A Better Journey for Patients, a Better Deal for the NHS: The Successful Implementation of an Enhanced Recovery Program After Renal Transplant Surgery

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Abstract

Objectives: **Our aim was to apply the principles of enhanced recovery in renal transplant recipients and to assess the changes in the quality of patient care and patient satisfaction.**

Materials and Methods: **Our study included 286 consecutive renal transplant patients. Of these, 135 patients went through the enhanced recovery program and 151 patients had traditional recovery. Patient education and discharge planning were commenced on admission. For enhanced recovery, prolonged pre-operative fasting was avoided by carbohydrate loading. Goal-directed fluid management was aided by transesophageal Doppler to avoid central line insertion. Intrathecal diamorphine and ultrasonography-guided transversus abdominis plane blocks were used to achieve adequate analgesia. Patients started oral intake a few hours postoperatively. The urinary catheter was removed 2 to 4 days after transplant.**

Results: **The postoperative patient-controlled analgesia requirement for morphine was significantly reduced in the enhanced recovery versus traditional recovery group (median of 9.5 vs 47 mg; *P* < .001). The length of stay was significantly reduced for living-donor (median 5 vs 7 days; *P* < .001) and for deceased-donor transplant recipients (median 5 vs 8.5 days; *P* < .001) with enhanced recovery versus recipients who had traditional recovery. Implementing enhanced recovery saves £2160 per living-donor transplant and £3078 per deceased-donor transplant. In the enhanced recovery group, readmission within 10 days after transplant was 5%.**

Conclusions: **Our service evaluation demonstrated that enhanced recovery benefits both types of renal transplant (living and deceased grafts) procedures, with excellent patient satisfaction and reduction of hospital length of stay.**

Key words: *Chronic kidney disease, Fast track, Kidney transplantation*

Introduction

The concept of enhanced recovery (ER) within elective surgery has revolutionized our surgical practice over the recent years since its introduction by Henrik Kehlet.[1] The technique was originally implemented as a rehabilitation program after colonic surgery[1,2] with its principles centered on a multimodal recovery pathway to reduce post-operative pain and to accelerate recovery. Although the principles of the pathway were originally developed and integrated for colorectal surgical patients, they have also been used in numerous operative procedures, including general, visceral, vascular, and thoracic surgery, as well as orthopedic, urologic, and gynecologic operations.[3] The ER program is about improving patient outcomes and speeding up a patient's recovery after surgery. It benefits both patients and staff members. The program focuses on making sure that patients are active participants in their own recovery process. It also aims to ensure that patients always receive evidence-based care at the right time. Improving patient care subsequently reduces the length of hospital stay (this length is reduced by default).[1]

There is no formally agreed on definition for enhanced recovery. The same principle has been described under different headings including "fast track" and "accelerated rehabilitation."[4]

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There was a wrong belief among renal transplant clinicians that the principle of ER would be difficult to implement in chronic renal failure patients undergoing renal transplant. These patients are typically American Society of Anesthesiologists grade III with many comorbidities. At end-stage renal disease (ESRD), dialysis patients have 8 times the mortality rate of their age-matched counterparts in the general population, with cardiovascular causes accounting for more than 50% of deaths.[5] Eighty-four percent are hypertensive and on more than 1 agent[6]; 31% have congestive heart failure at the time of initiation of dialysis, with 25% developing congestive heart failure during the course of dialysis.[7] The incidence and severity of coronary artery disease increase as glomerular filtration rate declines.[8] Small angiographic studies have suggested that this incidence exceeds 50% in unselected dialysis patients.[9,10] Forty percent are diabetic. Diabetes is the leading cause of chronic renal failure, accounting for 30% of its causes.[11]

Postoperative care of renal transplant patients is not straightforward. Immunosuppression increases the risk of infection and delays wound healing. If the kidney does not function right away, dialysis is required. In addition, patients may also need a kidney biopsy to exclude rejection of the transplanted kidney. This necessitates prolonged hospital stays or readmission. Perioperative fluid management is also challenging, especially in anuric patients, given the preexisting comorbidities mentioned above.

In this service review, we implemented various modalities of pain control and fluid treatment, enhanced by patient education, counseling, early resumption of oral intake, and early mobility to enhance the recovery of living-donor transplant and deceased-donor transplant patients during their journey through renal transplantation.

Materials and Methods

We analyzed 264 consecutive renal transplant patients. Of these, 135 patients (60 living-donor transplants and 75 deceased-donor transplants) went through the ER program compared with 151 patients (85 living-donor transplants and 66 deceased-donor transplants) who had traditional recovery. For deceased-donor transplant recipients, 22/75 ER patients received kidneys and 26/62 traditional recovery patients received kidneys from donors after cardiac death. Patient education and discharge planning were commenced on admission. For living-donor recipients, 40/60 ER patients (66%) received carbohydrate (CHO) loading (Nutricia preOp, 200 mL/carton; Nutricia Medical, Wiltshire, UK). The patients received 4 CHO drinks on the day of admission and 2 CHO drinks on the morning of surgery with no overnight fasting. The last CHO drink was given 2 hours before transplant. All patients were given light early breakfast at 6:00 AM (no solid food or any other oral fluid after 6:00 AM, with only CHO allowed). For deceased-donor recipients, 35/75 ER patients (46%) received 2 CHO drinks (Nutricia preOp, 200 mL/carton) while waiting for cross-match results. All diabetic patients were excluded (4/60 living-donor and 5/75 deceased-donor transplant recipients).

Intraoperative anesthetic care included goal-directed fluid therapy using transesophageal Doppler to achieve adequate fluid balance and to avoid the use of central lines. Central lines were only used (10/60 living-donor recipients [16%] and 7/75 deceased-donor recipients [9%]) when inotropic support was required or when intravenous access was needed for thymoglobulin induction, an immunosuppressive drug that requires central venous access for administration. Intrathecal diamorphine (ID; single dose of 200-600 μg) combined with ultrasonography-guided transversus abdominis plane block (TAP block; 40 mL of 0.25% bupivacaine) were administered to minimize patient-controlled analgesia (PCA) use of systemic morphine (1 mg/mL) and to improve the postoperative analgesia during the first 24 hours after surgery. Free oral intake was commenced a few hours after the operation, allowing discontinuation of intravenous fluid replacement within the first 24 hours after surgery. Early mobilization was encouraged from the first postoperative day, allowing patients to sit on a chair for 2 hours. Mobility was gradually increased on the subsequent postoperative days.

Laxatives and oral analgesia were also commenced after discontinuation of the PCA morphine on the first postoperative day. Urinary catheters were removed 2 to 6 days after transplant (average of 4 days). Wound drains, if used, were removed within the first 48 hours of surgery unless it was productive (> 100 mL/24 h). This enabled early mobilization and continued patient education.

The length of hospital stay, morphine requirements, and oral analgesia requirements were compared with consecutive historical controls extrapolated from our database who did not have any of the ER elements mentioned above. None of the patients in the traditional recovery group had CHO drinks, goal-directed fluid therapy with transesophageal Doppler, TAP blocks, or ID. This group had 20 to 30 mL of bupivacaine 0.25% as wound infiltration into the subcutaneous tissue. Patient-controlled analgesia morphine was also discontinued 24 hours after surgery. The urinary catheter in the control group was removed on day 5 or sometimes later. There was no agreed-on plan regarding removal of the surgical drain. There was also no formal plan for early mobilization or planned discharge date.

Statistical analyses

Data were analyzed using SPSS for Windows (SPSS: An IBM Company, version 19, IBM Corporation, Armonk, NY, USA). Parametric and nonparametric data are presented as means ± standard deviation (SD) or median with range. Categorical variables are expressed as frequencies and percentages. We used the *t* test for comparisons of parametric continuous variables. The Mann-Whitney *U* test was used for nonparametric continuous variables. Comparisons of nominal and categorical data were performed by means of the chi-square test or Fisher exact test as indicated.

Results

There were no differences in patient characteristics (age, sex, type of donor, and number of renal grafts received) between the ER group and the traditional recovery group (Table 1). The postoperative morphine PCA requirement was significantly reduced in the ER group (median of 4 mg; range, 0-56 mg) compared with the traditional recovery group (median of 53 mg; range, 10-140 mg) ($P < .001$; Figure 1). There were no significant differences in the oral analgesia requirement between the 2 groups, thus demonstrating overall better postoperative analgesia. The length of hospital stay was significantly reduced ($P < .001$) for living-donor kidney recipients (median of 5 days; range, 3-9 days) (Figure 2) versus patients who had traditional recovery (median of 7 days; range, 5-30 days). Length of hospital stay was also reduced for deceased-donor kidney recipients (median of 5 days;

Table 1. Patient Characteristics

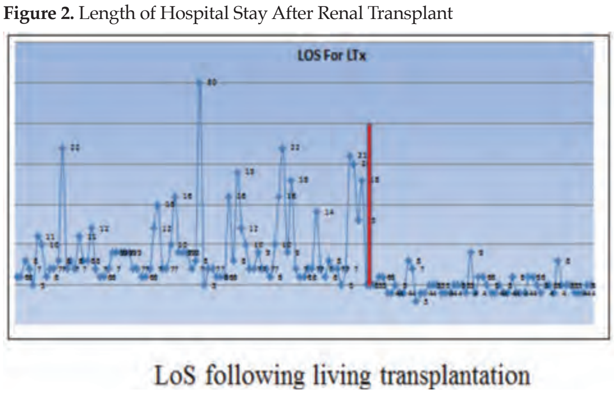
Characteristic	Enhanced Recovery	No Enhanced Recovery
Living-donor transplant	60	85
Deceased-donor transplant	75	64
Cardiac death	20	25
Brain death	55	39
Dual kidney transplant	2	2
Age, y	48	50
Males	94	98
Females	41	60

Results show number of patients, unless otherwise indicated. P = not significant.

Figure 1. Patient-controlled Analgesia Morphine Requirement in Enhanced Recovery and Traditional Recovery Groups

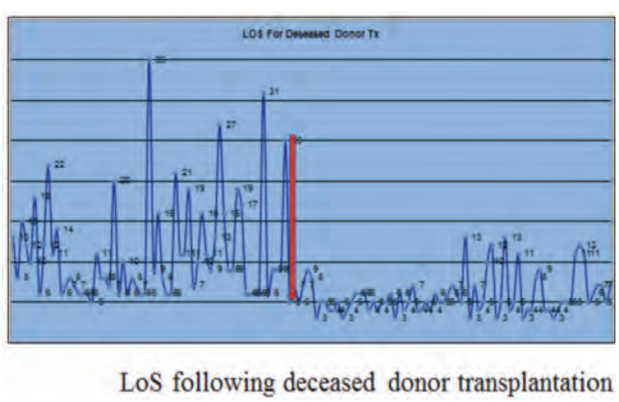
Abbreviations: ER, enhanced recovery; PCA, patient-controlled analgesia

Figure 2. Length of Hospital Stay After Renal Transplant



Abbreviations: LOS, length of stay; LTx, living-donor transplant

Figure 3. Length of Stay After Deceased-Donor Renal Transplant



Abbreviations: LOS, length of stay; Tx, transplant range, 3-12 days) ($P < .001$; Figure 3) compared with patients who had traditional recovery (median of 8.5 days; range, 4-35 days). Three living-donor (5.9%) and 4 deceased-donor (6.4%) kidney recipients were readmitted within 10 days of the transplant procedure (1 patient developed ureteric obstruction and 6 patients had medical issues). The patient satisfaction survey of the ER group demonstrated excellent patient satisfaction with early mobility (Table 2), early resumption of oral intake (Table 3), active involvement in care (Table 4), and the ER program as a whole (Table 5).

Table 2. Extent of Patient Satisfaction With Early Mobility After Renal Transplant

Response	Number*	%
Yes, completely	13	57
Yes, to a great extent	6	26
Yes, to some extent	1	4
No, not at all	3	13
Total	23	100

*2 patients did not respond.

Table 3. Extent of Patient Satisfaction With Early Oral Intake (Few Hours Posttransplant)

Response	Number*	%
Excellent	6	24
Very good	12	48
Good	6	24
Not so good	1	4
Total	25	100

Table 4. Extent of Patient Satisfaction With Their Active Involvement in Their Care

Response	Number*	%
Yes, completely	13	52
Yes, to a great extent	9	36
Yes, to some extent	3	12
Not satisfied at all	0	0
Total	25	100

Table 5. Extent of Patient Satisfaction With the Enhanced Recovery Program

Response	Number*	%
Completely satisfied	17	71
Satisfied to a great extent	4	17
Satisfied to some extent	3	13
Not satisfied at all	0	0
Total	24	100

*1 patient did not respond.

Table 6. Daily Cost Incurred for Hospital Stay

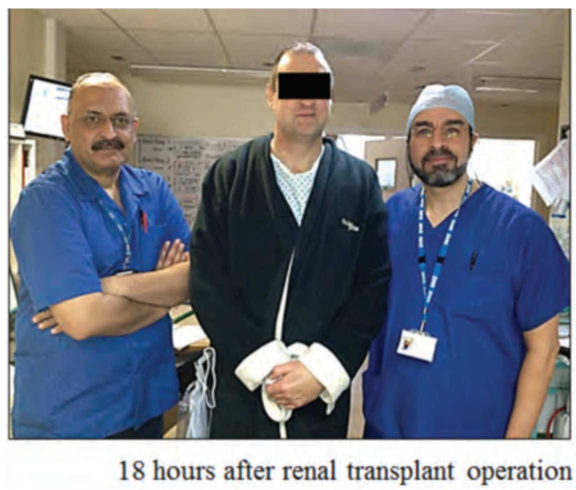
	Cost
Bed costs including consumables (posttransplant)	£350.46
Staff costs (posttransplant)	£162.87
Daily cost for hospital stay	£513.33

A 1-day hospital stay costs the NHS £513 (Table 6). Implementing the ER saves £2052 per living-related transplant (based on 4 days difference in the mean length of stay) and £2565 per deceased-donor transplant (based on 5 days difference in the mean length of stay).

Discussion

This is the first published report addressing the applicability of the ER principle in renal transplant. Our ER program is a multidisciplinary, evidence-based approach that benefits both patients by improving their care and also the NHS by reducing the workload on the medical staff. In addition, there is a reduction in the cost of treatment. We found reduced PCA morphine requirements, reduced lengths of hospital stay, and reduced readmission rates in association with the excellent patient satisfaction. These were taken as surrogate markers of improved quality of care (Figure 4).

Figure 4. Eighteen Hours After Renal Transplant



Here, we implemented a practical "multimodal package" to achieve these results. Fragmentation of this treatment package would not be effective in providing quality care. Preoperative patient counseling in association with good education is paramount for success of the program.

The various modalities that we used are not new to medical practice; however, when delivered together in a structured, well-designed care pathway, good results are achieved. Carbohydrate loading is known to reduce the postoperative catabolic phase and can enhance healing.[12-14] However, this has never been tested in ESRD patients. We believe it is valuable in enhancing recovery in ESRD patients and may counteract the postoperative hyperkaliemia due to its CHO content.

Postoperative pain after renal transplant may be severe, but administration of systemic analgesia may be limited due to impaired renal function and respiratory complications from opioids.[15,16] The use of systemic morphine for postoperative analgesia after renal transplant must be monitored carefully due to the delayed clearance of its active metabolite morphine-6-glucuronide in renal impairment, resulting in its accumulation and subsequent respiratory depression.[17] Intravenous opioid administration is the traditional modality for postoperative analgesia at most transplant centers in the United Kingdom.[18] However, significant accumulation of the metabolite to levels associated with respiratory depression has been observed in transplant patients despite sufficient primary graft function.[19] Intrathecal diamorphine has been shown to deliver effective postoperative pain control with a reduced adverse effect profile compared with systemic morphine.[20,21] The use of regional anesthesia for renal transplant remains controversial.[22] A TAP block proved to be effective in some studies[23-25] but failed to produce effective pain control in other studies.[26,27] Combining TAP block and ID together in this review showed significant reduction of the PCA requirement, with patient reliance mainly on oral analgesia. We did not score the postoperative nausea and vomiting in this study, as the picture is already confounded by the immunosuppressive drug-related nausea and vomiting. There is variability of immunosuppressive drugs used; some of these drugs are known for their gastrointestinal adverse effects (eg, mycophenolate mofetil).

The National Institute for Health and Care Excellence Guidelines in 2012 recommended the use of transesophageal Doppler to monitor fluid balance in patients who had a major operation.[28] Central venous pressure monitoring can be inaccurate and even inappropriate to guide the fluid therapy. The central venous pressure does not always give an accurate indication of the fluid status of the patient nor does it give a reliable response to fluid challenges.[29,30] We relied on the clinical assessment of the patient (fluid input and output and vital signs, mainly mean arterial pressure) with daily weight measurements to gauge postoperative fluid therapy. In ER patients, the central line was used only as an access for inotropic treatment in the intensive care unit setting or for administration of certain induction agents (eg, thymoglobulin).

In the absence of evidence, we felt it reasonable to reduce the catheterization time, although we remained sensitive to the individual bladder anatomy and renal function of patients. Removing the catheter earlier reduces the risk of infection in these immunocompromised patients and encourages their early mobilization.

This evaluation has a number of limitations. It involved a historical control group; however, the length of stay was accurately recorded in the hospital database. Morphine requirements of the control group were available for only 23 patients, but the trend is clear from the available data. In addition, CHO drinks were not given to all nondiabetic patients due to time constraints, mainly because there was an inability to predict the operation time. The satisfaction survey included only the last 25 patients. It was deferred to ensure the maturity of the ER program but still gives a meaningful conclusion and also guides the future development of the program.

Finally, nursing care is hugely important, as this program relies on nursing staff to implement and support the daily milestones, mobilization, and discharge. This may be best implemented in the form of structured care pathways. This role has expanded in our unit to involve the preoperative education and postdischarge follow-up. We have to emphasize that ER does not only improve the quality of care of renal transplant patients but also provides other patients with advantages by reallocating the nursing and medical staff to look after critically ill patients in the current National Health Service environment of shortage of health care workers.

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