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## Work-load generated by the establishment of a non-heart beating kidney transplant programme

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**Abstract** The work-load generated by a non-heart-beating donor (NHBD) kidney transplant programme over a 3-year period is reported. A total of 73 referrals were made, 64 from the Accident department and 9 from the wards. Organ procurement was performed in 24 cases (33%) and resulted in the retrieval of 44 kidneys. Reasons for failure to achieve organ procurement were: refused consent ( $n = 13$ ; 18%), relatives unavailable to ask for consent ( $n = 9$ ; 12%), technical problems with catheter insertion or perfusion ( $n = 10$ ; 14%), transplant staff unavailable ( $n = 1$ ; 1%), long asystolic period ( $n = 8$ ; 11%) and donor unsuitable for other reasons ( $n = 8$ ; 11%). Of the 44 kidneys retrieved, 30 were transplanted locally,

8 were transplanted at other United Kingdom centres and 6 were discarded. Locally transplanted NHBD kidneys represented 21% of the total transplant programme during the time period under study. We conclude that NHBD kidneys are a good source of additional organs for transplantation, but only one-third of referrals result in a successful procurement procedure. Moreover, the setting up of a successful programme is labour-intensive and requires a highly committed staff.

**Key words** NHB donor, kidney transplantation, workload · Workload, NHB donor, kidney transplantation · Kidney transplantation, NHB donor, workload

### Introduction

Renal transplant programmes in the United Kingdom continue to be seriously limited by a shortage of suitable organ donors. There are now over 5000 patients in the United Kingdom and Ireland awaiting a kidney transplant (UKTSS figures), but as only 1700–1800 transplants are being performed annually, the waiting list continues to grow. Two powerful demographic trends underlie these statistics. Firstly, the death rate from road traffic accidents has fallen in recent years as a result of effective seat belt legislation and drink-driving campaigns. Secondly, there has been a less explicable but even more dramatic decline in the number of deaths resulting from intra-cerebral haemorrhage in the last 20 years [8]. These changes have limited the supply of brain stem-dead cada-

veric donors from Intensive Care Units, and the trends are so strong that efforts to increase the number of organ donors from this traditional pool are unlikely to succeed. In Leicester an attempt has been made to address the falling numbers of organ donors by establishing a non-heart-beating donor (NHBD) programme [11, 12]. An important aspect of this work, which has not been emphasised, is the additional work-load generated by the establishment of a NHBD programme. This report addresses this issue in the Leicester unit over a 3-year period.

### Patients and methods

The organisation of a NHBD kidney retrieval had five stages: (1) referral by medical staff in Accident and Emergency Department/

medical wards and mobilisation of the NHBD team, (2) obtaining consent from relatives, (3) in-situ kidney cooling and perfusion, (4) consultation with the local coroner and (5) transfer to an operating theatre for the donor nephrectomy operation.

#### Referrals

Referrals for NHBD organ retrieval were made by medical staff in the Accident and Emergency Department of the Leicester Royal Infirmary and from the physicians responsible for appropriate ward-based patients. Suitable donors were largely patients dying as a result of a myocardial infarction, and in whom attempts at resuscitation were unsuccessful. A smaller number of patients who died in the ward setting following a sudden intra-cerebral catastrophe were also referred. Donor selection criteria included: no history of renal impairment, uncontrolled hypertension, complicated insulin-dependent diabetes, systemic sepsis or malignancy except for a primary tumour of the central nervous system. The upper age limit accepted was 60 years and the total acceptable duration of absolute warm ischaemia (time without external cardiac massage and artificial ventilation) was 40 min.

In Leicester, the Accident Department in the Royal Infirmary, and the Transplant Unit in the General Hospital are separated by a distance of 3 miles. Consequently, the NHBD team has had to travel between the two hospitals by car through a busy part of the city. To facilitate a rapid response to referrals, funding has been obtained to base a surgical research fellow at the Royal Infirmary. This doctor is on-call for NHBD referrals during normal working hours, and for out of hours referrals, a separate on-call team has been established. The team consists of a transplant co-ordinator (1 in 2 rota), a consultant transplant surgeon (1 in 2 rota) and a surgical trainee at the registrar grade (1 in 4 rota). All team members were available to attend either hospital within 15 min of a referral.

#### Consent

This has been the responsibility of the transplant co-ordinator, who approached the relatives of the deceased as soon as possible after death had been pronounced. If the relatives were not available, the in-situ organ cooling procedure was performed and consent for kidney retrieval was asked for at a later stage when the next of kin could be contacted. This sequence of events was unusual and was only introduced after detailed consultation with the local coroner.

#### In-situ kidney perfusion/cooling and kidney retrieval

At the pronouncement of death, cardio-pulmonary resuscitative measures were stopped for a period of 5–10 min, but then restarted so that the kidneys were perfused and oxygenated until they could be cooled in-situ. More recently a mechanical cardio-pulmonary 'resuscitator' (CPR board 'thumper', Michigan Instruments, USA) has been employed to perform donor external cardiac massage and ventilation with 100% oxygen. This releases hard-pressed Accident or Medical Department staff for other duties. In-situ perfusion and cooling was achieved using the double-balloon triple-lumen intra-aortic catheter [3] introduced into the aorta via a femoral artery cut-down in the right groin. The kidneys were then perfused with hyperosmolar citrate cooled to 4°C. The system was vented by placing a Foley catheter into the inferior vena cava via the right femoral vein.

**Table 1** Yield of transplant kidneys from the Leicester NHBD programme (1 March 1992–28 February 1995)

Referrals	73
Potential kidneys available	146
Retrieval rate	24/73 (33%)
Suitable kidneys obtained	44/48 (92%)
Kidneys transplanted	38/44 (86%)
Ratio actual transplants to total no. potential kidneys	38 : 146 (26%)

#### Consultation with the coroner

The vast majority of NHBDs had suffered a sudden and unexpected death within 24 h of admission to hospital and were therefore referred to the coroner. Following in-situ perfusion, the coroner's permission to proceed to organ retrieval was sought in all cases. The coroner's pathologist was also involved in this consultation to make sure that the proposed retrieval operation would not interfere with the subsequent post-mortem examination.

#### Donor nephrectomy

This was always performed in a fully equipped operating theatre. Although the kidneys were cooled and perfused, every effort was made to remove them as quickly as possible.

## Results

During the period 1 March 1992 through 28 February 1995, a total of 73 referrals were made to the NHBD team. A kidney retrieval operation resulted from 24 (33%) of these referrals and the transplant kidneys resulting from this are shown in Table 1. Of the 48 kidneys retrieved, 4 were not suitable for transplantation either because they were found to be poorly perfused ( $n = 2$ ) or were hypoplastic ( $n = 2$ ). Six of the remaining 44 usable kidneys were not transplanted because there were no acceptably matched recipients on the Leicester list and they could not be placed through the national matching system. The final ratio of actual transplants to the total number of potential kidneys was 38:146, or 26%. Thirty NHBD kidneys were transplanted locally and 8 were transplanted in other United Kingdom centres via the UKTSS matching scheme. During the study period, 144 kidney transplants were performed in Leicester, and the 30 NHBD transplants therefore accounted for 21% of the total programme. This equates to an increased transplant activity of 30/114 or 26%.

The reasons for failure to procure organs are shown in Table 2. In ten cases the perfusion catheter was either incorrectly positioned in the aorta or proved impossible to introduce as a result of iliac artery atheroma and tortuosity. In 16 cases the referral proved to be inappropriate because age or warm ischaemic time criteria were

**Table 2** Reasons for failure to achieve kidney retrieval

Total referrals	73 [%]
Came to retrieval operation	24 (33)
Refused consent	13 (18)
Relatives not available	9 (12)
Technical problem inserting catheter or with perfusion	10 (14)
Warm ischaemic time > 40 min	8 (11)
Donor unsuitable for other reasons	8 (11)
Transplant surgeons not available	1 (1)

exceeded. On one occasion the transplant team was already retrieving kidneys at another centre and so were not available to attend the NHBD referral. Consent for organ retrieval was sought in 47 of the 73 referrals and was obtained in 34 of these (72 %).

## Discussion

A number of European centres have established NHBD kidney transplant programmes over the last decade. The early published results suggest that asystolic donors can provide a useful source of additional transplantable organs [7, 11] and the functional results have been encouraging [1, 2, 9, 10, 12]. A recent comparative study concluded that the results of NHBD kidney transplantation were as good as those for conventional heart-beating donors [13].

When assessing the success of NHBD kidney transplant programme, the work-load generated must be balanced against the number of successful renal transplants that result. Published reports so far have concentrated on the number and success of NHBD kidney transplants but have not included a denominator figure to include the failed attempts at organ procurement from asystolic donors. The data presented here show that for every successful NHBD retrieval there are two unsuccessful attempts, and this process is labour-intensive. A large team is required to run NHBD programme, and in Leicester an extra transplant co-ordinator and surgical trainee have been recruited to support the NHBD work-load.

Although a direct cost comparison has not been made in this study, NHBD kidney transplants may be more expensive than conventional transplants for a number of reasons. The double-balloon triple-lumen catheters used are relatively expensive, and the volume of perfusion fluid used during NHBD kidney retrieval is approximately three-fold that required for a heart-beating donor. The incidence of delayed graft function in Leicester NHBD kidney transplants is 100 % [12], and this has meant longer in-patient stays. Finally, the use

of anti-lymphocyte preparations as induction therapy has also added to the unit cost of a NHBD kidney [5]. Nonetheless, NHBD transplantation is still cost-effective, as maintaining a patient on dialysis is many times more expensive than a successful transplant.

The establishment of a NHBD programme has had important effects on the working practices of a number of different groups. In particular, the NHBD programme has dramatically altered the role of the transplant co-ordinators and surgical staff who must remain within 15 min of the Accident department at all times when on-call for NHBD donors. This level of readiness has placed extra stresses on an already busy staff. The programme has also committed the nursing and medical staff in the Accident Department and on the medical wards to additional duties at the time of a NHBD donation. At least two members of staff are required to perform the external cardiac massage and hand ventilation of the cadaver until the surgical team can arrive and introduce the intra-aortic catheter for in-situ organ perfusion. The acquisition of a mechanical cardiorespiratory 'resuscitator' has proved to be of benefit in releasing hard-pressed Accident Department staff to their other duties, as well as having the advantage of standardising the external cardiac compression and ventilation procedure.

In this series consent for organ procurement was refused in 13 of 47 patients (28 %). This figure is very close to that derived from a national survey of organ donation consent rates in Intensive Care Units in the United Kingdom [4]. The circumstances in which consent is asked for are very different in the NHBD situation compared to that for brain stem-dead donors in the setting of an Intensive Care Unit. By their very nature, NHB donors die suddenly and unexpectedly, and as there is a pressing need to cool the kidneys in order to limit the amount of ischaemic damage, there is very little time in which to consult the family and ask for consent. Clearly, this difficult task needs to be handled with sensitivity, and we believe that the involvement of an experienced transplant co-ordinator is essential to the high level of success achieved.

The establishment of a successful NHBD kidney transplant programme requires good communication pathways and the fostering of a close relationship between the transplant team and staff in the Accident Department. The retrieval team needs to be available 24 hours a day and must be able to respond to calls quickly. Of necessity, a relatively large number of personnel are required to staff such a rota. Experienced and highly motivated transplant co-ordinators are a key requirement for a successful programme. It may be possible to increase the NHBD retrieval rate by looking for new donor sources. Leicester does not have a neurosurgery unit and so very few Maastricht category III and IV NHB donors [6] have been identified. We do, how-

ever, have a busy cardiac unit, and patients who fail to come off cardiopulmonary bypass following open heart surgery may prove to be an additional source of NHBD kidneys for transplantation.

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