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ORIGINAL ARTICLE/ARTICLE ORIGINAL

Is brain computed tomography combined with somatosensory evoked potentials useful in the prediction of brain death after cardiac arrest?

La tomodensitométrie cérébrale associée aux potentiels évoqués somesthésiques est-elle utile dans la prédiction de la mort cérébrale après arrêt cardiaque ?

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Brain computed tomography;
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Summary
Background. — Brain death (BD) in coma after cardiac arrest (CA) is difficult to predict. Basal ganglia gray matter/white matter (GM/WM) ratio density and somatosensory evoked potentials (SEPs) may differentiate patients evolving toward BD.
Methods. — We used SEPs and brain computed tomography (CT) after coma onset, within the first 24 hours.

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Organ transplantation; Cardiac arrest

Results. — Of the 160 patients included in the study, 22 (14%) evolved toward BD. SEP patterns predicted BD (ROC area = 0.82, $P < 0.0001$). The combination of SEP patterns, bilaterally absent (AA) and absent on one hemisphere and pathological on the other (AP), predicted BD with a sensitivity of 100% and a specificity of 62.3%, with a positive likelihood ratio of 2.65. The GM/WM ratio predicted BD (ROC area = 0.68, $P = 0.01$). A GM/WM ratio < 1.07 had a sensitivity of 30.4%, a specificity of 94.9%, and a positive likelihood ratio of 6.27. The combination of SEP and CT findings did not increase the prediction of BD.
Conclusion. — SEPs and brain CT within 24 hours predicted BD after CA. Severe SEP findings (SEP patterns: AA, AP) identified a subset of patients in whom BD could occur. Brain CT (GM/WM ratio in basal ganglia) predicted an early evolution toward BD with high specificity but lower sensitivity.

MOTS CLÉS
Arrêt cardiaque ;
Mort cérébrale ;
Potentiels évoqués somesthésiques ;
Tomodensitométrie cérébrale ;
Transplantation d'organes

Résumé
Objectif. — La mort cérébrale survenant dans le coma post arrêt cardio-respiratoire (ACR) est difficile à prédire. La densité de la substance grise et de la substance blanche (SG/SB) et les potentiels évoqués somesthésiques (PES) peuvent différencier les patients évoluant vers la mort cérébrale.
Méthodes. — Nous avons étudié les PES et la tomodensitométrie cérébrale (TDMc) au cours des 24 premières heures après le début du coma post ACR. Nous avons mesuré le rapport SG/SB des ganglions de la base dans un groupe de 160 patients comateux post ACR en association avec l'enregistrement des PES.
Résultats. — Sur les 160 patients inclus dans l'étude, 22 (14 %) ont évolué vers mort cérébrale. Le profil des PES a prédit une mort cérébrale (aire ROC = 0,82, $p < 0,0001$). La combinaison des PES absents bilatéralement (AA) ou absents sur un hémisphère et pathologique sur l'autre (AP) a prédit la mort cérébrale avec une sensibilité de 100 % et une spécificité de 62,3 % avec un rapport de vraisemblance positif de 2,65. Le rapport SG/SB prédit mort cérébrale (aire ROC = 0,68, $p = 0,01$). Le rapport SG/SB < 1,07 présentait une sensibilité de 30,4 %, une spécificité de 94,9 % et un rapport de vraisemblance positif de 6,27. La combinaison des résultats de PES et de TDMc n'a pas augmenté la prédiction de la mort cérébrale.
Conclusion. — Les PES et la TDMc prédisent la mort cérébrale dans les 24 heures après ACR. L'analyse des PES a permis l'identification d'un sous-groupe de patients à risque accru de progression vers la mort cérébrale. La TDMc cérébrale a permis de prédire une évolution précoce vers la mort cérébrale avec une spécificité élevée mais une moindre sensibilité.

Introduction

Organ transplantation is often the last resort for patients with end-stage organ failure. Brain death (BD) is the major source of organ donation to date [11,20,30]. Therefore, the early prediction of BD in patients with acquired brain injuries (ABIs) is important for identifying potential organ donors. Nevertheless, identifying patients with severe ABIs deteriorating toward BD is particularly difficult in the early acute phase because, to date, no accurate criteria for predicting evolution toward BD in comatose patients have been reported. A few prior studies have evaluated predictors of BD in patients with intracerebral hemorrhage (ICH), traumatic brain injury (TBI), and brain infarction [6,9,16,27]. Severe hypoxic ischemic encephalopathy (HIE) less frequently evolves toward BD compared to acute brain damage of different vascular and traumatic aetiologies [1,5,26,27].

To the best of our knowledge, predictors of BD in patients with HIE due to cardiac arrest (CA) have been evaluated in only a few papers [1,27,31]. Adrie et al. (2008) [1] investigated clinical and laboratory tests as predictors of BD but did not find a significant relation with evolution toward BD. In a previous study by our group [27], evolution toward BD occurred only in subjects with greater alterations in cortical somatosensory evoked potentials (SEPs), for instance, bilaterally absent (AA) or unilaterally absent SEP, associated with contralateral pathological (AP) cortical SEP; however, these SEP patterns had a low predictive value for BD. Vigneron et al. (2016) [31] suggested that a certain value of the basal ganglia gray matter/white matter (GM/WM) ratio density identified all patients with HIE evolving toward BD. They compared the GM/WM ratio density of BD patients to those of normal healthy controls but not to those of patients who survived after CA and did not evolve toward BD.

Given the limitations of these previous works, the present study was designed to integrate the predictive power of SEPs and brain CT data obtained within 24 hours after coma onset in patients with CA. The main goal was to evaluate whether combining these tests would enable early differentiation of patients who evolved toward BD, from those who succumbed to non-neurological death (NND) and those who survived.