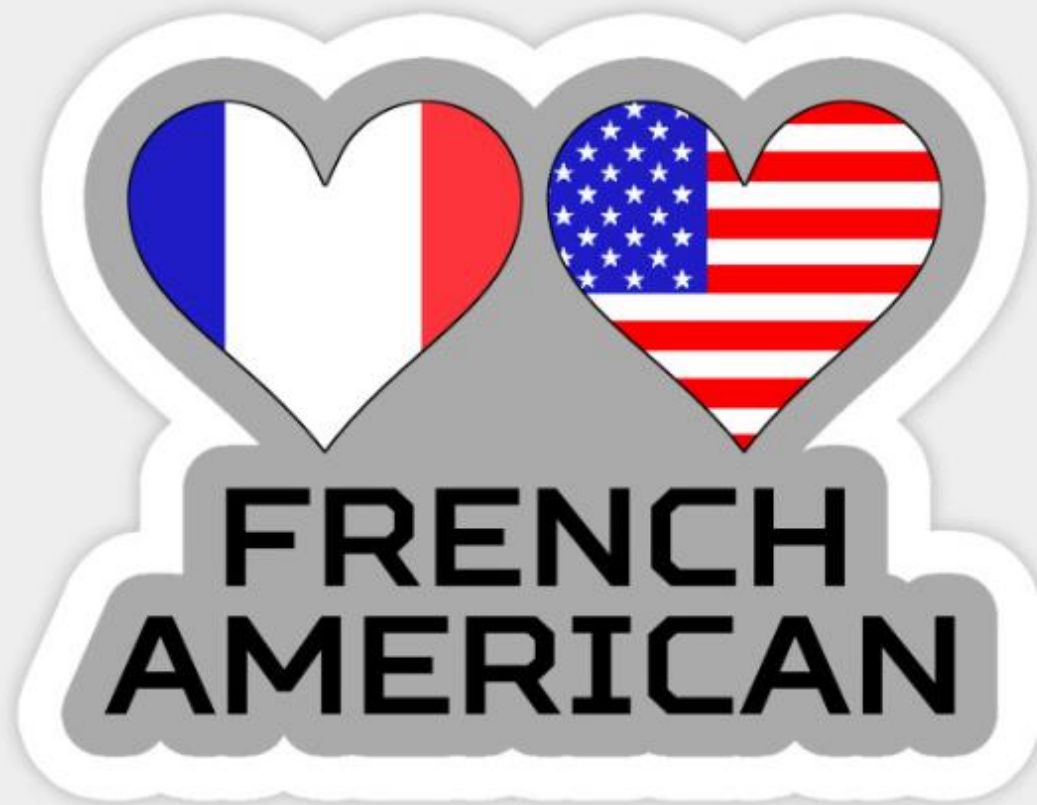Sergio Brasil

Marcelo de-Lima-Oliveira

Gabriel Gattás

Douglas Mendes Nunes

Fabio Silvio Taccone

Raphael A. G. Oliveira

Paulo Tierno

Rafael Becker

Luís Marcelo de Sá Malbouison

Wellingson Paiva

Ricardo Nogueira

Edson Bor-Seng-Shu

Manoel Jacobsen Teixeira.

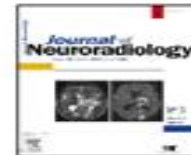# COMPUTED TOMOGRAPHY ANGIOGRAPHY X BRAIN DEATH

EXPERIÊNCIA BRASILEIRA

REVIEW

Role of computed tomography angiography and perfusion tomography in diagnosing brain death: A systematic review

Sérgio Brasil[a,*], Edson Bor-Seng-Shu[a,*],
Marcelo de-Lima-Oliveira[a], Milena K. Azevedo[a],
Manoel J. Teixeira[a], Luca Bernardo[b], Wanderley M. Bernardo[b]

[a] University of São Paulo, School of Medicine, Hospital das Clínicas, Division of Neurological Surgery, São Paulo, Brazil
[b] University of São Paulo, School of Medicine, São Paulo, Brazil

- Conclusion: No evidence supporting its use in BD Although
- Meta-analysis conducted to the venous score- 97.5% sensitivity.

1

2

Evaluate the accuracy of CTA in the diagnosis of BD

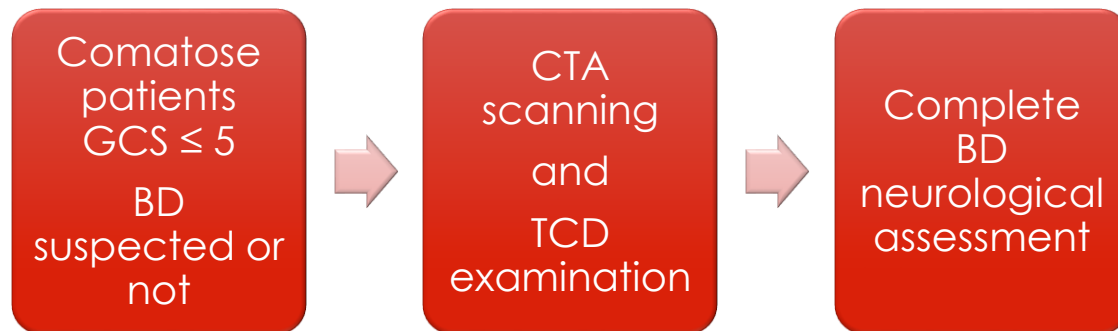Define the best tomographic criteria of intracranial circulatory arrest.

METHODS

- Prospective controlled observational study.

- Inclusion criteria: Neurological comatose patients (GCS ≤ 5), with or without the presence of central nervous system depressants, presenting or not brain stem reflexes.

- Exclusion criteria: Patients presenting contraindications to contrast injection, such as hyper sensibility or severe renal failure (AKIN 2), arterial hypotension or neurological examination positive for BD .

METHODS

- Intensive care physicians selected eligible patients to be submitted to CTA scanning.

- One experienced neurosonologist performed TCD examinations **blinded** whether clinical status was positive for BD or not.

- Two neuroradiologists evaluated CTA images **blinded** to patient's clinical status.

- Inter-observer heterogeneity was calculated.

Comatose patients GCS ≤ 5 BD suspected or not → CTA scanning and TCD examination → Complete BD neurological assessment

- The same physicians which selected patients performed the assessment for neurological determination of death (NDD) posterior to CTA scanning and TCD, keeping themselves **blinded** to tests results.

- Time interval between tests was monitored, and NDD was stopped at the first sign BD was absent.

- For statistical analysis, patients were separated in two groups with reference to condition brain death or no brain death.

METHODS- *COMPUTED TOMOGRAPHY ANGIOGRAPHY*

- Three tomographic phases

- Our target was to observe presence or absence of opacification of the distal MCA and ICVs (4-point score).

- Sensitivity and specificity were calculated with both the 4-point score (4PS) and the venous score (VS).
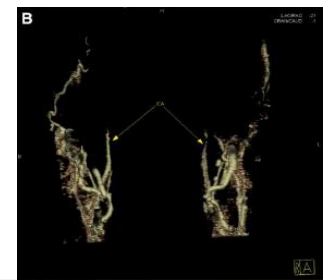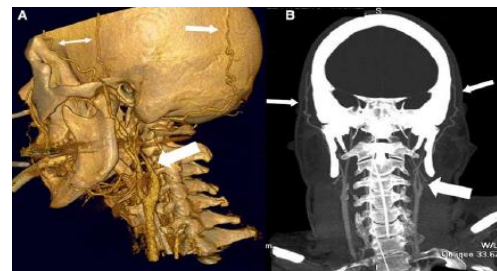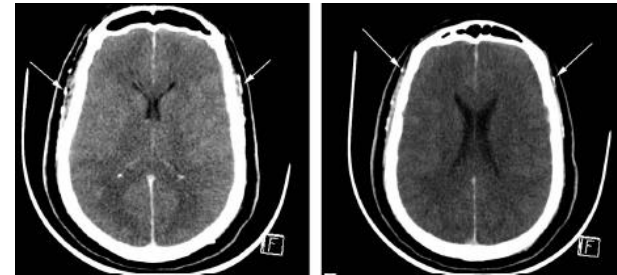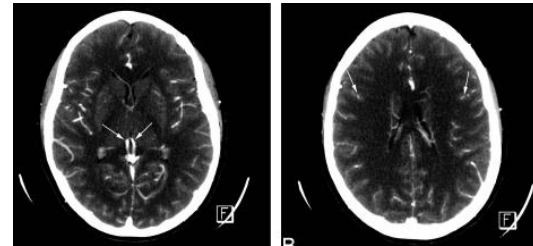
METHODS- *COMPUTED TOMOGRAPHY ANGIOGRAPHY*
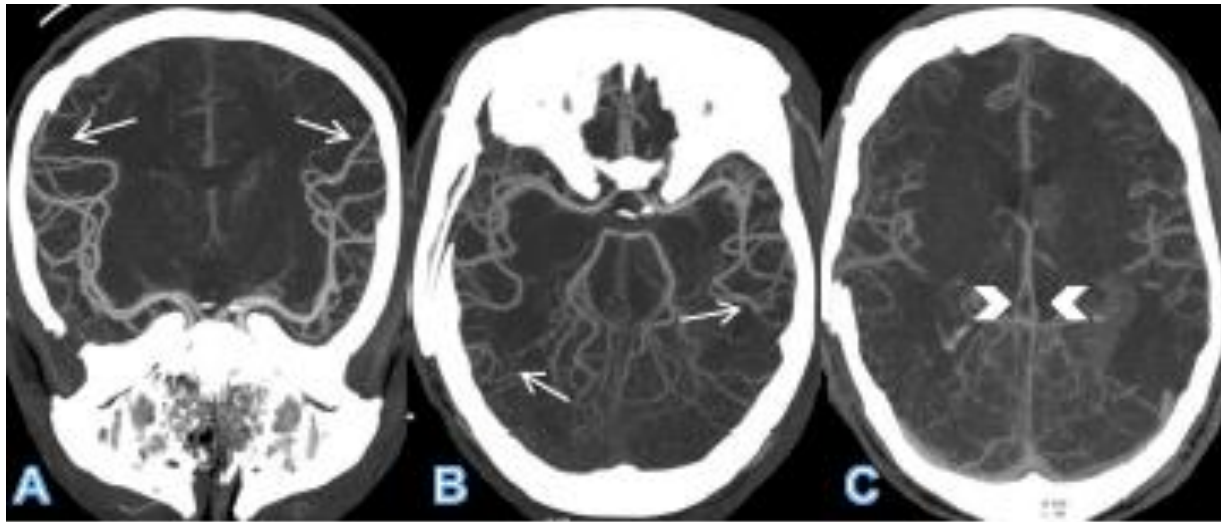
CTA targets were distal middle cerebral arteries segments (arrows in A and B) and internal cerebral veins (arrowheads in C).

METHODS- TRANSCRANIAL DOPPLER

- Our gold standard due to its practicability, high sensitivity and specificity.

  BD diagnosis was positive if systolic spikes lower than 50 cm/s or non-progressive oscillatory flow was present in the MCAs and basilar artery.

Chang JJ, Tsivgoulis G, Katsanos AH, Malkoff MD, Alexandrov AV, (2016) Diagnostic Accuracy of Transcranial Doppler for Brain Death Confirmation: Systematic Review and Meta-Analysis. AJNR Am J Neuroradiol 37: 408-414
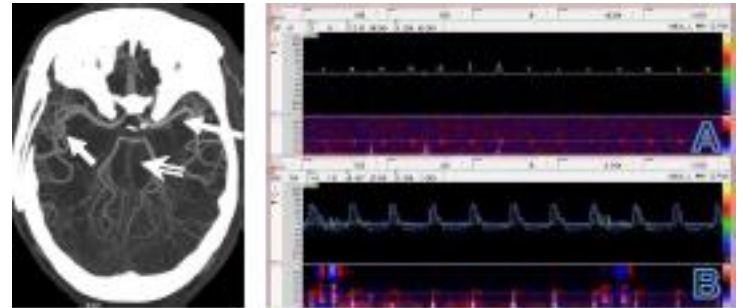
RESULTS

194 eligible patients enrolled

- 84 excluded:
  - 31 acute kidney injury
  - 21 parental refusal to participate
  - 32 hemodynamic instability

110 triple exams

- 4 Losses
  - 2 CTA unapropriate
  - 2 Cardiac arrest before NDD

106 complete examinations

- 100 patients
- 6 patients included twice (cohort)

RESULTS

- 52 no BD, with TCD and CTA also negative in all cases (**specificity 100%).**

- 54 (52%) BD:

 33+ 4-point score **(sensitivity 61%),**

  47+ venous phase exclusively **(sensitivity 87%).**

  TCD 52+ **(sensitivity 96%).**

Table 2 – Statistical results with reference to time interval between tests					
Technique	≤ 12 hours		> 12 hours		Full sample	
	Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity	Specificity
TCD	100% (90.1–100)	100% (93.2–100)	98.1% (92–100)	100% (92–100)	96% (55.5–99.7)	100% (15.8–100)
CTA 4PS	81.8% (67.3–91.8)	100% (93–100)	55.6% (21.2–86.3)	100% (2.5–100)	61.1% (46.9–74.1)	100% (93.2–100%)
CTA VS	95.5% (84.5–99.4)	100% (93–100)	66.7% (29.9–92.5)	100% (2.5–100)	87% (75.1–94.6)	100% (93.2–100)
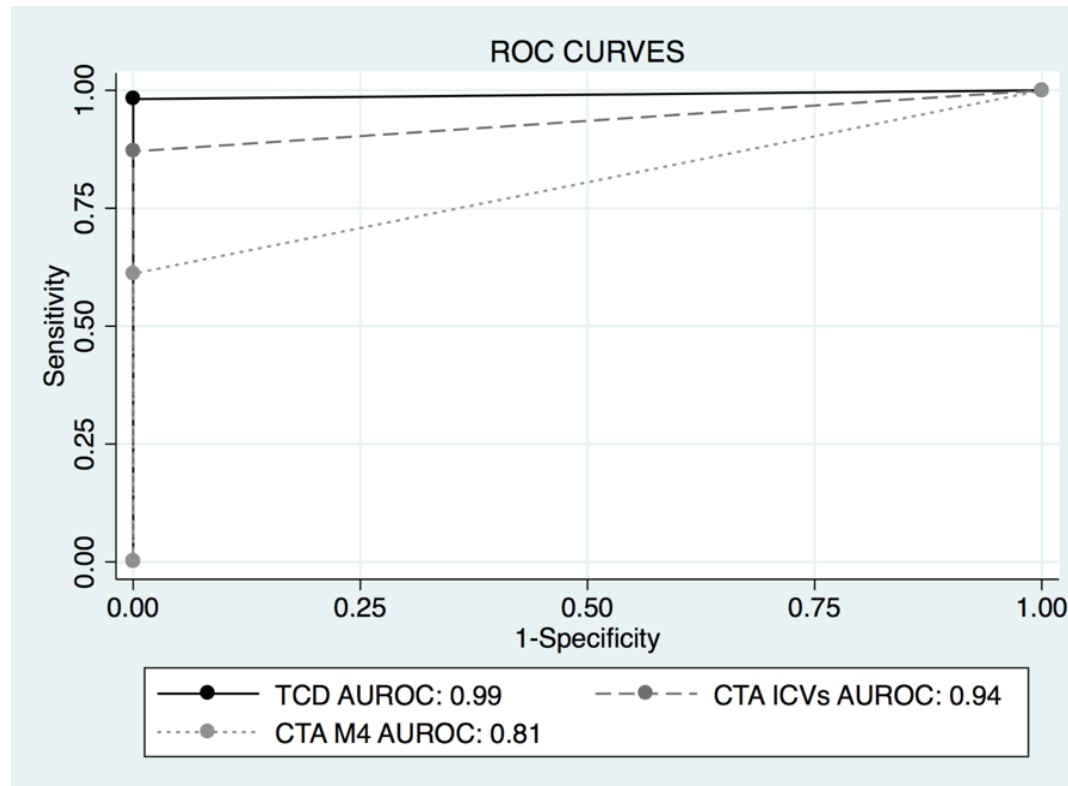
ROC curve depicting brain computed tomography angiography in predict brain vessels collapse in overall patients (AUROC: area under curve).

RESULTS

- 7 with ICVs opacification

- 2 TCD -

CTA >12h 9 (16%)	9 CTA >12h 4/7 FN (57%)
TCD >12h 9 (16%)	9 TCD >12h 2/2FN (100%)

12 NDD + → 12 ICVs - 7 MCAs + (sensitivity 41%)

- 20 Open Skull

8 NDD - → 8 ICVs + 8 MCAs +

RESULTS

- *Tests and interobserver agreements*

Disagreement inter-observer was higher on the evaluation of the 4PS, *kappa* score was 0.77 (strong), while 0.96 (almost perfect) on the VS

	Agreement	Kappa	Std. Err.	P
CTA 4PS	89.62 %	0.775	0.095	<0.001
CTA VS	98.11 %	0.962	0.097	<0.001

MEDICINA
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DISCUSSION

- First triple blinded study.

- CTA did not failed among controls.

- First study that performed CTA exam prior to NDD.

DISCUSSION

- Why CTA should not obey same standard as digital subtraction angiography?

- DSA is performed under pressure, what about CTA?

- What is the ideal delay to assure ICVs have not opacified?

DISCUSSION

- Limitations

1. Time flow to complete NDD,
2. Venous score is not brain stem drainage,
3. Artifacts and confounders,
4. Absence of deep venous thrombosis cases in our sample,
5. High dropout rate,
6. TCD.

DISCUSSION

- CTA
1. Demands patient transportation;
2. Use of contrast
3. Images interpretation require specific expertise and training

- CTA
1. widely available;
2. Acquires images promptly;
3. Peripheral vein, under pressure;
4. Able for additional scanning the entire body of a potential organ donor;
5. May be remotely evaluated;

CONCLUSIONS

- CTA is reliable to support BD diagnosis.

- The criterion of absence of ICVs opacification can confirm the occurrence of cerebral circulatory arrest.

Dr. Sergio Brasil
University of São Paulo
Neurology
Av. Dr Eneas Aguiar 250
São Paulo 05403-000
Brazil

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Dear Dr. Brasil:

We are pleased to inform you that your article entitled "Computed tomography angiography accuracy in brain death diagnosis," submitted to Journal of Neurosurgery, has been accepted for publication.

Editor-in-Chief's comments:

After careful review of your revised manuscript, I am satisfied that you have answered the Reviewers' many comments. Accordingly, your manuscript will now be prepared for publication.

Congratulations to you and your co-authors!