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ORIGINAL ARTICLE

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Medical-record review of potential donor pool in the Czech Republic suggests a possible increase to more than double the number of donors

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Abstract The objective of this study was the investigation of the maximal potential donor pool and causes of non-realized organ donation. On-site retrospective medical-record review was performed for all cases of patient death ($n = 1608$) occurring in 1999 at 34 (83% of all) intensive care units (ICUs) in the region of the transplant center in Prague, Czech Republic. Two hundred and eighty-eight (18%) patients died with clinical signs of brain death. ICU physicians considered 111 of them as being potential donors at the time; 63 became donors and 48 did not. The remaining 177 patients with clinical signs of brain death were, in retrospect, assessed as being unsuitable ($n = 105$) or suitable ($n = 72$) for donation. The maximal potential donor rate was 55.7 per million population (pmp), with a more conservative estimate of 37.4 pmp. The actual donor rate was 18.1 pmp. For the maximal level to be approached, further educational efforts are warranted, targeting ICU physicians and concentrating on the identification of potential donors.

Keywords Maximal donor pool · Donor rate · Donor identification

Introduction

The shortage of organs available for transplantation is a well-recognized problem. In most parts of Europe the numbers of patients on waiting lists are increasing year by year [1]. A few years ago, at the beginning of the 1990s, the situation in the Czech Republic was slightly different. The number of cadaveric donors showed an increasing trend, probably due to the progress of transplant programs in the country: the new occupation of transplant coordinator had been established, a wide acceptance of transplant programs was seen, cooperation with donor hospitals had improved, and educational conferences were organized. Another reason, and perhaps one of the most important at our center, was the expansion of criteria for donor acceptance, including sub-optimal cases. Before 1993, we did not accept potential donors over 55 years of age or with hypertension. Since then, we have not had an upper age limit per se, and isolated hypertension has not been a contra-indication for organ donation. This change could be seen in the donor rate, and the maximum number of cadaveric donors was reached in 1997 (23.2 per million population; pmp) (Fig. 1). However, since then the development has declined. Two years later, in 1999, the number of donors had diminished by 30%. It is not likely that this reduction was due to chance, but the cause is obscure. Negative attention towards organ donation in the Czech media has been a factor of negative impact.

There are two pivotal conditions for organ donation: diagnosis of brain death and consent. In the clinical situation in our country, when brain death is suspected and the patient is identified as a potential donor, angiography is performed. According to legal standards established by the Ministry of Health in 1984, brain death may be confirmed only by cerebral angiography and is defined as

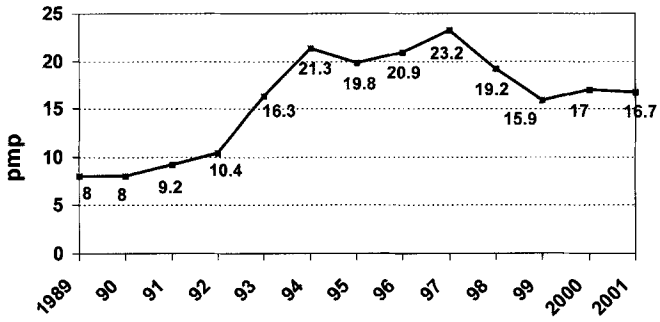

Fig. 1 Number of cadaveric donors per million population (*pmp*) in the Czech Republic from 1989 to 2001

the absence of contrast medium above the base of the skull, upon angiography. Thus, arteries supplying the brain may not be filled intra-cranially. This formulation may create problems; for example, the ophthalmic artery is intra-cranial but extra-cerebral, and often this artery is patent and well filled even though there is no intra-cerebral circulation. In this situation brain death cannot be confirmed according to the legal standards, although there can be no doubt about the diagnosis of brain death. The norms of the Ministry of Health also regulate the question of consent; consent is presumed and it is not obligatory for the relatives to be informed. The legislation was not changed during the 1990s, for either diagnosis of brain death or consent. For several years there have been ongoing preparations for a new law on organ donation, but in essence no great changes are envisaged.

With this background, the following questions arise: what are the reasons for the diminished number of organ donors in recent years, and what is the size of the entire potential donor pool? An initial step would be for one to obtain an overview of potential donors in a large part of the country during a specific time period and analyze the obstacles on the path towards accomplished organ donation.

The objective of this study was the investigation of whether or not all potential donors in the region of the Transplant Center in Prague had been identified and had actually become organ donors. In the event of potential donors being missed, we aimed the study at clarifying the reasons for this and formulating a plan of what action should be taken. As a secondary objective of the study, the detailed monitoring of intensive care unit (ICU) files from deceased patients would allow for a cooperation of an educational nature with colleagues in intensive care. This is the first medical-record review and analysis of organ donation performed in the Czech Republic.

Materials and methods

There are seven transplant centers in the Czech Republic. In each one there are transplant coordinators and transplant surgeons responsible for kidney retrieval and transplantation. The Transplant Center at the Institute of Clinical and Experimental Medicine (IKEM) in Prague plays the role of national center, coordinating donors of liver, pancreas, heart, and lungs, in addition to being responsible for the national waiting list and allocation of all organs. Assistance is provided by the Transplant Center at IKEM in all cases of marginal donors. This is a retrospective study of all patients who died during 1999 at ICUs in the region of the Transplant Center at IKEM. The total population of the region was 4.2 million at this time. There were 41 ICUs, and 34 (83%) of them (with a population of 3.48 million) participated in the study (including ICUs for neurosurgery, 2; neurology, 2; general surgery, 1; anesthesiology, 29). Forty-six intensive care physicians took part as local investigators. It was their responsibility to initiate the medical-record review on each patient who died in the ICU. These data were then monitored by the primary investigator (E.P.) who compared them with the original medical files in each case. If any discrepancies were found, consensus was reached during meetings with the local physicians.

Basic data included age, gender, nationality, time in ICU, clinical diagnosis, and presence and cause of brain damage. The key questions were related to clinical signs of brain death and identification of potential donor suitability. If these signs were present, a series of more specific data was collected, including laboratory values and investigations such as chest X-ray, electrocardiogram, computed tomography, and ultrasound. Most important were the questions of whether brain death had been confirmed by cerebral angiography in preparation for organ donation and whether organ retrieval was performed or not.

Results

The total number of patients treated at the ICUs during 1999 was 10,269, and 1,608 (16%) of them died. Of the patients who died, 950 had clinical diagnosis of brain damage and 288 (18%) had clinical signs of brain death (Fig. 2). The local investigators identified 233 of these patients in retrospect and after monitoring; another 55 were added in consensus with local physicians. This group with clinical signs of brain death included 174 (60%) male patients, and the median age was 54 (range 4–93) years. The median time of stay in ICU was 2.8 (range 0.1–68) days. The most common diagnoses at admission were cerebral hemorrhage, which occurred in 119 (41%) patients, and trauma, which affected 92 (31.9%) patients (Table 1).

At the time of the clinical event, the intensive care physicians identified 111 patients with clinical signs of brain death as potential donors (Fig. 2). Sixty-three of them became donors, and 160 organs were retrieved and transplanted (111 kidneys, 19 hearts, 20 livers, six pancreases, four lungs). In 48 cases organ donation was not performed (Fig. 2). In 25 of them, cerebral angiography confirmed the absence of intra-cerebral circulation, but contrast medium was found in parts of the intra-cranial arteries (either ophthalmic artery or carotid siphon). Thus, the diagnosis of brain death according to Czech legal standards could not be established and organ donation could not be performed. Another ten patients had circulatory failure before or just after angiography

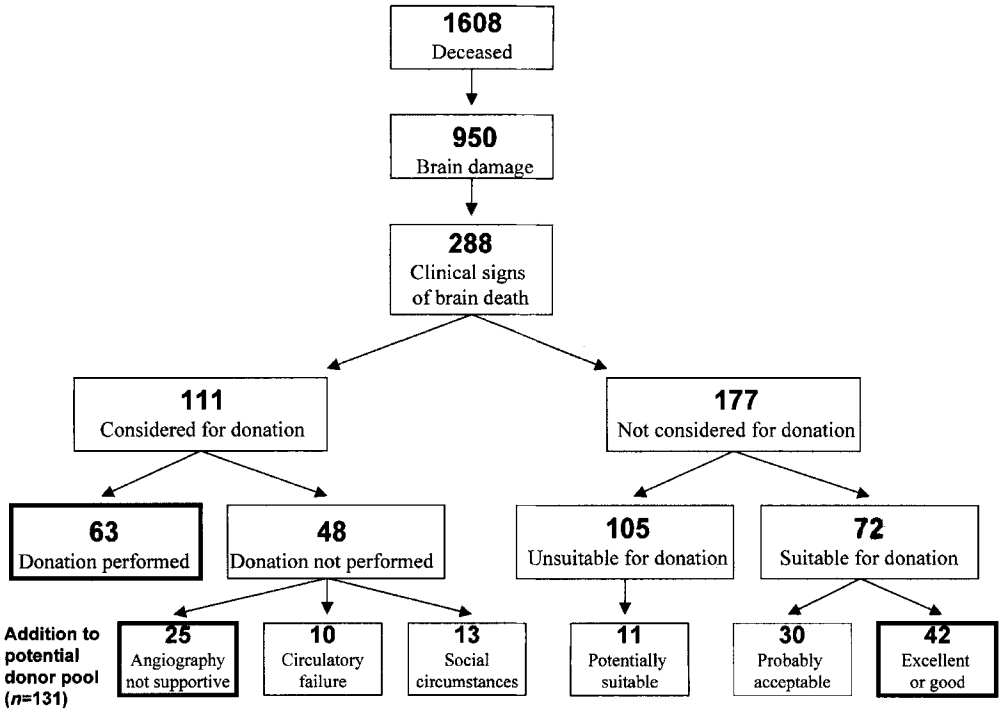

Fig. 2 Overview of various subgroups of 1,608 patients who died during their stay at the ICU. Organ donation was performed in 63 patients. Addition to the potential donor pool, *the lower line of boxes*, included 131 patients. With a more conservative estimate, organ donation could have been performed in 25 patients if the legal standards on angiography had been supportive, and in 42 patients if the potential donors had been identified at the time of events

had been performed. In 13 cases, social circumstances or family disagreement precluded organ donation. The Transplant Center was informed about these 111 cases at the time of events, except for 12 of the 13 patients in the latter subgroup.

The remaining 177 patients with clinical signs of brain death were not considered for organ donation, i.e., they were not identified and treated as potential donors. In retrospect, 72 of these patients were considered as being suitable for organ donation (Fig. 2). In none of these cases was the Transplant Center contacted. We judged from the medical records that 42 patients would have been good or excellent donors. In the remaining 30 cases, some additional laboratory investigations or details of the medical history would have been requested before a final decision on organ donation would probably have been made. It is important to note that the location of these retrospectively identified patients was spread symmetrically throughout the majority of the ICUs.

The remaining major group of patients consisted of 105 individuals who, in retrospect, were considered to be not suitable for organ donation. The Transplant Center was contacted in only one case. The most frequent reasons for contra-indication of organ donation were old age in combination with a history of hypertension or diabetes mellitus and signs of severe organ dysfunction, which occurred in 41 cases (39%) (Table 2). In another 43 patients (41%) there was severe circulatory instability at the time of clinical signs of brain death: in 32 cases because of cardiac or multi-organ insufficiency for other reasons. However, the remaining 11 patients had been young and could have been good donors, yet they developed circulatory failure apparently because of inadequate treatment; for example, limited infusion of fluids and no administration of catecholamines.

In an ideal situation, with non-failing identification of every potential donor and an indisputable instrument for diagnosis of brain death, the number of donors at these donor hospitals and in this period of time would have been 131 cases greater (Fig. 2), an increase of 208% (from 63 to 194). This would suggest that the maximal potential donor rate for the region (with a population of 3.48 million) would be 55.7 pmp. A more conservative estimate would still add 67 cases, excluding the ten patients who were identified as potential donors and had received donor treatment, and also the 11 potentially suitable patients who were not identified as potential

Table 1 Clinical diagnosis at admission in patients with clinical signs of brain death ($n = 288$)

Clinical diagnosis at admission	*n*	%
Trauma	92	31.4
Cerebral spontaneous hemorrhage	119	41.3
Cerebral thrombosis or embolization	27	9.4
Status after cardiac arrest due to myocardial infarct	12	4.2
Status after cardiac arrest due to other reasons	13	4.5
Respiratory insufficiency	10	3.5
Cardiac insufficiency	3	1.0
Infection	7	2.4
Generalization of malignancy	5	1.7

Table 2 Reasons for identifying thedeceased as being unsuitable for organ donation ($n = 105$) (S_{Cr} serum creatinine)

Reasons	*n* (%)	*n*
Old age[a] with hypertension, diabetesmellitus, ischemic cardiac disease, and/or severe organ dysfunction	41 (39)	
Old age, hypertension, elevated S_{Cr}[b]		12
Old age, elevated S_{Cr}[c]		6
Old age, diabetes mellitus, elevated S_{Cr}[d]		4
Old age, hypertension, diabetes mellitus		11
Old age, ischemic cardiac disease		8
Chronic dialysis with secondary complication	6 (5.7)	
Circulatory instability or failure	43 (41)	
Circulatory failure with high doses of catecholamines		18
Multi-organfailure		7
Sepsis and multi-organ failure		7
Circulatory failure, inadequate treatment		11
Malignancy	15 (14.3)	
Total	105	

[a]Median age 74 (range 51–93) years; two patients < 60 years
[b]Median S_{Cr} 158 (range 130–270) µmol/l
[c]Median S_{Cr} 185 (range 162–440) µmol/l
[d]Median S_{Cr} 260 (range 196–361) µmol/l

donors and not treated adequately – all developed circulatory insufficiency (Fig. 2). Furthermore, it would exclude the 13 identified potential donor cases who were not considered due to social circumstances and, finally, the 30 non-identified potential donors who probably would have been medically acceptable had the work-up been done. The conservative estimate yields a potential donor rate of 37.4 pmp. Since the number of identified and referred patients was 99 and the total potential donor pool was 194 cases, the rate of efficacy in donor identification and referral was 51.0%.

Discussion

The estimate of the maximal potential donor pool in this study concurs very well with that in previous studies, although these were performed in different countries and a decade ago. For example, Nathan et al. [5] found a maximal potential donor rate of 55.2 pmp and arrived at a conservative estimate of 38.3 pmp in Pennsylvania within the study period of 1987. Others found maximum donor rates of 43.7 pmp [2], 50.8 pmp [3], and 55 pmp [4]. Furthermore, Nathan et al. [5] reported an efficacy rate of 52%, which is in accordance with our finding of 51%. This consistency in outcome suggests an international applicability of the results of this and similar studies.

In this report we identified two areas of inadequate routines requiring careful consideration for possible improvement: identification of potential donor suitability and diagnosis of brain death by means of cerebral angiography.

With regard to the first area, identification of potential donor suitability at the time of events, it should be stressed that the clinical signs of brain death were well described in the medical records. However, these findings did not lead the physician responsible to consider organ donation, and a great number of potential donors failed to proceed to organ donation. Actually, in only 39% (111/288) of the cases was the Transplant Center contacted. There might well be a series of simple explanations. Organ donation is not yet an established part of the medical field of anesthesiology. The duty of intensive care physicians to improve organ donation is not stressed sufficiently by hospital authorities. Overburdened with other clinical work, they might be reluctant to start a process that would lead to an extra workload that is considered of secondary priority. One possible solution would be the obligation that contact with the Transplant Center always be established when clinical signs of brain death occurred in a patient. In the new law on organ donation in the Czech Republic it is stressed that it is the duty of the donor hospital to inform the Transplant Center of any potential donor. Following such a contact, transplant coordinators on duty may well assist the ICU physician in assessing the status of the potential donor, deciding on donor treatment, and preparing for the retrieval operation. It is vital that the Transplant Center be involved in the consideration of contra-indications against organ donation in all potential cases, since donor suitability ought to be balanced against recipient urgency, e.g., in liver and heart transplantation. The latter information is not available at the donor hospital. Furthermore, appraisal of marginal donors is beyond the expertise of local ICU physicians.

It is not an uncommon belief amongst colleagues working at ICUs that the reason for the low number of donors is that there are not more potential donors. This is not correct, and it was a positive sign in this study that of the 288 retrospectively identified potential donors, all except 55 were found by the local co-investigators (that is in total 81%). The remaining cases were found by the primary investigator and added after agreement with the local physicians. This was a process

of mutual understanding, which has created a platform for continued collaboration between the Transplant Center and the donor hospitals. During these meetings it also became clear that there was widespread knowledge concerning indications and contra-indications for organ donation. At least this was the case among the participating ICU physicians. Whether this is true of the majority of ICU physicians would have to be investigated via knowledge and attitude surveys. Another reason why clinicians might not proceed to identify a deceased person as a potential donor when clinical signs of brain death are present may be their routine of assessing the prognosis in general terms and deciding on withdrawal of treatment. A preferable routine would be the performance of a full-scale clinical investigation to establish the presence of brain death, a diagnosis that should automatically lead to determination of the possibility of organ donation.

Continuous education of intensive care physicians and nurses is a pivotal and mandatory task of transplant units. The theme for such education may be called the critical donation pathway, and there are various educational and practical programs with this intent, for example, Donor Action [6]. The following are the most important steps: diagnosis of severe brain damage, identification of potential donor suitability, diagnosis of brain death, and referral contact with the transplant center. More intensive contact and cooperation between the transplant center and the donor hospital should lead to an incentive to improve the local supportive organization of organ donation. This could, for example, include a registry or medical-record reviews according to Donor Action [6] and specialized personnel being locally responsible for organ donation. It is vital for the transplant center to have a local contact at each donor hospital. At present, there is also the problem of inadequate reimbursement of the hospital for extra costs associated with the process of organ donation. In contrast, there is very good hospital reimbursement for dialysis treatment.

The second area of inadequate routines concerns the legal norm of angiographic diagnosis of brain death. It is evident from this study that a number of potential donors were lost, not because angiography did not confirm brain death, but because the investigation was not in accordance with the legal standards. The number of potential donors was considerable; without this problem, the donor pool would have been 40% greater. It has also been estimated that a total of 141 donors and 460 potentially retrievable organs were lost within the entire Czech Republic during the years 1998 to 2000. There are also great ethical and social aspects to this problem. In many cases, doctors in the ICU have taken care of the patient for several days, identified the potential for donation, and treated the potential donor according to specific routines. Often the family has agreed and is motivated for donation. Then the paradoxical situation arises whereby their relative has developed brain death, is dead, but is not considered as being dead according to the legal norms and organ donation is therefore prohibited.

In conclusion, the maximal potential donor pool in this region of the Czech Republic was 55.7 pmp, with a conservative estimate of 37.4 pmp, and an efficacy rate of referral of 51%. The rate of donation realized in the same year was 18.1 pmp. These figures suggest that organ donation could be increased, ideally to double the amount. The main obstacles include identification of the potential donor at the time of events, which implies the need for further education to increase the awareness of organ donation amongst colleagues at ICUs. The obligation for the donor hospital to contact the Transplant Center in all cases of brain death is a pivotal factor. Furthermore, there is a need for reinforcement of the donor program, including review of donor hospital routines, improvement of reimbursement for donor hospitals, review of the legal standards for diagnosis of brain death, and support of the health authority for improvement of the general conditions for organ donation.

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