

Brain death determination in Australia and New Zealand: a survey of intensive care units

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There has been recent discussion about the determination of brain death in both the medical literature and the Australian lay press.¹⁻⁵ A prominent article reported on two patients who regained spontaneous breathing after having been diagnosed as brain dead by clinical testing.¹ The authors of the report questioned whether brain blood flow analyses should play a larger role in the determination of brain death, instead of reliance on clinical testing alone.¹ The article was accompanied by an editorial that discussed brain blood flow testing as an adjunct to clinical diagnosis.²

The Australian and New Zealand Intensive Care Society (ANZICS) provides detailed guidelines for the determination of brain death, which conform to the various legislative requirements of the Australian (federal and state) and New Zealand jurisdictions.⁶ Within these guidelines, unless otherwise contraindicated, clinical testing is the method of determination of brain death, with brain blood flow analyses being used only for defined indications.

In view of the international interest in the possible use of brain blood flow analysis and the dearth of research in this area from Australia and New Zealand, our aim was to determine the current practices in diagnosing brain death in Australian and New Zealand intensive care units. As we wished to gain as complete a picture as possible on current practices, we aimed to make the survey simple and quick to fill out so that we could optimise our return rate.

ABSTRACT

Background: The Australian and New Zealand Intensive Care Society (ANZICS) guidelines for the determination of brain death involve clinical testing and/or the use of brain blood flow analysis techniques. Recently, there has been professional and lay discussion regarding the role of brain blood flow analysis in the determination of brain death.

Objective: To determine the current practices in Australian and New Zealand intensive care units for the determination of brain death.

Methods: All adult ICUs in Australia and New Zealand accredited for training in intensive care by the College of Intensive Care Medicine of Australia and New Zealand were surveyed to determine the unit size, whether certification of brain death occurs in that unit, and the method routinely used to determine brain death if there were no contraindications to clinical testing.

Results: There were 47 responses (53% response rate). Of the surveyed units, 89% of units used two sets of clinical tests for brain death determination; 9% used one set of clinical testing and one imaging technique; and 2% of units used one imaging technique only. When an imaging technique was used, four units used radionuclide imaging, one unit used magnetic resonance imaging and one unit used computed tomography angiography.

Conclusions: Two sets of clinical testing is the most common method for determining brain death in Australian and New Zealand ICUs. A minority of units used some form of brain blood flow imaging. Based on these findings, all brain death certification is in accordance with ANZICS guidelines.

Crit Care Resusc 2011; 13: 271–273

Table 1. Response rates according CICM accreditation

Type of ICU (CICM accreditation)	No. of ICUs	No. responded (response rate)
Advanced training (C24)	28	27 (96%)
Advanced training (C12)	21	9 (43%)
Advanced training (C6)	24	8 (33%)
Total advanced training	73	44 (60%)
Basic training	15	3 (20%)
Total	88	47 (53%)

CICM = College of Intensive Care Medicine of Australia and New Zealand. ICU = intensive care unit. C24 = unlimited core training. C12 = 12 months' core training. C6 = 6 months' core training.

Methods

As this research was in the form of a survey that required no patient information, ethics approval was not required.

A list of all accredited adult ICUs in Australia and New Zealand was obtained from the College of Intensive Care Medicine of Australia and New Zealand (CICM) website. Paediatric ICUs were excluded from the survey. Eighty-eight adult ICUs were invited to participate in the survey.

Table 2. Routine method for determination of brain death according CICM accreditation

Testing method used routinely	No. C24 units (%)	No. C12 units (%)	No. C6 units (%)	No. basic training units (%)	Total
Two sets of clinical tests	24 (89%)	7 (78%)	8 (100%)	3 (100%)	42 (89%)
One set of clinical testing and one imaging technique	2 (7%)	2 (22%)	0	0	4 (9%)
Imaging technique only	1 (4%)	0	0	0	1 (2%)
Total	27	9	8	3	47

CICM = College of Intensive Care Medicine of Australia and New Zealand. C24 = unlimited core training. C12 = 12 months' core training. C6 = 6 months' core training.

Table 3. Imaging techniques used*

Type of imaging	No.
Four-vessel intra-arterial angiography	0
Radionuclide imaging	4
Contrast CT or CT angiography	1
Magnetic resonance imaging	1

* Some units used more than one technique. CT = computed tomography.

An introductory letter was sent to the directors of the units, and the survey was also advertised in the CICM electronic newsletter. Where possible, telephone follow-up was conducted to increase the response rate.

A survey questionnaire was devised, which is shown in Appendix 1. The survey was available for completion on paper or via the internet.

Data were collated with reference to CICM training unit accreditation (ie, 6 months', 12 months' or "unlimited" core training units [C6, C12 or C24] or basic training units).⁷

Results

There were 47 responses (53% response rate). The response rate according to different training unit classification is shown in Table 1.

Most ICUs (89%) used two sets of clinical tests to determine brain death. Four units (two C24 and two C12; 9% of all respondent ICUs) used one set of clinical testing and one imaging technique. One C24 unit used an imaging technique only (2% of all respondent ICUs). The routine method of determining brain death in units is shown in Table 2.

Of the ICUs that used imaging techniques, radionuclide imaging was the most commonly used technique. The imaging techniques used routinely are shown in Table 3.

Discussion

In this survey of adult ICUs in Australia and New Zealand, we found that two sets of clinical testing, as provided for in the ANZICS guidelines,⁶ is the most common method for determining brain death. Four units routinely used one set of clinical testing and one imaging technique. In three of these four units radionuclide imaging was the imaging method of choice. One unit used radionuclide imaging alone to determine brain death. Based on these findings, all brain death certification in the units surveyed is carried out in accordance with ANZICS guidelines.

Although the overall response rate was 53%, brain death testing is most likely to occur in the C24 training units, and the response rate from these units was 96%.

Given that the number of units using imaging techniques is relatively small, it would now be feasible to contact them directly to determine their reasons for using imaging. Interestingly, many of those who did use imaging contacted us directly to give informal reasons as to why they used imaging. We were reassured that there did not appear to be any problems with the ANZICS guidelines. Since this issue is a sensitive one as a result of lay media interest, it may be inappropriate for us to discuss further reasons as to why imaging is used, as the units may be identifiable from data we have shown in our study and a review of the CICM website, which could potentially cause distress to staff and patients of these units if the lay press took a further interest in this subject. It was not our wish to cause problems for any units; rather, we wanted to determine what current practices are. If we were to follow up on why units do use imaging techniques, we believe we would need to seek specific approval from those units to publish their reasons. This, however, would be an appropriate follow-up study that we would be willing to consider.

In all cases, the survey was sent to the director of the ICU. Although we did not specifically ask if there were any unit guidelines as to how brain death is determined, given that this is a relatively uncommon event in many units and that two medical practitioners are required to determine brain death clinically (often both required to be consultants or

senior trainees according to different state guidelines), it would be likely that the consultant filling in the survey would have been aware of alternative practices within the department, and may have commented on them.

Anecdotally, there is some variation between consultants, but the views expressed are the consensus views of the unit. Questions were directed at the directors of the unit, but with a request to convey the unit consensus and not the individual's view.

Clinical determination of brain death is frequently performed in ICUs for cessation of treatment and to allow for organ donation. For public confidence and acceptance of brain death, it is imperative that these processes are beyond question. There have been no recorded instances of misdiagnosis of brain death when the clinical guidelines published by ANZICS were used. On this basis, clinicians can be confident that the current guidelines are robust, and brain blood flow analysis remains an adjunct to clinical determination of brain death. This is borne out by the responses received in this study.

Reports that have arisen casting doubt on clinical testing as the sole basis for determination of brain death have either relied on guidelines not identified by ANZICS,⁶ or have involved clinicians not following the guidelines.^{1,2}

Guidelines for determination of brain death vary in countries around the world. This makes extrapolation of problems related to diagnosis of brain death from one region to another difficult.

A survey of European units showed significant differences with regard to guidelines for determining brain death among the different member countries, and even differences in terminology between brain stem and brain death testing.⁸ All the European guidelines emphasise that the diagnosis of brain death is primarily a clinical diagnosis. However, in several European countries, imaging techniques are mandatory when determining brain death. Four-vessel intra-arterial angiography is usually the accepted test when an imaging technique is used. As in Australia, in the United States, the definition of death is a state (not federal) legal process, and there are many different practices in the different states. For this reason, we think it unrealistic to be able to provide a comprehensive discussion on brain death determination worldwide as current world practices vary so widely.

The ANZICS guidelines recommend four-vessel intra-arterial angiography or radionuclide imaging when required.⁶ Anecdotally, magnetic resonance imaging and computed tomography angiography are also used, but they are not currently recommended for determining brain death due to reduced sensitivity possibly leading to false-positive results. It was beyond the scope of this article, and beyond

our technical expertise, to provide the rationale behind newer imaging techniques. As part of preparing this article, we did have discussions with expert neuroradiologists about progress in neuroimaging, specifically related to magnetic resonance imaging; however, we believe we would not do justice to this with our limited technical knowledge. Although we acknowledge this point, we believe that it should be for expert neuroradiologists to write about the advances in these techniques, rather than critical care physicians.

The results of the survey showed confidence by clinicians in the ANZICS guidelines, with a minority of units using imaging techniques routinely to confirm brain death.

Competing interests

None declared.

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SURVEY

Appendix 1. Questionnaire

- 1 What is the name of your hospital? (Please note, this information is only for checking responses, and information collected after this question will be separated from this answer)
- 2 How many adult beds does your unit have?
- 3 What is the approximate number of admissions per year to your ICU?
- 4 Has your ICU declared an adult (age greater than 16 years) patient brain dead (either for organ donation or for cessation of treatment) in the last two calendar years 2009–2010?
 - Yes
 - No
- 5 If the data is easily accessible, would you be able to give an approximation of how frequently adult patients are declared brain dead in your unit?
 - more than once per month (i.e. greater than 12 patients per year)
 - between once a month and once every three months (i.e. approximately between 4 and 12 patients per year)
 - once every six months (i.e. approximately two patients per year)
 - approximately one patient per year
 - less than one patient per year
 - no patient declared brain dead in the past two years
 - data unavailable
- 6 If there is NO contraindication to determination of brain death by clinical examination, what is your routine method for establishing brain death in adults?
 - two sets of clinical testing
 - one set of clinical testing and one imaging technique to assess intracranial blood flow
 - one imaging technique to assess intracranial blood flow
- 7 If you answered yes to using an imaging technique to determine brain death, which of the following do you use? (tick as many boxes as relevant)
 - 4 vessel intra-arterial angiography with digital subtraction
 - radionuclide imaging
 - contrast CT or CT angiography
 - magnetic resonance imaging