# CILIARY ACTIVITY OF THE MUCOUS MEMBRANE OF THE TRACHEA AND BRONCHI AFTER EXPERIMENTAL BURNS

V. N. Khrebtovich

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One week after a burn of the body the activity of the ciliary epithelium in the lower portion of the trachea and bronchi is depressed.

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The importance of the billowing movements of the ciliary epithelium of the mucous membrane of the respiratory tract in performance of the normal drainage function of the tracheobronchial tree is generally known. In various pathological states changes in ciliary activity of the epithelium lead to disturbances of tracheobronchial drainage, facilitating the development of lung complications [5, 6]. The ciliary activity has not been studied in burns.

The object of this investigation was to study the function of the ciliary epithelium of the trachea and bronchi after burns covering 30% of the body surface.

## EXPERIMENTAL METHOD AND RESULTS

In 39 experiments on cats a circular burn of the trunk was produced by a method developed in the Research Laboratory of the Military Medical Academy [1, 3]. Activity of the ciliary epithelium of the upper and lower portions of the trachea and large bronchi was investigated 2, 3, 5, 7, and 10 days after burns by our modification of the method of Korsen and Allen (cited in [7]).

Korsen and Allen's method is as follows. Explants of the tracheal mucous membrane were cut out by means of a small cup (2-3 mm in diameter) fixed to a long handle and introduced into the trachea through the vocal cleft. The excised piece of tissue was placed for a few hours in Gey's or Hanks's basic salt solution at 37°, and then transferred to a Rous chamber consisting of two sterile glass lids fixed by metal panels on both sides of a flat rubber ring. A small volume of fluid was introduced into the chamber through a needle to ensure humidity. The cilia of the epithelium continued to function for 10-14 days. Examination of the chamber under the microscope with a magnification of 250× showed cells separating from the explant. Since the cilia are located externally on one pole of the cell, the billowing movement of the cilia on a cell in the solution rotates it around its own axis. The number of rotations per minute gives an indication of the ciliary activity of the epithelium.

In our experiments pieces of the mucous membrane of the trachea and bronchi were taken from recently killed animals. Explants of the mucous membrane were immersed in Hanks's basic salt solution and incubated at 37° for 2-3 h. During this period the mucous membrane became somewhat looser in texture, facilitating separation of the ciliary epithelial cells without much risk of injury.

To measure the velocity of rotation of the cells a slide was used on which a rubber ring (25 mm in diameter, 0.4 mm thick) was placed, and 3-5 drops of Hanks's solution was applied at its center, and the piece of mucous membrane placed in it. The membrane was gently broken up with forceps, so that ciliary epithelial cells or groups of cells became detached. The chamber was covered with a cover slip and placed under the microscope (a thermostatically controlled stage was used to maintain a temperature of 37° in the chamber), and the number of rotations of the cell per minute was counted. Several rotating cells (up to 10) were counted. To determine the effect of Hanks's solution on activity of the ciliary epithelium,

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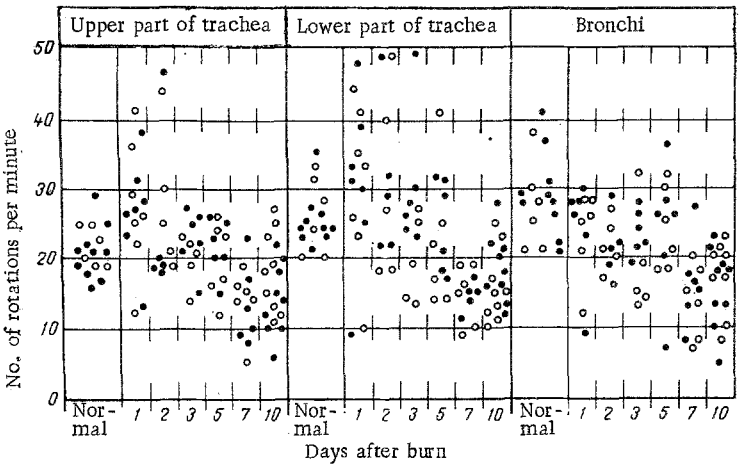


Fig. 1. Activity of ciliary epithelium after burns covering 30% of body surface when investigated in Hanks's solution (I) and in animal's own plasma (II).

and to reveal any possible influence of plasma of burned animals, the investigations were carried out in parallel in Hanks's solution and in plasma from the same animal. The experimental results were subjected to statistical analysis using nonparametric criteria [2].

To establish the normal activity of the ciliary epithelium, the mucous membrane of the upper and lower parts of the trachea and the large bronchi of 10 healthy animals was studied by this method. In healthy animals the activity of the ciliary epithelium was found to increase toward the lungs (differences between ciliary activity of the upper part of the trachea and the large bronchi are significant, $P < 0.05$).

During the 5 days after infliction of a burn covering 30% of the body surface, no significant change occurred in the ciliary activity of the epithelium. Starting from the 7th day after injury, activity of the ciliary epithelium was reduced (Fig. 1, $P < 0.01$) in all parts of the respiratory tract which were investigated. At this time the ciliary activity of the bronchi was indistinguishable from that of the trachea. Consequently, remembering that in healthy animals the ciliary activity of the bronchi is higher, it may be considered that the ciliary epithelium of the bronchi is more severely damaged after burns. Parallel investigation in Hanks's solution and in the animal's own plasma revealed no difference between the ciliary activity of healthy animals or after burns.

The results of this investigation thus showed that, starting from the 7th day after infliction of a burn, the function of the ciliary epithelium of the trachea and, more especially, the large bronchi is considerably disturbed. These disturbances are possibly significant in the pathogenesis of lung complications in burned patients, because as a result of inhibition of the billowing movement of the ciliary epithelium, the drainage function of the tracheobronchial tree may be significantly impaired.

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