Title : RAPID, BEDSIDE AND NON INVASIVE ASSESSMENT OF BRAIN DEATH FOR ORGAN TRANSPLANTS

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Introduction: Despite the spectacular improvement in the outcome of organ transplantation from unrelated donors, the supply of cadaveric organs is not adequate to meet the demand. The delay for brain death diagnosis and hemodynamic instability may lead to cardiac arrest or significant reduction in subsequent organ function[1]. Then rapid and rigorous assessment of this status is mandatory. Since brain death is characterized by cerebral circulatory arrest, a cerebral blood-flow test should be used as a confirmatory test[2]. In this regard contrast and isotopic angiographies are poorly accepted because of their lack of ready availability and portability, their cost and risk.
Since intracranial circulation could be evaluated by common carotid blood velocity or flow (CCBF)[3], we conducted a prospective study of CCBF in brain dead and severe coma patients. Using pulsed Doppler CCBF and metabolic parameters, we tried to define specific, quantitative, non invasive, rapid and bedside criteria of brain death.

Material and Methods: Two age-matched (38 ± 3yrs SD) groups of patients hospitalized for neurological or neurosurgical disorders were studied prospectively.

Group I : 28 patients with brain death assessed by the usual clinical and EEG criteria, i.e. coma with cerebral unresponsitivity, apnea, dilated pupils, lack of cephalic reflexes and electrocerebral silence.

Group II : 28 severe coma assessed by Glasgow coma scale (GCS) lower than 7.

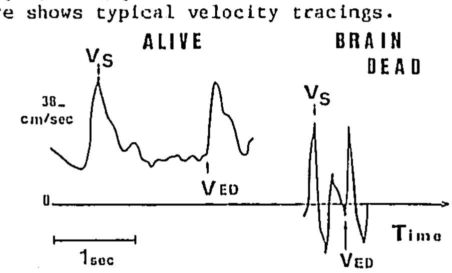
For each patient, the following parameters were measured or calculated : 1) common carotid diameter (D in cm) and CCBF (ml/min) using an 8 MHz pulsed Doppler flowmeter. This apparatus has a double transducer probe and an adjustable range-gated time system which provides an accurate D measurement with a well defined incidence angle betwen ultrasonic beam and vessel axis. Mean sectionnal carotid velocity (Vm in cm/sec) was electronically integrated from instantaneous velocity curves and CCBF was computed as follows[3]: CCBF = $\pi D^2/4 \times Vm \times 60$. Peak systolic velocity (Vs), end-diastolic blood velocity (VED) and flow (QED) were measured on a beat to beat basis. 2) Mean arterial pressure using a radial catheter or a sphygmomanometer; 3) Arterial and jugular gulf gases in order to measure arterio-venous difference in O_2 (a-vDO_2) and O_2 consumption (VO_2 = a-v $DO_2 \times$CCBF in $mlO_2.min^{-1}$). 4) A cerebral metabolic index (CMI = QEDxa-vDO_2 in $mlO_2.min^{-1}$). When QED was negative, CMI was considered to be null.

Statistical analysis: Discrimination between brain dead and severe coma patients was performed by a step wise logistic regression analysis. The significance for each parameter was obtained following the Chi^2 likelihood ratio test (BMDP package).

	Group I (n = 28) Range	Mean ± SEM	Group II (n = 28) Range	Mean ± SEM
MAP	48 — 127	80.0 ± 3.7	68 — 104	86.6 ± 2.3
DAV	.12 — 5.9	2.22 ± .25	1.8 — 7.7	4.35 ± .32***
Vs	22 — 73.3	41.21 ± 2.4	30.5 — 87.2	47.7 ± 2.3
VED	-7 — 2.13	-.88 ± .49	3.65 — 30.71	14.45 ± 1.26***
Vm	2 — 18	8.51 ± .73	12 — 38	21.78 ± 1.34***
D	.277 — .66	.429 ± .017	.381 — .69	.487 ± .013**
CCBF	19.1 — 164.1	71.88 ± 7.11	102.5 — 412	238.9 ± 13.9***
VO_2	.04 — 5.54	1.51 ± .22	3.96 — 16.73	9.72 ± .64***
QED	-77.5 — 12	- 8.91 ± 4.66	42.63 — 338.69	156.6 ± 12.4***
CMI	0 — .29	.04 ± .01	1.57 — 12.33	6.37 ± .54***

** : $p<.01$; *** : $p<.001$

Figure shows typical velocity tracings.



Results: In group II, GCS was uniformely distributed from 3 to 6 and the mean value was significantly higher than group I (4.5 vs 3; $p<.001$).
All variables except Vs and MAP were significantly different.
Using logistic regression analysis two calculated parameters were discriminant in absolute fashion between brain dead and alive patients :
QED (X^2 = 77.6) and CMI (X^2 = 77.6), with a specificity and a sensitivity of 100%.

Discussion: This study demonstrates the alteration of pulsed Doppler common carotid blood flow in brain death. QED value narrowing zero in brain death reflects the considerable elevation of downstream resistances. Among the variables sensitive and specific for brain death diagnosis, only CMI takes into account oxygen uptake. Adding other parameters did not improve the accuracy of the diagnosis. We conclude that common carotid blood flow analysis, in combination with metabolic parameters and accepted clinical criteria authorizes the declaration of brain death. The main interest of this easy-to-use new tool is its bedside, non invasive, quantitative, repetitive and costless characteristics.

Réferences:
1. WICOMB WN, COOPER DKC, LANZA RP, et al :
J. Thorac. Cardiovasc. Surg: 91, 896-909, 1986.
2. BLACK PM :
N Eng J Med: 229, 338-344 & 393-401, 1978.
3. PAYEN DM, LEVY BI, MENEGALLI DJ et al :
Stroke: 13, 382-398, 1982.