

## METHODS

# Methods for Diagnosis and Prevention of Pyoinflammatory Complications of Postoperative Wounds

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Aseptic and pyoinflammatory course of the wound process was studied in dogs and in patients by frequently repeated multipoint electrothermometry and confirmed by morphological analysis. Potassium permanganate electrophoresis promoted wound healing.

**Key Words:** wound; electrothermometry; electrophoresis

Pyoinflammatory (PI) processes in postoperative wounds are detected by infrared thermography [3,8], electric current [4,10], biochemical analyses of the blood [7] and wound exudation, etc. Many of these methods are not used in clinical practice because they are expensive, difficult to perform, inaccurate, and slow.

The diagnosis of wound course is closely related to prevention of purulent complications. By the present time, the main etiological factors of PI complications of postoperative wounds are detected and methods for their prevention are developed [1,2,5]. However, the incidence of postoperative PI complications remains high.

We developed a new method for the diagnosis of PI complications in postoperative wounds by means of frequently repeated multipoint electrothermometry.

## MATERIALS AND METHODS

Experiments were carried out on 16 adult mongrel dogs with experimental 6-8-cm transrectal laparotomic incisions closed with interrupted sutures. In controls, the wounds were inflicted under aseptic conditions; in experimental dogs, the wound edges before suturing were damaged by a geared clamp and after suturing

the peritoneum, infected with a 24-h culture of pathogenic staphylococcus (strain 75).

Electrothermometry of 4 sites adjacent to the wound was carried out simultaneously every other hour for 12-24 h after the intervention with a TPDM-1M electrothermometer. The data of each measurement were summed up and the integral value was estimated using Fisher's method. Wound biopsy specimens were examined morphologically 12, 18, 24, and 72 h after surgery.

The efficacy of experimentally developed method for diagnosis of postoperative PI complications was verified in 150 patients at a high risk of complications operated on for appendicitis, cholecystitis, peptic ulcer, and abdominal hernias.

The accuracy of this method under experimental and clinical conditions was estimated by the formula:

$$\text{Accuracy} = \frac{P_i + N_i}{n} \times 100\%,$$

where  $N_i$  are truly negative cases,  $P_i$  truly positive cases, and  $n$  is the number of cases.

In 15 patients PI complications were prevented by electrophoresis of 5% aqueous solution of potassium permanganate on a Potok-1 device twice a day for 15 min for 3-4 days. Negatively charged 6×12.5 cm pads impregnated with 10-15 ml potassium permanganate solution were applied to the wound. The status of wounds was visually evaluated.

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## RESULTS

The time course of electrothermometry data was different in the control and experimental dogs: in the control the temperature curve was represented by a polynomial, while in the experiment by a parabola (Fig. 1). Morphological analysis 18 and 24 h after surgery confirmed these results. In wounds with the polynomial temperature curve the epidermis was intact after 24 h and there were no suppurative changes. On the other hand, edema and mucoid degeneration were detected in the papillary and reticular layers of the derma. Infiltration and evenly distributed histiocytic, but not purulent cells were detected in the dermal papillary layer (Fig. 2, *a*).

In wounds represented by a parabolic temperature curve, the adjacent skin was involved in severe PI process, the epidermis was thinned and its surface layers were rich in detritus. Large destructive foci were seen along the entire length of the epidermis-derma interface. The derma, particularly its papillary layer, was destroyed, and there were large diffuse and focal macrophagal histiocytic infiltration and accumulation of necrotic masses (Fig. 2, *b*).

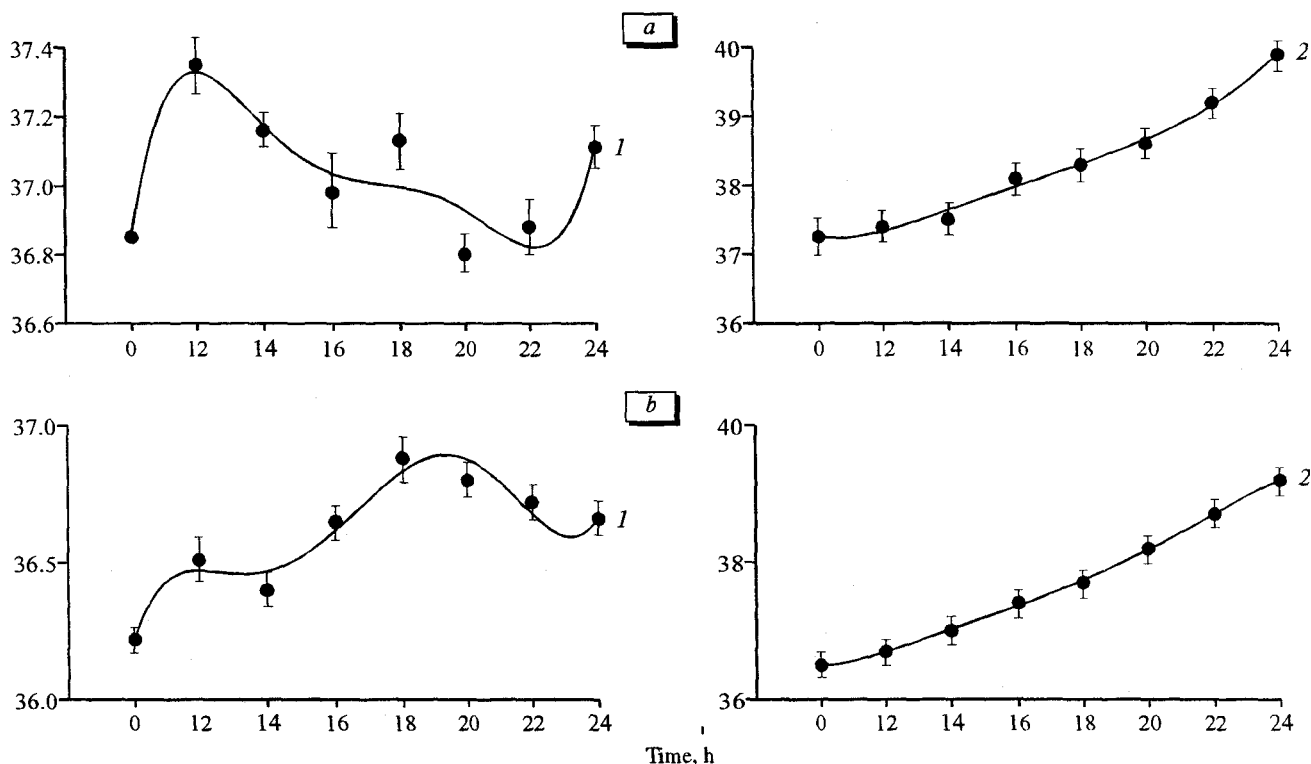
Hence, polynomial curve of local temperature indicated aseptic, while parabolic curve attested to PI course of wound healing.

In clinical trials, this method yielded polynomial curves of local temperature of postoperative wounds in 121 patients and parabolic curves in 29. Suppuration with separation of the wound edges starting from days 3-4 and secondary healing were observed in 20 patients; in 9 patients with parabolic temperature curves the wounds healed by primary intention. According to the above-mentioned formula, the accuracy of detecting suppuration was 94%. Partial separation of edges and suppuration were observed in 10 out of 121 patients with polynomial curves of local temperature. In this case, the accuracy of the method was 93.3%.

Electrophoresis of 5% potassium permanganate solution reduced hyperemia, infiltration, and tissue edema, and restored mobility of the wound.

In 12 out of 15 patients (77.7%) the wounds healed by primary intention, and in 3 patients partial separation of the edges and suppuration were observed.

A favorable (aseptic) course of postoperative wounds in patients at risk of suppuration can be explained by stimulation of phagocytic processes in wounds and activation of the antioxidant system by molecular oxygen, a product of potassium permanganate degradation under the effect of electrophoresis. Electric current could contribute to improvement of tissue status by improving microcirculation associated with intensification of metabolic processes.



**Fig. 1.** Time course of temperature of soft tissues of aseptic (1) and pyoinflammatory laparotomic wounds (2) in experimental dogs (a) and patients (b).

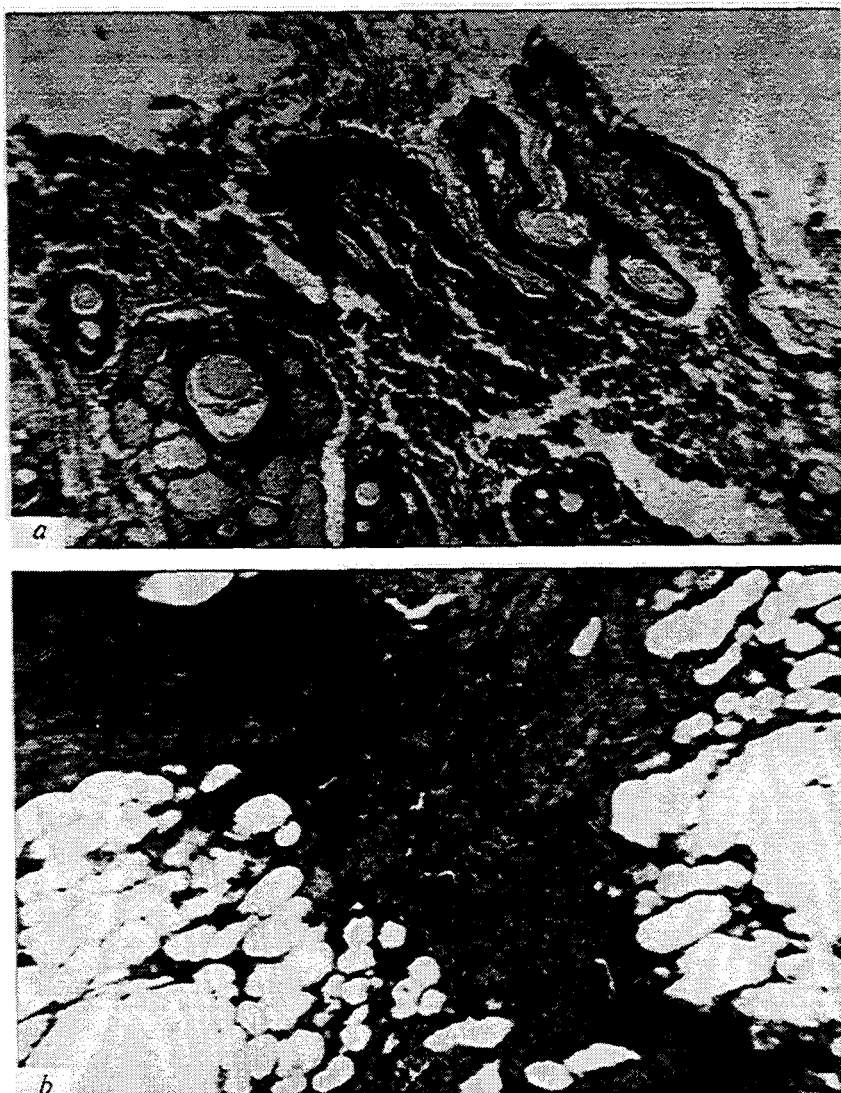


Fig. 2. Aseptic (a) and purulent (b) wounds 24 h after surgery. Hematoxylin-Eosin staining: a) reticular layer of the derma adjacent to the wound and nonpyogenic inflammatory infiltration,  $\times 250$ ; b) destruction of epidermis, detritus, large foci of destruction,  $\times 12.5$ .

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