USE OF THERMOGRAPHY IN KIDNEY TRANSPLANTATION: TWO YEAR FOLLOW UP STUDY IN 75 CASES

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Summary

During a period of 24 months 75 renal transplant recipients were examined by thermography according to Tricoire. Thermography is a non-invasive, quickly available and reproducible method. Because of the 92% incidence of exact diagnosis this investigation is a helpful additional test in kidney transplantation for evaluation of graft function as well as for diagnosis of pathological intrarenal or perirenal disorders. Thermography is especially recommended for patients if postoperative haemodialysis is necessary. In these cases information can easily be achieved whether postoperative oligo-anuria is caused by acute tubular necrosis or by primary vascular insufficiency of the transplant.

Introduction

The efficient and reliable method of thermography of Tricoire was first instituted in the diagnosis of diseases of the breast [1, 2], of the thyroid gland [3–6] and of peripheral blood circulation [4–8]. This thermographic investigation was successfully applied for detection of acute inflammatory abdominal processes [9] and for control of skin transplants. The purpose of our study is to evaluate the diagnostic relevance of thermography in kidney transplantation by a long term follow up in renal transplant recipients.

Material

Within two years, 75 transplant patients (55 male, 20 female) with functioning grafts were checked by the method of Tricoire as an additional investigation. At the time of surgery the mean age of the group was 33.2 years, ranging from 12 to 59 years. Seventy-three cases received cadaveric grafts, two received a transplant from a related living donor. Fifty seven persons had their first transplant, 15 a second and three a third. The underlying renal disease was chronic glomerulonephritis in 61, chronic pyelonephritis in four, polycystic kidney disease in three,
hereditary nephritis (Alport’s syndrome) in three, malignant nephrosclerosis in three and gouty nephropathy in one case. Two thousand, one hundred thermographic studies were made. The examinations were done not earlier than ten days after transplantation and extended up to 94 months. Sixty-four recipients (48 male, 16 female) were observed at regular intervals from three to eight weeks during the whole follow up, six (four male, two female) returned to chronic haemodialysis programme, five (three male, two female) died.

Methods

The thermographic film was put on the skin of the lower abdominal region at the site of the transplant and for comparison on the opposite groin. The surface body temperature over the graft with normal function was 31 to 34 degrees C, being 1 to 2 degrees higher than the environment or the opposite side. The transplant was revealed as a local hyperthermic spot with the normal structure of larger kidney vessels.

At each thermographic study routine diagnostic methods were performed: clinical investigation, blood pressure, urinanalysis and laboratory data on BUN and serum creatinine. In addition simultaneously in 32 cases ultrasonography, in 28 renal scintigraphy, in 16 i.v. urography, in six renal arteriography and in one case computertomography were done.

Faults in temperature gradients may be caused by extreme obesity, muscle asymmetry of the lower abdominal region, spinal abnormalities, acute inflammatory abdominal disturbances, small size or deep position of the transplant. In case of pregnancy thermographic investigations are not recommended because of alteration in cutaneous temperature. Ovulation and menstruation however, do not influence temperature measurement. Patients suffering from fever must be excluded from thermographic check up.

Results

In an observation period of two years 45 out of 64 renal transplant patients (mean serum creatinine 1.3mg/100ml (0.5—1.85)) showed a normal thermographic surface pattern. The temperature over the transplant area was elevated 1 to 2 degrees C when compared with the ambient temperature or with the opposite groin. In cases with intact circulation to the kidney the individual skin temperature ranged from 31 to 34 degrees C and differed from the surrounding temperatures (29—32 degrees C). Ten cases with 18 reversible acute rejection episodes had a transient drop of temperature from 1 to 4 degrees C over the graft mainly because of parenchymal oedema. An increase of the serum creatinine level up to at least 2mg/100ml seems to be necessary for deterioration of local thermoregulation. Heat conduction in the transplant was impaired in three cases with irreversible rejection: the surface temperature being distinctly cooler than the opposite side.

Thirty recipients with chronic rejection (serum creatinine more than 2mg/100ml) revealed an inverse thermographic pattern due to reduced blood supply to the transplant. The course of rejection was rapidly progressive in four with
appropriate thermographic signs such as a cool surface area, rarefaction of intra-renal vessel structures and vague contours.

Chronic urinary tract infection did not influence the regional surface temperature whereas acute urinary tract infection led to a local increase of body temperature of more than 2 degrees C in six patients with normal and in five patients with impaired renal function. When the acute infection was brought under control thermographic findings returned to normal.

In the very early post-transplant period up to eight weeks eight thermograms were analysed. Local hyperthermia from 2 to 4 degrees C was registered obviously as a consequence of good renal vascularisation. There was no difference between primary well-functioning grafts and kidneys with acute tubular necrosis necessitating initial haemodialysis treatment [10, 11].

The observation included one recipient with acute transplant rupture and corresponding to the clinical data, severe local hyperpyrexia was seen. The blood flow corresponded with a very hot band and was verified intraoperatively.

Superficial perirenal changes (two haematomata, two abscesses, one inflammatory ‘urinoma’) led to topical temperature elevation as expected. Profound intrarenal or perirenal abnormalities did not influence surface temperature [12].

Thermography can be of great value in the differential diagnosis of pathological processes in a transplant-nephrectomy region. Supported by X-ray, lymphangiography and computertomography of the iliac fossa suspected suppuration could be verified by repeated thermographic investigations and thus lead to surgical intervention.

Discussion

The practicable method of Tricoire may be used for recognition of site, size and vascularisation of a grafted kidney [10–16]. Onset of acute or chronic rejection [13] leads to impaired heat conduction to the body surface either by oedema or by diminished renal blood flow. According to our experience a rise of serum creatinine of at least 2mg/100ml is necessary before one finds colour change on the thermographic film. In three cases with moderate rejection the creatinine threshold value was not reached, so that thermographic diagnosis was not available.

Information achieved by thermography reveals the patient’s very individual body surface temperature pattern; therefore repeated examinations must be carried out during the observation period. High temperature gradients are found in case of urinary tract infection [11, 12, 14–16] or of inflammatory intrarenal or perirenal superficial processes.

For those recipients who require postoperative haemodialyses because of a priori rejection, occlusion of renal artery or acute tubular necrosis, thermography is a very sensitive parameter for differential diagnosis. It is independent of the excretory function of the kidney and gives information about metabolism [10] and blood supply even in oligo-anuria.

In the wide field of diagnostic procedures necessary for transplant recipients with complications, thermography can be applied as a screening test supplementary to clinical investigation and laboratory findings. The high reliability of 92% correct diagnoses recommends thermography as a helpful additional examination in the care of renal transplant patients.
References

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Open Discussion

WOODS (Leicester) Could you just make clear — the healing wound does cause problems in interpreting thermography in the early stages and that is when most vascular problems occur with transplants. So is it really of value in differentiating these early vascular problems within the first ten days? The second problem which was not very clear from your presentation, is thermography of any value in actually predicting acute rejection or are you simply able to confirm acute rejection and try to differentiate it from acute tubular necrosis and renal infections?

KOPSA To your first question, as I mentioned, it is a very sensitive parameter in the very early post transplant period for differential diagnosis, but it is not an absolute method. It should be used as an investigation concomitantly carried out with an evaluation of blood urea nitrogen and serum creatinine or for instance isotopic measurements. To your second question, thermography cannot predict the course of the renal transplant. Thermography is only available for the acute diagnosis and again in combination with other laboratory data or an additional investigation such as x-ray or urinalysis.

OEI HONG-YOE (Utrecht) Is the thermography disturbed by fever?

KOPSA Thermography is disturbed by fever because we are working with thermographic plates, one at 31°C and the second at 31.5°C, the third 32°, 32.5°, 33°C, and so on up to 35°C, and as I mentioned one thermographic study is not sufficient to permit or to establish a diagnosis. We say that three thermographic investigations are necessary, and in case of fever you have a body surface temperature of, for instance, 38°, 39° or 40°C and so you do not have any comparison with previous levels. That is the reason why thermography is not a method available in kidney transplantation in cases with fever.
JACOBS (Paris) Since you clearly pointed out that this method is by no means sufficient or discriminating in learning a precise diagnosis, may I ask what is the implication of cost and time? Is it a time consuming procedure and what is the cost? We are adding more and more investigations towards diagnoses that in most cases may be or should be made clinically or with simple investigations.

KOPSA The procedure is carried out by an experienced investigator in thirty seconds; by an inexperienced investigator or in a very difficult case in about one minute, two minutes, or at least three minutes. Secondly I want to say that because the procedure is not troublesome for the patient you can avoid, in a lot of patients, even arteriography of the kidney which is a very invasive procedure. I think that thermography should be done first. One thermographic investigation costs about 3,500 Austrian schillings, that is about 500 or 600 French francs, and one thermographic film can be used for four to five patients.