Potential organ donors referred to Ontario neurosurgical centres

[Les donneurs d'organes potentiels dirigés vers les centres neurochirurgicaux de l'Ontario]

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Purpose: Eleven hospitals in Ontario are adult neurosurgical centres (ONCs). Patients transferred to ONCs from community hospitals with acute intracranial emergencies often have non-survivable injuries, and may be returned to the referring hospital for end-of-life care. These referring hospitals may not be familiar with neurological determination of death, or organ donation. Our objective was to determine the number of patients with severe brain injuries assessed in ONC emergency departments where progression to brain death may be reasonably expected, and to determine their outcome.

Methods: A one-year retrospective cohort study was undertaken using a convenience sample of patients transferred to eight ONCs for neurosurgical assessment, with evidence of either (a) brain death in the emergency department, or (b) severe brain injury who met criteria of a reasonable likelihood of progression to brain death. The outcome of these patients to disposition from the ONC was determined by chart review.

Results: Three thousand four hundred and forty-seven patients were identified of whom 141 met inclusion criteria. Eleven patients (7.8%) were pronounced dead in the emergency department, 96 (68.1%) patients were admitted, and 34 (24.1%) were transferred back to their referring hospital. Fourteen patients (9.9%) became organ donors: two died in the emergency department and 12 died following admission.

Conclusions: A significant number of patients transferred to ONCs have an injury with a likelihood of progressing to brain death, but only a small proportion of these patients become organ donors. Emergency department triage, assessment and admission decisions for patients with intracranial catastrophes should consider diagnostic criteria for brain death and recognition of donor potential as part of end-of-life care.

Objectif: En Ontario, 11 hôpitaux sont des centres neurochirurgicaux (CNO) pour adultes. Les patients, transférés des hôpitaux communautaires vers les CNO, présentant des lésions intracrâniennes aiguës à traiter d'urgence, souvent ne survivent pas et peuvent être retournés à l'hôpital d'origine pour des soins aux mourants. La détermination de la mort neurologique, ou du don d'organe, n'est peut-être pas familière aux hôpitaux communautaires. Notre objectif était de déterminer le nombre et l'évolution de patients atteints de lésions cérébrales sévères évaluées dans les urgences des CNO où la progression vers une mort encéphalique peut être raisonnablement attendue.

Méthode: Une étude rétrospective a été entreprise en utilisant un échantillon de commodité des patients transférés dans huit CNO au cours d'un an, pour une évaluation neurologique qui présentait des signes (a) de mort encéphalique au service d'urgence ou (b) d'une lésion cérébrale sévère qui, selon les critères, allait probablement progresser vers la mort encéphalique. L'évolution des patients retournés à leur hôpital par le CNO a été faite par l'examen du dossier.

Résultats: Des 3 447 patients recensés, 141 répondaient aux critères d'inclusion de l'étude. Onze patients (7,8 %) ont été déclarés morts au service d'urgence, 96 (68,1 %) ont été admis et 34 (24,1 %) retournés à leur hôpital communautaire. Quatorze patients (9,9 %) sont devenus des donneurs d'organes : deux sont morts à l'urgence et douze après l'admission.

Conclusion: Un nombre significatif de patients transférés vers les CNO ont une lésion qui va probablement progresser vers la mort encéphalique, mais peu d'entre eux deviennent des donneurs d'organes. Le tri à l'urgence, l'évaluation et l'admission des patients atteints de lésions intracrâniennes catastrophiques doivent comporter les critères diagnostiques de mort encéphalique et l'identification de donneur potentiel comme une partie des soins de fin de vie.

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This study was supported by a grant from the Clarica Corporation.

Accepted for publication September 6, 2005.

Revision accepted February 16, 2006.

Competing interests: None declared.

ORGAN transplantation as a treatment option for patients with end-stage organ failure has been severely restricted because the number of potential organ recipients exceeds the supply of donated organs. As of December 31st, 2004, approximately 4,000 people were waiting for solid organ transplants in Canada.¹ In 2004, 224 people died on Canadian transplant waiting lists.² Cadaveric donors have traditionally been the most common source of organs, although the past three to four years have seen this trend reverse, with a decline in cadaveric donations and an increase in living donations.³ In 2004, the crude cadaveric donor rate was 13.0 per million (414 donors).⁴

Cadaveric organ donors are patients pronounced dead by neurological criteria, most often due to head trauma or spontaneous catastrophic intracranial events such as intracranial hemorrhage. Most, if not all, of these potential organ donors receive their initial care in emergency departments (EDs), and from neurosurgeons and emergency physicians. In Ontario, 11 hospitals are designated as adult neurosurgical centres (ONCs). Patients are referred to ONC EDs from other facilities for neurosurgical management. Patients with a catastrophic illness/injury are evaluated for potential neurosurgical intervention and/or prognosis, and when not amenable to treatment, often die in the ED or are returned to their sending facility. Some of these patients may progress to meet neurological criteria for death (brain death), and be potential organ donors. However, if the health care professionals in the ED or sending hospital are not familiar with the criteria for neurological death, or in approaching families for organ donation, potential organs for transplant may not be realized. The purpose of this study was to estimate the number of patients referred to EDs with acute neurosurgical conditions where progression to brain death might reasonably be expected, and to determine the number of patients who actually became organ donors.

Methods

Ethical approval for chart reviews were obtained from the Research Ethics Boards of each participating ONC. All patients seen in the ED from April 1st, 1998 to March 31st, 1999 inclusive with an acute intracranial emergency were identified in each of the eight participating ONCs (Appendix). Patients were included if there was documented evidence of either (a) brain death in the ED, or (b) potential progression to brain death within 24 hr based upon *a priori* established criteria (Table I). These criteria were developed in consultation with neurosurgeons and intensive care

TABLE I Inclusion criteria

Evidence of brain death in the ED
All three of:
- GCS 3 in the ED
- Documented lack of brainstem reflexes (does not require calorics or formal apnea testing in the ED)
- CT scan showing pathology consistent with the above clinical condition
Evidence of likelihood of brain death within 24 hr
GCS $\leq$ 5 in the ED and CT scan showing $\geq$ 1 of:
- Mass lesion with transtentorial or falcine herniation
- Subarachnoid hemorrhage
- Penetrating wound to brain with path of projectile crossing midline

ED = emergency department; GCS = Glasgow coma scale; CT = computed tomography.

FIGURE Data from eight Ontario neurosurgical centres.

physicians at one ONC based on expert opinion and clinical experience, and were meant to qualitatively identify those patients with severe brain injury and a high likelihood of progression to neurologic death. There was no attempt to formally validate these criteria in terms of their sensitivity and specificity.

Diagnosis, Glasgow coma scale (GCS) in the ED, documentation of examination of brainstem reflexes and head computed tomography scan results were reviewed to identify the number of patients meeting inclusion criteria. Patients were excluded if they had a GCS $>$ 5 in the ED and/or an absence of catastrophic intracranial pathology visualized on computed tomography scan of the head. Disposition from the ED was defined as 1) admission to the ONC, 2) transfer back to sending facility, or 3) death in the ED. The charts were reviewed to determine demographics (age, sex, referring hospital), and to determine (a) if brain death occurred, (b) whether or not organ donation was

TABLE II Number of organ donors referred to ONCs by site 1998–1999

ONC#	No. of NS referrals	No. potential donors	No. actual donors	Donor rate (%)
1	516	26	3	11.5
2	186	8	2	25
3	353	14	3	21.4
4	933	40	1	2.5
5	491	16	3	18.8
6	191	9	0	0
7	336	24	2	8.3
8	441	4	0	0
Total	3,447	141	14	-
Total (%)	-	4.1	9.9	9.9

ONC = Ontario neurosurgical centre; NS = neurosurgery.

TABLE III Disposition of patients referred to ONCs with clinical evidence of (imminent) brain death 1998–1999

ONC#	No. potential donors	Pronounced in ED	Admitted	Returned to sending facility
1	26	4	17	5
2	8	1	7	0
3	14	0	13	1
4	40	2	24	14
5	16	2	12	2
6	9	0	9	0
7	24	1	11	12
8	4	1	3	0
Total	141	11	96	34
Total (%)	-	7.8	68.1	24.1

ONC = Ontario neurosurgical centre; ED = emergency department.

discussed with the family, (c) if consent was obtained, and (d) if the patient became an organ donor. Patient demographics, date of initial assessment at the ONC, referring institution, GCS in ED, and disposition were collected and tabulated at each ONC by the principal investigator (N.T.L.) and/or a research assistant with prior knowledge of the GCS who was trained by the principal investigator. For patients meeting the inclusion criteria, further details of their course in hospital, discussions with family about organ donation, and final disposition from the ONC were recorded in narrative form.

In order to maintain anonymity, results will be presented in table form without identifying the participating ONCs connected with specific statistics. Only the principal investigator and research assistants had access to non-anonymized data. A list of the participating institutions can be found in the Appendix.

TABLE IV Number of family discussions occurring at ONCs 1998–1999

ONC#	Pronounced in ED	Discussion in ED	Admitted	Discussion in hospital
1	4	0	17	5
2	1	0	7	0
3	0	1	13	1
4	2	1	24	14
5	2	0	12	2
6	0	0	9	0
7	1	1	11	12
8	1	0	3	0
Total	11	3	96	34
Total (%)	-	27.3	-	35.4

ONC = Ontario neurosurgical centre, ED = emergency department.

Results

The number of potential organ donors referred to each participating ONC is presented in the Figure and Table II. Of 3,447 patients in Ontario transferred to the participating ONCs, 141 patients (4.1%) met the study inclusion criteria. The number of referrals to the neurosurgery service and potential donors assessed at the ONCs varied widely between institutions, reflecting the overall size of the institution and the population density of the catchment area served. Ninety-six patients (68.1%) were admitted to ONCs. They ranged between 17 and 97 yr of age. None sustained penetrating brain injuries. Eighty-six patients died during the hospitalization, and ten patients survived to be transferred to a rehabilitation facility. Each of these patients had an initial GCS of 4–5 in the ED and an intracranial lesion amenable to operative treatment. Of the 86 patients who died, in 22 cases organ donation was considered: consent was obtained in 14 cases, 12 of whom became organ donors. The donor rate was also variable between ONCs, from 0–25%, with an average donor rate of 9.9% (Table II).

The disposition of patients referred to ONCs who met the study inclusion criteria are presented in Table III. Eleven of the 141 patients (7.8%) were pronounced dead in the ED. They were between 39 and 79 yr of age. Nine of these patients died of circulatory collapse. The other two patients met neurological criteria for death, and consent was obtained for organ donation following a request initiated by the family (Table IV).

Thirty-four of the 141 patients (24.1% of cases) were returned to the sending facility (Table III). They were between 35 and 85 yr of age. None sustained penetrating brain injuries. By our criteria, 11 likely had brain death in the ED, and 22 met the criteria

for potential progression to brain death within 24 hr. In one of these cases, it was recommended that the patient return to their sending facility “for formal declaration of brain death, then possible consideration of organ donation.” It is unknown if any of these patients subsequently became organ donors.

Fourteen patients (9.9% of all potential donors) became actual organ donors (Table II). Discussion of organ donation occurred for 37 (26.2%) of the 141 potential donors (Table IV). Eight of these patients became organ donors at their family’s request during discussion with either a staff neurosurgeon or staff intensivist. Both donors pronounced dead in the ED became donors after family-initiated discussion of the topic. Ten discussions (27% of discussions) were family-initiated. In contrast, of the potential 141 donors, 117 (83%) patient charts had no documented evidence of being identified as such by a health care professional or family member.

Discussion

This study sought to evaluate the disposition of patients with acute neurosurgical conditions referred to the ED of ONCs. Of 3,447 patients, 141 (4.1%) were identified as having a severe intracranial injury that would result in progression to a potential organ donor. Of these patients, 14 of 141 went on to organ donation. Two of 11 patients who died in the ED met neurological criteria for death, and consent for organ donation was obtained. It is likely that patients were admitted to the ONC under the assumption that further interventions were warranted, and therefore their prognosis was better than that of patients transferred back to the sending facility. Of the 96 patients admitted to an ONC, 14 (14.6%) had their injury progress, and after admission met criteria for brain death. Consent for organ donation was given by 14 families. However, 34 of 141 (24.1%) patients were returned to their sending facility for end-of-life care. On subsequent review, 11 of 34 patients who returned to the sending facility may have met criteria for brain death in the ED prior to transfer. A further 23 patients had clinical criteria that suggested a reasonable likelihood of progression of their injury to brain death within 24 hr. The lack of recognition, and transfer of these patients may represent a significant loss in potential organ donors.

Our findings suggest that lack of identification of potential donors represents a major rate-limiting step in the organ donation process. Other work suggests that centres with expertise in the critical care management of neurosurgical emergencies have higher rates of organ donation than centres without this infrastruc-

ture.³ It is likely that these centres have established processes in diagnosing brain death, organ donor identification, and familiarity with family support as part of end-of-life care. System problems affecting the ED such as increasing patient volumes, increasing ED lengths-of-stay, limited availability of intensive care unit beds that may affect admission criteria and, other causes of ED overcrowding may create a barrier to realizing potential organ donors by forcing the transfer of these patients back to their sending facility. Identifying as a priority the end-of-life care, which may include organ donation of these severely injured patients, may increase the number of potential and actual donors.

This study has limitations. First, chart reviews at three ONC centres were not undertaken due to inaccessibility of charts for the population sought in this study. Our results may inaccurately estimate the organ donor potential if there are systematic differences in how these three ONCs manage the decision to admit patients or return them to their sending facility, compared to the eight ONCs included in our study. It is possible that the rate of discussion of organ donation is also underestimated in our study. Some physicians could have considered and/or requested donation without documenting their request.⁵ Unfortunately, in a retrospective study, the only record is the documentation in the patient’s chart. Our study sample is not representative of the population of patients who usually progress to brain death. Our sample had a lower proportion of patients with traumatic brain injury compared to usual national statistics. Our sample probably under-represented the proportion of patients with traumatic brain injury because the ONC’s are also regional trauma centres, and patients are likely directly transferred to these facilities, not from other facilities. Finally, despite our criteria having been developed *a priori* and reviewed for face and content validity, our criteria did not always correctly identify patients who would progress to brain death. Of the patients admitted to ONCs who were expected to progress to brain death, ten of 96 (10.4%) ultimately survived, to be discharged to a rehabilitation facility. This finding highlights the uncertainty of early clinical findings in predicting outcome from brain injury. As discussed by Rocker *et al.*,⁶ survival predictions are characterized by significant practice variation, partly related to the patient and his/her disease, but also heavily influenced by physician and hospital characteristics. Given the evolving neuroprotective therapies,^{7–10} perhaps all patients with severe brain injury should be considered for a trial of treatment and accurate prognostication. Given these considerations, health care professionals

must also ensure that they provide clear information to the patient's family. Perceived miscommunication from the health care professionals involved can play a major role in family refusal.¹¹ For example, a premature request or conflicting statements from a variety of physicians can undermine a family's willingness to consider donation.¹¹

The Canadian health care system does not yet have a reliable information collection procedure to assess the extent to which Canadian hospitals can identify potential donors, and take the steps to maximize organ use from each donor.¹ Our study emphasizes the importance of ED health care professionals in identifying potential organ donors. Efforts including educational initiatives for ED staff on donor recognition,^{12,13} and the use of in-hospital donation coordinators^{5,12,14,15} have been shown to have a positive impact in this area. System barriers within the hospital system may prevent patients from being admitted to facilities with expertise in end-of-life care, including organ donation. Our study implies that patients referred with catastrophic injury should be considered for admission for a trial of treatment and/or to facilitate end-of-life care. Data on organ donation practices should incorporate a mechanism to document and track the 'at-risk' population; i.e., patients with severe, catastrophic brain injuries assessed in EDs.

APPENDIX

Participating Ontario neurosurgical centres

Hamilton Health Sciences Center – General Site, Hamilton, Ontario
 Hotel Dieu Hospital, Windsor, Ontario
 Kingston General Hospital, Kingston, Ontario
 St. Michael's Hospital, Toronto, Ontario
 Sunnybrook and Women's College Health Sciences Center – Sunnybrook Campus, Toronto, Ontario
 The Ottawa Hospital – Civic Campus, Ottawa, Ontario
 Trillium Health Center – Mississauga Site, Mississauga, Ontario
 University Health Network – Western Division, Toronto, Ontario

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