Hess scale.
Variables of interest: DCI (decrease of 2 points in GCS or focal deficit), mean velocity (MV) of middle cerebral arteries (MCA), Lindegaard Index (IL). Sonographic vasospasm pattern (SVP) was considered if MCA-MV >120 cm/s and IL >3.
Results: The mean age of the 122 patients was 54.1 ± 13.7 years; 57.3% were women. SVP was detected in 24 patients (19.7%), although high velocities patterns (HVP) were present in 38 patients (31.1%). DCI developed in 21 patients (MV183 ± 49 cm/s), all with previous SVP. In this group MV increased 22 ± 5 cm/s/day during the first 3 days. The group without HVP (84 patients/MV of 67 ± 16.6 cm/s), compared with DCI group, showed differences in highest MV ($p < 0.001$), and also ΔMV/day (8.30 ± 4.5 cm/s vs 22 ± 5 cm/s) during the first 3 days ($p = 0.009$). In our series, ROC analysis selected the best cut-off value for ΔMV/day as 21 cm/s ($p < 0.001$).

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Conclusion: During the first 3 days, an increase of 21 cm/s/24 h in MCA-MV was associated with the development of symptomatic vasospasm. TCD is a useful tool for the early detection of patients at risk of DCI after SAH.

PALABRAS CLAVE
Doppler transcranial;
Vasoespasmo;
Deterioro neurológico;
Isquémico;
Hemorragia subaracnoidea espontánea

Ultrasonografía doppler transcraneal urgente: utilidad predictiva del vasoespasmo sintomático en la hemorragia subaracnoidea espontánea en pacientes con buena situación neurológica

Resumen
Objetivo: Establecer el valor predictivo, para desarrollar deterioro neurológico tardío de origen isquémico (DNI), de un estudio doppler transcraneal (DTC) en pacientes con hemorragia subaracnoidea espontánea (HSA) en buena situación neurológica.
Diseño: Estudio descriptivo-observacional desarrollado durante 3 años.
Ámbito: Cuidados Críticos y Urgencias.
Pacientes: Se incluyeron de forma consecutiva aquellos pacientes con HSA en buena situación neurológica (Hunt-Hess I-III).
Variables de Interés: DNI (disminución en 2 puntos del GCS o déficit focal), velocidad media (VM) en arterias cerebrales medias, índice de Lindegaard (IL). Se consideró patrón sonográfico de vasoespasmo (PSV) cuando la VM fue > 120 cm/s y existía un IL > 3.
Resultados: La media de edad de los 122 pacientes fue de 54,1 ± 13,7 años. El 57,3% eran mujeres. Se detectaron 24 pacientes con PSV (19,7%) encontrándose VM elevadas en 38 pacientes (31,1%). 21 pacientes desarrollaron DNI (VM 183+/-49 cm/s), todos presentaron PSV. En los pacientes con DNI se detectó un aumento de VM de 22+/-5 cm/s/24 h durante los 3 primeros días. Al comparar aquellos pacientes que no presentaron VM elevadas (85 pacientes/VM 67+/−16,6 cm/s) con respecto a los que desarrollaron DNI encontramos diferencias en las VM ($p < 0,001$) y en el ΔVM/24 h (8,30+/−4,5 cm/s Vs 22+/−5 cm/s) durante los 3 primeros días ($p = 0,009$). Mediante curvas ROC, se fijó que el ΔVM/día de 21 cm/s ($p < 0,001$), era el que mejor predecía el DNI.
Conclusión: Durante los 3 primeros días un incremento en la VM de 21 cm/s/24 h se asoció con el desarrollo de vasoespamo sintomático. El DTC es una herramienta útil para la detección de aquellos pacientes con HSA en riesgo de desarrollar DNI.

Introduction

Hemorrhagic cerebrovascular disease of aneurysmal origin accounts for about 80% of all cases of bleeding within the subarachnoid space secondary to non-traumatic causes. Spontaneous subarachnoid hemorrhage (SAH) represents 5–10% of all cases of stroke, with a mean incidence of 6–10 cases/100,000 inhabitants, and is the most common cause of sudden death due to stroke.[1–4] An avoidable mortality rate of up to 20% has been recorded following SAH.[5] One of the main complications, responsible for the ominous outcome and particularly for the neurological sequelae, is symptomatic vasospasm or delayed cerebral ischemia (DCI).[6,7] This occurs in 26.5–46% of all patients between days 4 and 14 following the initial event,[8,9] and manifests clinically as diminished consciousness or the appearance of focal neurological defects not attributable to repeat bleeding or hydrocephalia. The underlying etiopathogenesis and physiopathology are not well known. The diagnosis is established by arteriography, revealing a reduction in arterial caliber, or by ultrasound – with the recording of an increased flow velocity. In this context, mean velocity (MV) values of over 120 cm/s in the middle cerebral artery (MCA) are significantly correlated to vessel narrowing.[10]

Due to the frequency and seriousness of DCI, many attempts have been made to establish an early prediction of the disorder, using a range of approaches such as bleeding volume determined by computed axial tomography, clinical severity, different hematological parameters, and transcranial Doppler ultrasound (TCD).[11–17]

While the usefulness of TCD for the diagnosis and follow-up vasospasm (symptomatic or otherwise) in SAH has been well established, its validity in predicting DCI due to vasospasm remains to be determined.[18–23] To date, studies have been made of different elements such as the absolute MV value, its increment, or the application of ultrasound techniques allowing us to measure the auto-regulatory capacity of the brain.[17,24–26] However, the contradictory results obtained explain the current lack of recommendations for performing emergency TCD.[26–29] For this same reason, the possibility of using the technique in deciding which SAH patients in good neurological condition should receive closer care and monitoring has not been explored to date. Establishing in the first hours of patient management which cases of non-serious SAH belonging to a group at high risk of suffering DCI could benefit from admission to the Intensive Care Unit (ICU) would be essential as well as efficient in prescribing early and aggressive prophylactic