THE EFFECT OF SURGICAL PROCEDURES ON BLOOD SUGAR AND RENAL PERMEABILITY.

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By a study of the effect of surgical procedures on the blood sugar, Epstein and Aschner have found that the blood sugar content after operations is invariably increased. The degree of elevation appears to be dependent principally upon the character and the duration of the anesthesia. From the extraordinary height to which the blood sugar rises after operation one would expect the presence of sugar in the post-operative urine to be of very frequent occurrence. However, glycosuria after operation occurs only occasionally, one case in fifty showing traces of sugar in the urine.

These facts have led the above authors to conclude that the failure of sugar to appear in the urine might be ascribed to one or both of two causes: (1) that the hyperglycemia might be only "relative"—similar to that occurring after hemorrhage, and (2) even if the observed hyperglycemia represented an actual increase in the amount of sugar in the blood, a glycosuria might not develop, because the kidneys might be rendered impermeable to sugar through the action of the anesthetic upon them.

The present study is supplementary to the one mentioned above. Its object is to ascertain to what extent renal function becomes affected by the operative procedures (anesthesia, etc.). In a recent paper by Epstein and Baehr experiments are recorded which show that in the diabetes following pancreatectomy, im-

* Work done under the tenure of the Moses Heinemann Fellowship in Pathology.

3 Epstein and Baehr, J. Biol. Chem., 1916, xxiv, 1.
Surgical Procedure and Renal Permeability

Pairment of renal function leads to reduction or disappearance of the sugar in the urine with a consequent accumulation of sugar in the blood. This is in keeping with the observations on human beings recorded by Von Noorden,\(^4\) Lepine,\(^5\) and more recently by Epstein and Felsen.\(^6\)

So that if the effect of the anesthesia and the other surgical procedures upon the kidneys is such that their function becomes impaired, it is more than likely that the failure of sugar to appear in the urine may be ascribed, at least in part, to a lessened renal permeability.

**Method of Procedure.**

The function of the kidneys was tested by means of phenolsulfonephthalein.

The cases selected for the study were those of simple surgical conditions in which no evidence of renal disease could be found. 24 hours prior to the operation the patients received 6 mg. of phenolsulfonephthalein intramuscularly, and the time of appearance, together with the amount of the dye excreted in 1 and 2 hours, was determined. On the day of the operation the blood sugar was determined directly before the anesthesia, and again after the operation. Another dose of phenolsulfonephthalein was also injected, and its elimination in the urine observed. The blood sugar was estimated by means of the microchemical method of one of the authors.\(^7\) The phenolsulfonephthalein excretion was determined in the Hellige apparatus.

One of the effects of the surgical procedures common to all the cases studied was a marked diminution in the amount of urine secreted. This is undoubtedly due in part to the withholding of food from the patient prior to the operation, and to the loss of fluid from the body by sweating during the operation. Postoperative vomiting may also contribute to the loss of fluid.

The results obtained in the estimation of the blood sugar are in confirmation of those found in the work mentioned above.\(^1\) A


\(^5\) Lepine, R., *Rev. méd.*, 1897, xvii, 832.

\(^6\) Epstein and Felsen, to be published.

\(^7\) Epstein, A. A., *J. Am. Med. Assn.*, 1914, lviii, 1667
<table>
<thead>
<tr>
<th>Case</th>
<th>Phenolsulfonephthalein excretion 24 hrs. before operation</th>
<th>Blood sugar</th>
<th>Phenolsulfonephthalein excretion directly after operation</th>
<th>Urine for 24 hrs. after operation</th>
<th>Operation</th>
<th>Kind</th>
<th>Duration</th>
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<tr>
<td></td>
<td>Appearance</td>
<td>1st hr</td>
<td>2nd hr</td>
<td>Total</td>
<td>Directly before anesthesia</td>
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FIG. 1. Showing the post-operative rise in the blood sugar and the decrease in the phenolsulfonephthalein excretion. The dotted blocks represent the phenolsulfonephthalein, the cross-lined ones the blood sugar. The shaded portion of the dotted blocks represents the difference in the excretion of phenolsulfonephthalein before and after operation. The clear area in the cross-lined blocks represents the difference in the blood sugar.
comparison of the results obtained with phenolsulfonephthalein before and after operation shows a uniform delay in the time of appearance of the dye and a decrease in the amount excreted. The reduction in the phenolsulfonephthalein elimination is very striking in some of the cases (see table and Fig. 1). The decrease in the amount of phenolsulfonephthalein eliminated after operation as compared with that prior to operation ranges from 12 to 73 per cent, the average being about 25 per cent.

SUMMARY.

Operative procedures under anesthesia cause an increase in the blood sugar content (hyperglycemia), associated with a reduction or impairment of renal function. From this it is concluded that diminished permeability of the kidneys is responsible for the infrequent elimination of sugar in the urine after operations.
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