

**Early assessment of kidney allograft function by microdialysis
in the perioperative period
(Case Report)**

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The clinical example illustrates the use of microdialysis techniques for assessing the function of the kidney allograft in the early postoperative period. Microdialysis allows the evaluation of metabolic changes in the graft interstitial space in a real-time mode.

Keywords: microdialysis, kidney transplantation, graft function.

Transplantation of solid organs is one of the most successfully developing areas of modern medicine elaborating multiple theoretical and practical issues of the long-term organ preservation, and organ transplantation, the prevention and treatment of graft rejection [1]. Over the last decade, the outcomes of solid organ transplantation have improved [2, 3]. But, despite the obvious success, the issue of initial graft function still remains relevant, especially in terms of using organs from expanded criteria donors.

It is known that the postoperative period requires continuous dynamic monitoring of graft function for potential complications due to severe reperfusion injury in kidney allograft (KAG).

However, the dynamics of metabolic processes in the first hours after cadaveric kidney transplantation has not been studied. Currently, it became possible to monitor the metabolic processes occurring in the tissue of the transplanted kidney, using the microdialysis that provides hourly concentration measurements of endogenous chemical substances in KAG tissues.

Aim

The aim was to assess the efficacy of microdialysis technique in the evaluation of KAG function in the perioperative period.

A 55-year-old patient with an underlying diagnosis of type I diabetes mellitus, a severe course, decompensation, Stage V diabetic nephropathy, had the following complications of the underlying diagnosis: an end-stage renal disease with a renal replacement therapy by a programmed hemodialysis; a secondary arterial hypertension, renal anemia; diabetic polyneuropathy, Grade II diabetic retinopathy, micro- and macroangiopathy; a diabetic foot syndrome, a neuroischemic form. The patient had a chronic superficial gastritis being a concomitant disease.

The patient underwent a cadaveric kidney allotransplantation (CKAT). Patient's physical status was assessed as Degree IV according to the Operative and Anesthetic Risk Classification (developed by Moscow Scientific Society of Anesthesiologists and Critical Care Physicians abbreviated as MNOAR). Anesthetic management was provided as combined endotracheal anesthesia (CETA). Induction into anesthesia was performed as intravenous infusion of *Propofolum* (2 mg/kg), *Fentanyl* (3 mcg/kg), *Cisatracurium* (0.15 mg/kg). Maintenance of surgical anesthesia levels was provided with *Sevorane* concentrations of 2–2.4 %, with infusion of *Fentanyl* (2 mcg/kg/h) and *Nimbex*[®] (0.1 mg kg).

Intraoperative monitoring included continuous ECG, heart rate, body temperature measurements, non-invasive BP measurement, pulse oximetry (SpO₂), invasive measurement of CVP, "Bispectral Index" (BIS) monitoring.

After the kidney graft circulation had been restored (reperfusion), a CMA 70 Microdialysis Catheter (CMA Microdialysis, Sweden) was implanted in the kidney parenchyma. Biochemical parameters were recorded using the CMA 600 Microdialysis Analyzer (CMA Microdialysis AB, Stockholm, Sweden). The following biochemical parameters were measured in the interstitial fluid of the kidney allograft (KAG): glucose, lactate, pyruvate lactate/pyruvate ratio (LPR), glycerol, glutamate. Biochemistry tests were performed every 60 minutes within 20 hours of the catheter placement.

The obtained results are presented in Tables 1–4.

Table 1. Central hemodynamic parameters at surgery stages

Stages of surgery / Hemodynamic parameters	BP, mm Hg	Heart rate, beats per min	CVP, mm Hg
Skin incision (3:15)	138/75	55	6
Mobilization of iliac vessels	147/65	58	8
Forming vascular anastomoses	163/91	67	11
Reperfusion (5:00)	142/76	63	10
Hemostasis and closure of the surgical wound (6:55)	160/75	61	10

Table 2. Parameters of acid-base balance (ABB) at surgery stages

Stages of surgery /ABB parameters	pH	Potassium, mmol/L	Glucose, mmol/L	Lactate, mmol/L
Incision	7.349	5.7	5.2	0.5
Mobilization of vessels	7.382	6	12.7	0.7
Forming vascular anastomoses	7.357	6.2	11.5	1.1
Reperfusion	7.318	5.8	10.3	1.1
Hemostasis and closure of the surgical wound	7.303	6	9.4	1.8

Table 3. Central hemodynamics parameters during the observation period

Time, h/Hemodynamic parameters	BP, mm Hg	Heart rate, beats per min	CVP, mm Hg
1	164/95	61	10
2	162/93	82	12
3	170/91	74	11
7	154/75	75	9
9	147/68	73	7
12	160/70	78	5
16	150/80	71	8
20	153/74	74	9

CVP – central venous pressure

Table 4. Laboratory parameters before and after surgery

Parameter	Before surgery	After surgery
Creatinine, mcmol/L	967.3	565.5
Urea, mmol/L	23.42	14.6

The patient was observed to have an immediate KAG function. Intraoperative urine output made 250 ml. Infusion therapy in the Operating Room made 2000 ml (crystalloids).

Hourly urine output was 120 ml/h, daily diuresis made 2130 ml. Volume replaced at infusion therapy (crystalloids) was 2410 ml for initial 24 hours post-surgery.

KAG intercellular metabolism levels recorded throughout observation are presented in Fig.1–6.

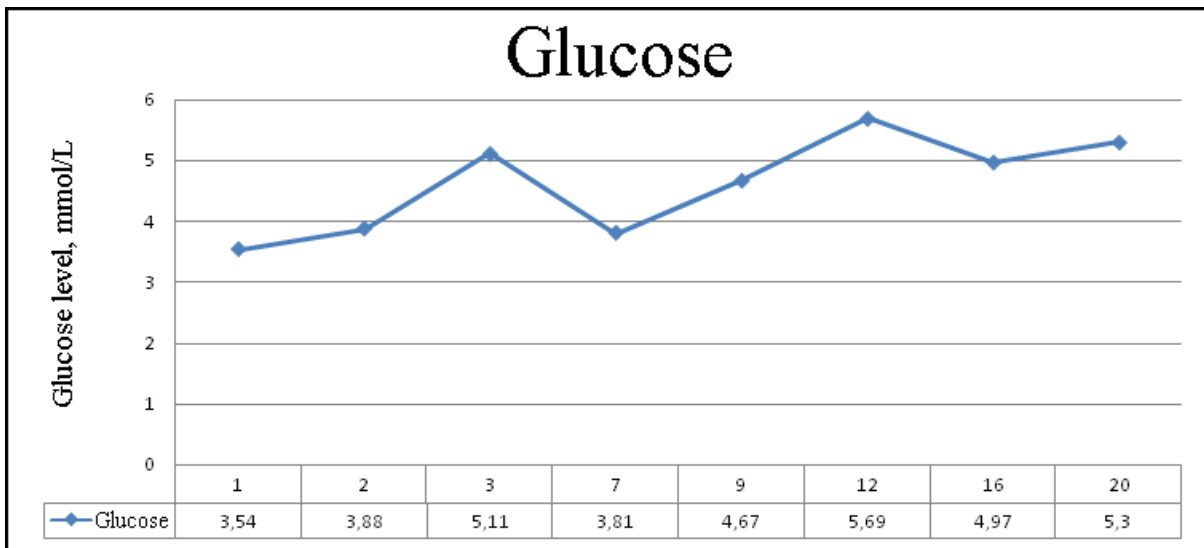


Figure 1. Glucose level in the KAG interstitial space

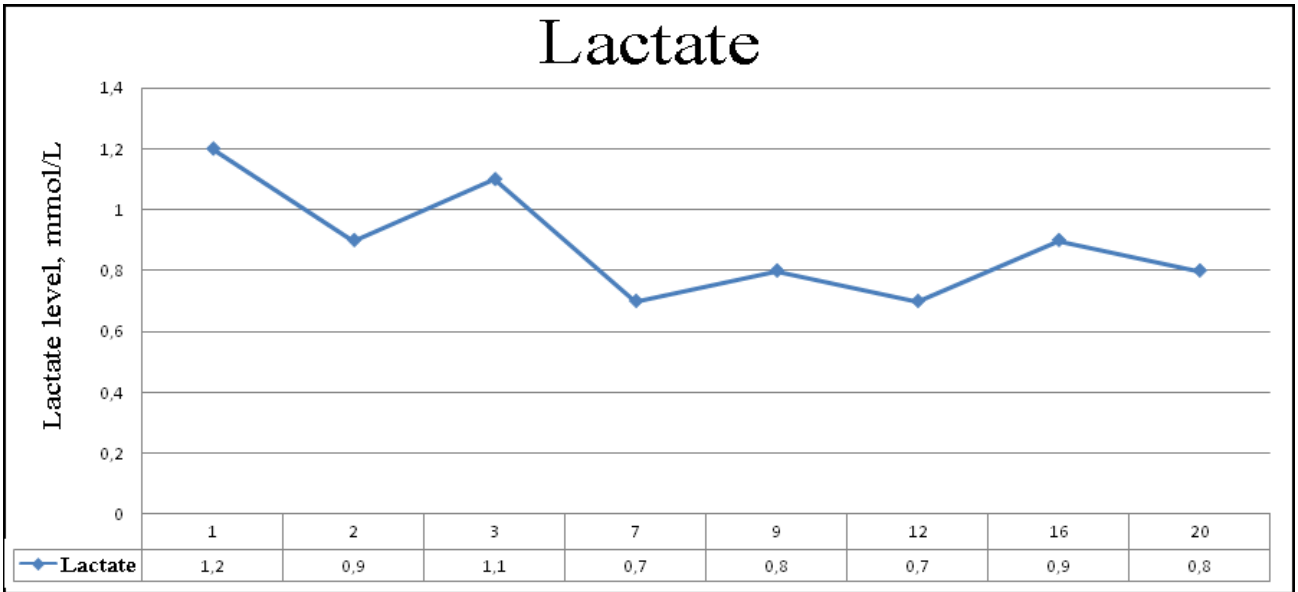


Figure 2. Lactate level, a main marker of ischemia, in the KAG interstitial space

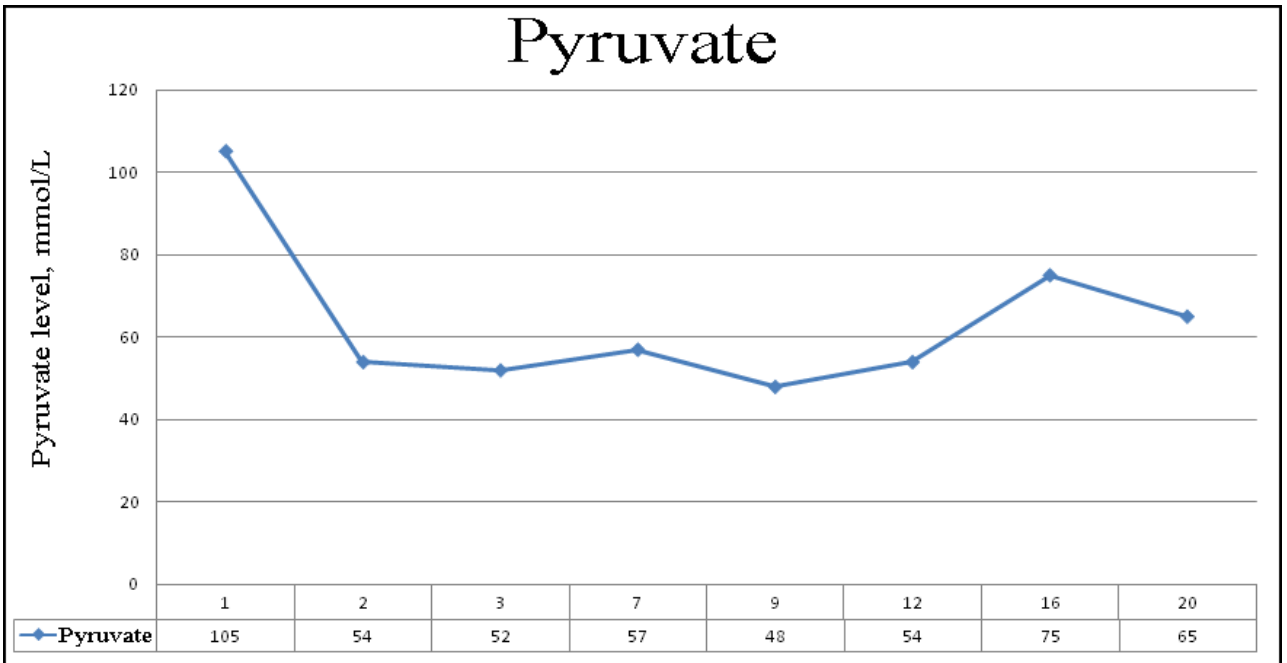


Figure 3. Pyruvate level in the KAG interstitial space

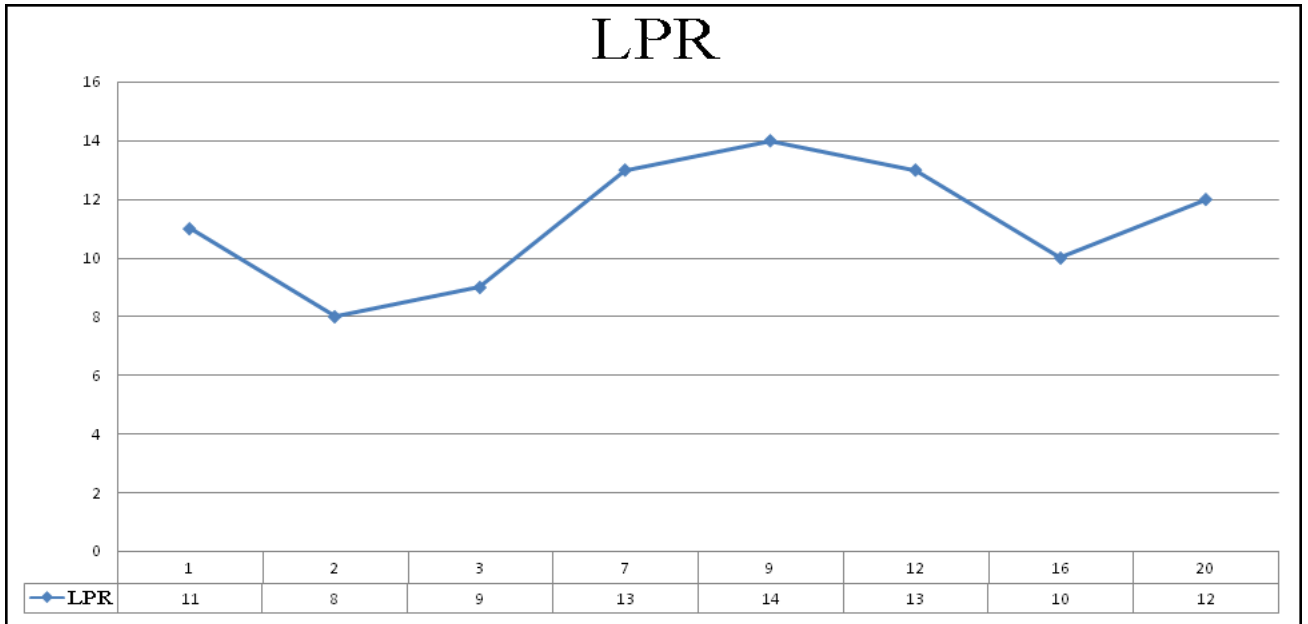


Figure 4. Lactate/Pyruvate ratio (LPR) in the KAG interstitial space

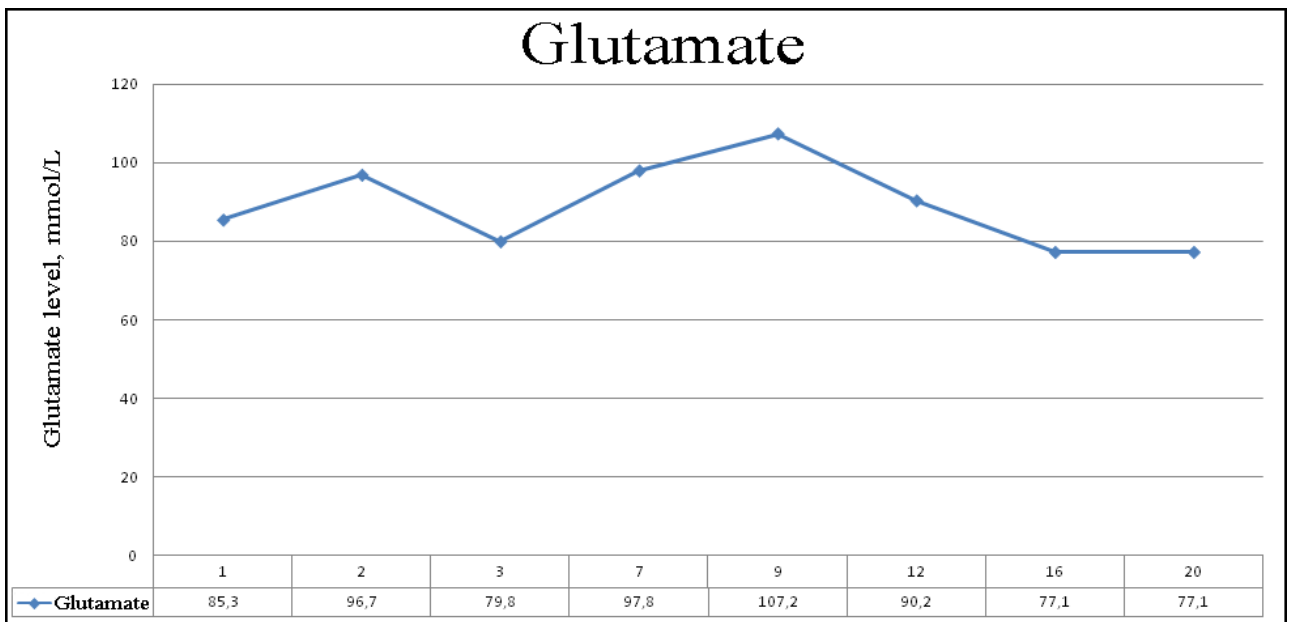


Figure 5. Glutamate level in the KAG interstitial space

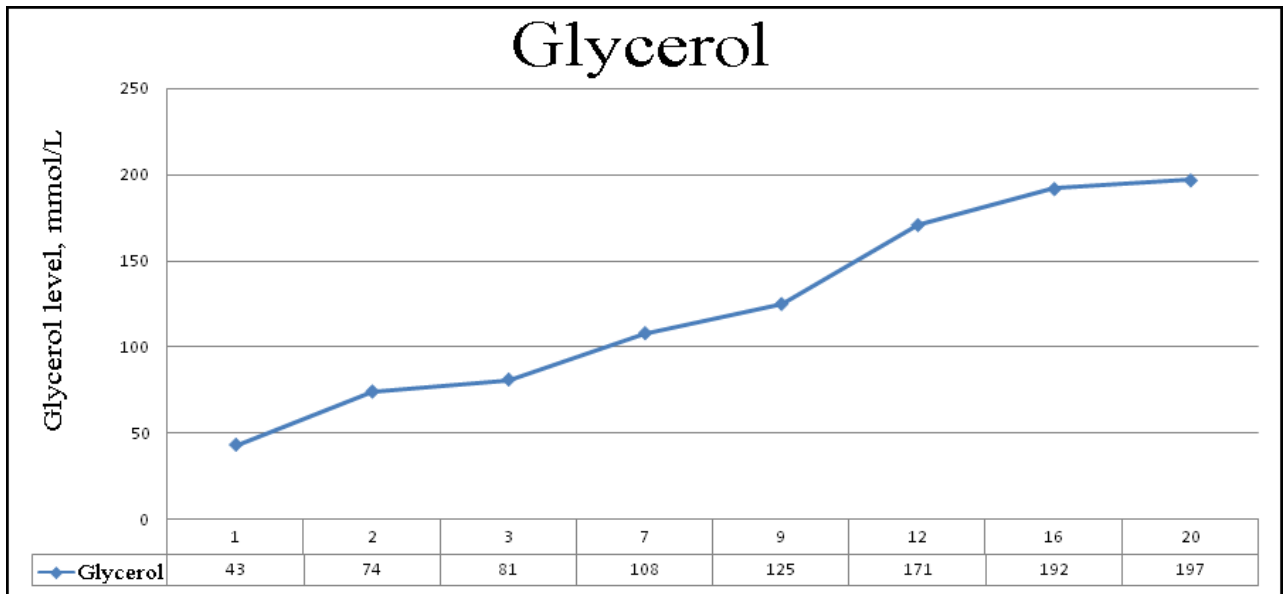


Figure 6. Glycerol level in the KAG interstitial space

Blood glucose levels were within normal ranges throughout the observation period.

Lactate levels measured throughout the observation period ranged between 0.6 and 1.3 mmol/L.

Within the first 3 hours of KAG reperfusion, we observed the trend of LPR to decrease from 25 to 12. Later LPR decreased slightly from 12 to 9 for the following 17 hours of observation.

Measured glutamate level was within normal ranges for the entire observation period.

Glycerol level was persistently increasing throughout the observation period and raised up to 246 mmol/L.

The primary function of the kidney transplant was observed in the postoperative period. Uremia decreased to normal values at day 6. The

patient was discharged from hospital having a satisfactory KAG function, and diuresis of 2400–2700 ml/day.

Ultrasonography (US) before discharge demonstrated the KAG measuring 117x57x8 mm in size, having even clear-cut contours, blood flow being present in the whole allograft, Ri making 0.64–0.76. Pyelocaliceal system was not dilated; no abnormal fluid collections in KAG were visualized.

Glomerular filtration rate made 48 mL/min.

Discussion

These results suggest a certain efficiency of microdialysis as a new type of monitoring the KAG intraorganic metabolism for early prediction of KAG initial function.

Noteworthy is the fact that this method helps to assess the allograft function in the initial hours following the reperfusion [4–6]. After KAG revascularization, a patient develops a reperfusion syndrome manifested by both hemodynamic, and metabolic changes [7, 8].

The monitoring of changes in lactate and pyruvate levels as the main ischemia and hypoxia markers, as well as the glucose being the main energy substrate, allows the evaluation of metabolism rate in the graft. Moreover, assessments of absolute concentrations of lactate and pyruvate, and also LPR values, reduce considerably the risk of an erroneous interpretation of the results, since LPR provides a sensitive marker of cellular ischemia and dysfunction.

Changes in a glycerol concentration may serve as an indicator to estimate the disruption of the membrane barrier function and, as a consequence, the degree of KAG cellular dysfunction.

Conclusions

The method allows the identification of early abnormalities in the KAG metabolic parameters.

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