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Changes in Platelet Aggregation During Voluntary Hyperventilation

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The authors study the changes in ADP-, epinephrine and collagen-induced platelet aggregation after voluntary hyperventilation in ten young healthy men, which resulted in marked decrease of capilary blood pCO_2 and rise in capillary blood *p*H.

A statistically significant decrease in platelet aggregation induced by ADP and epinephrine was observed. Collagen-induced platelet aggregation values also decreased, but the differences were not statistically significant.

The authors believe that this reaction is possibly a defensive mechanism against the thrombophilia determined by stress.

Blood *p*H is one of the homeostatic factors which more directly influence the development of hemocoagulative phenomena. The experimental induction of a markedly acidotic state is followed by a shortening of the coagulation time of hole blood (4), as well as inactivation of circulating heparin, thus giving rise to an hipercoagulable state (6). This acidosis-induced hypercoagulability includes an increase in platelet function consisting in an acceleration of the phenomena of the release reaction and the secretion of vasoactive substances such as epinephrine, serotonine, etc. The release of these substances enhances peripheric vasoconstriction, thus increasing acidosis. Tnat is what HARDAWAY (7) calls the *vicious circle* of hypercoagulability and acidosis.

It is well known that platelets play a mayor role in the development of thrombosis. The functional status of platelets, as measured by the aggregation-adhesion tests notably influence the development of facts in thrombogenesis (8, 9).

The purpose of the present paper is to study the changes in ADP, epinephrine and collagen-induced platelet aggregation as a resultat of experimental alcalosis produced by hyperventilation.

Materials and Methods

Ten male volunteers, all of the medical students, with ages ranging between 18 and 22 have been studied.

Blood samples for plaquetary function tests were obtained by venipuncture of antecubital veins and collected in plastic syringes. After the drawing, the volun-

teers perfomed deep respiratory movements during two minutes at 12 inspirations per minute rate. A second sample was obtained in the same conditions inmediately after completion of the breathing exercise. These samples were made incoagulable by adding 3.8 % sodium citrate by puncture in a finger tip, just before and after the respiratory exercise, and maintained in heparinized tubes.

The platelet-rich plasma (PRP) was prepared by spontaneous sedimentation on an inclined surface at room temperature during two hours.

The platelet-poor plasma (PPP) was prepared by centrifugation of PRP at 3,000 r.p.m. for half an hour.

Platelet counts were made by the phase contrast method in plasma, as described by BRECHER and CRONKITE (1).

Platelet aggregation tests were perfomed following born's technic as described by stage haemorreactives pamphlets. Each sample was teasted for 0.4 mcg ADP, 0.1 mcg epinephrine and 40 mcg collagen. Photometric readings were made with a Spectronic 20 (Bauch-Lomb) spectrophotometer; seven readings were made in each aggregation test, with one minute intervals, which included 30 seconds of shaking with an electrical Junkel-Kunkel shaker.

*p*H and pCO_2 were determined with aid of Model 113 Gas-Analizer from Laboratory Inc. (Boston, Mass.).

Statistical study was made according to FISHER and YATES (3). Values of $p<0.05$ have been considered significant.

Results and Discussion

Hyperventilation was effective in in-

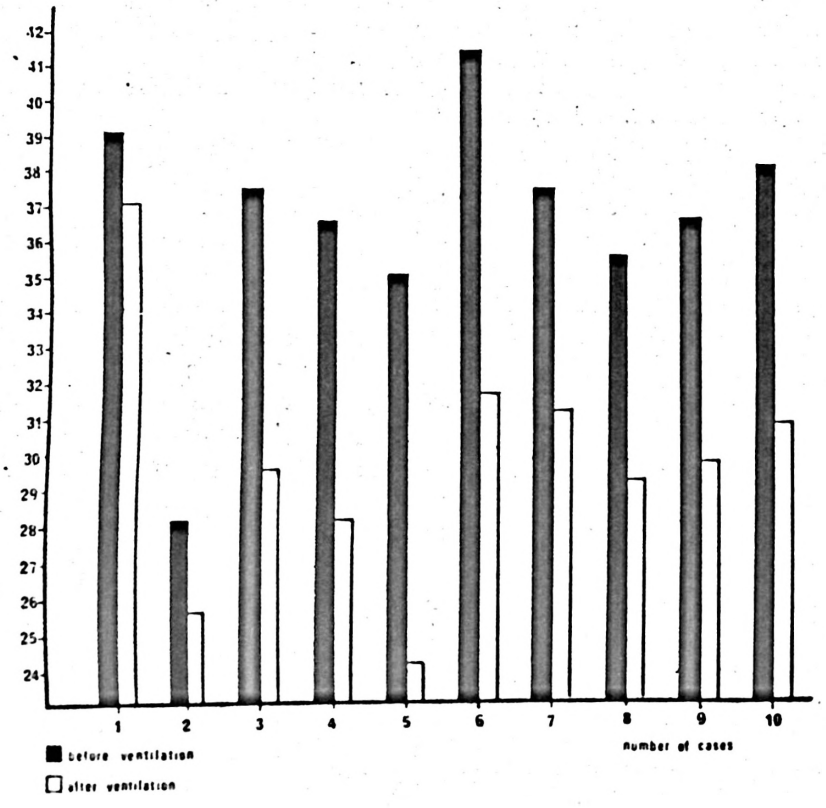

Fig. 1. *Variation of the pCO_2 in mm Hg after voluntary hyperventilation.*

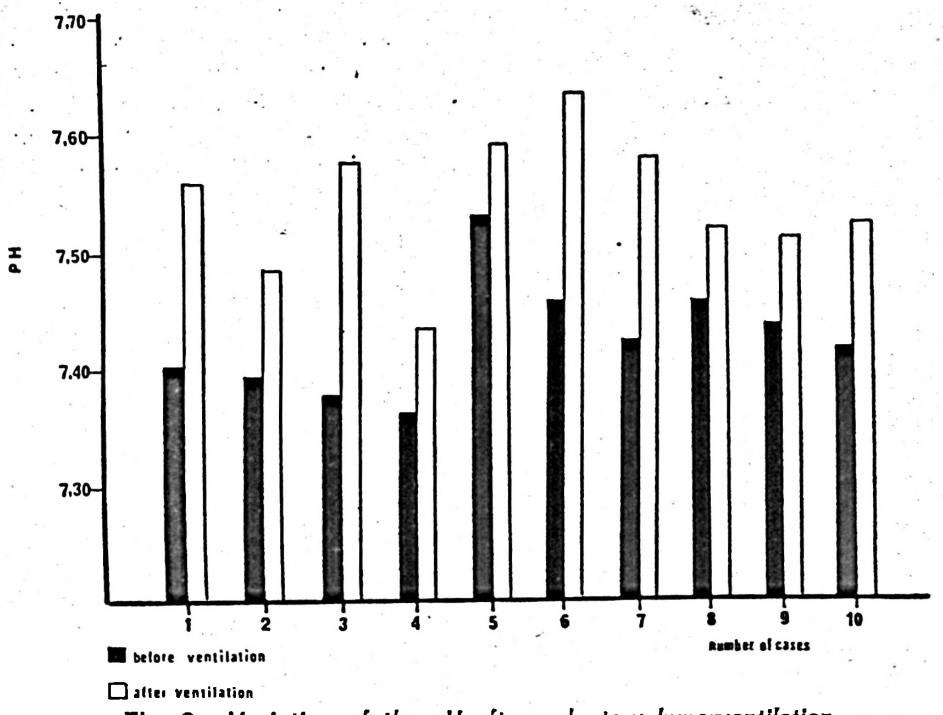

Fig. 2. *Variation of the* pH *after voluntary hyperventilation.*

ducing alcalosis. Results of *p*H and pCO_2 measures are expressed on figures 1 and 2. The mean value of capillary blood pCO_2 fell from 36.2 to 29.56, a decrease of 18.4 %. There was a definite tendency towards hypocapnia in the group of volunteers studied, which may be reported to the unconscious spontaneous hyperventilation determined by the emotional stress or by the experience of venipuncture.

*p*H values rose in all cases. Mean values before ans after hyperventilation were 7,420 and 7,527 respectively. One of the volunteers developped respiratory alkalosis.

Platelets counts suffered no marked changes, main values before and after ventilation being 379,000/ml and 384,000/ml respectively.

Figures 3 and 4 show decreases in platelet aggregation induced by ADP and epinephirine. These decreases are statistically significant ($t = 3.35$; $p < 0.01$ in ADP test and $t = 7.16$; $p < 0.01$ in epi-

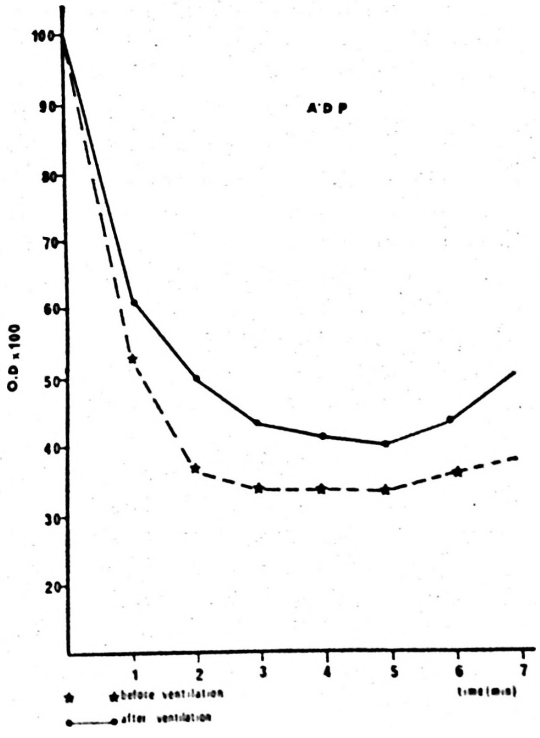

Fig. 3. *Significative variation of the platelet aggregation induced by ADP after 2 minutes of voluntary hyperventilation.*

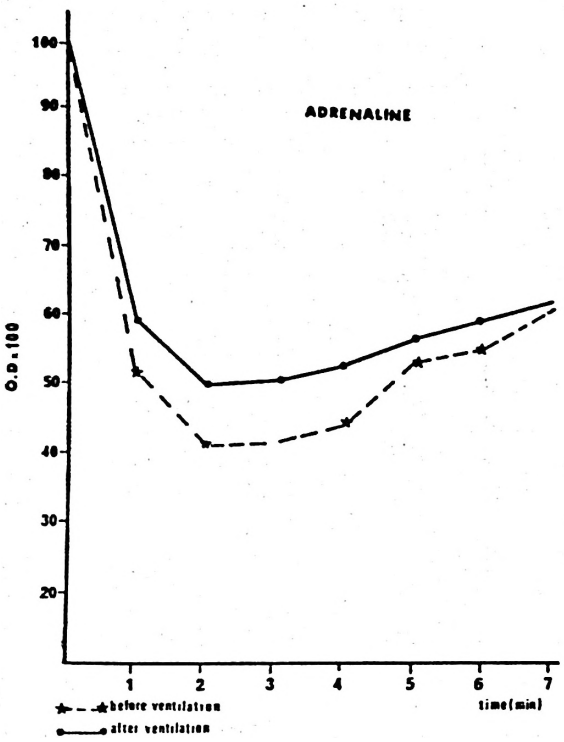

Fig. 4. *Significative variation of the platelet aggregation induced by adrenaline after 2 minutes of voluntary hyperventilation.*

nephrine tests). We also observed decrease in platelet aggregation induced with collagen (fig. 5), but these changes are not statistically significant ($t = 1.10$; $p < 0.020$).

We are not able to find a reasonable explanation for the phenomena observed. The contrary effect, that is, increase in platelet aggregation during acidosis, has been described by several investigators and none of them found a physiopathological reason for it.

However, we are tempted to see in the decrease of platelet aggregation during respiratory alkalosis a physiological and defence response. Stress conditions, with its enhanced cathecolamine secretion, produce an acceleration of the hemocoagulative process, which carries an eventual risk of thrombosis. Anxiety and stress-induced hyperventilation (2) may be considered as a way to protect somehow the subject from the risk of thrombosis.

In any case, without trying to consider more or less suggestive hypothesis, we want to emphathize the biological interest of this phenomenon which, as much as we know, has never been described before (5).

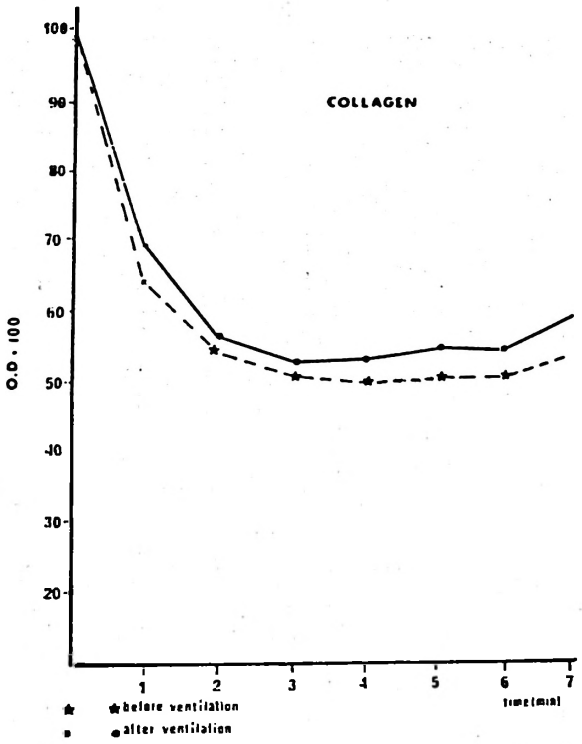

Fig. 5. *Non significative variation of the platelet aggregation induced by collagene after 2 minutes of voluntary hyperventilation.*

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