Observations on Urinary White Cell Excretion Before and After Surgery

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Quantitative determination of the cells excreted in the urine has until recently been regarded as a cumbersome and time-consuming procedure (Lancet, 1961). Houghton and Pears (1957) attempted to simplify the technique, and McGeachie and Kennedy (1963) described a method of semi-quantitative cell counting which was suitable for routine use yet was much more accurate than the ordinary wet-film technique. In the course of a recent study of renal function after surgery (Lindsay et al., 1965) it was observed that there was a considerable difference between urinary white cell excretion rates before and after surgery in many patients, so further investigation of this was undertaken.

Patients and Methods

A group of 138 patients (81 males and 57 females) undergoing surgery in a general surgical ward were studied. The surgical procedures ranged from ligation of varicose veins to total colectomy, and any patient having direct interference with the genitourinary tract (including catheterization) was excluded. All had general anaesthesia. Preoperatively each patient was questioned about urinary tract symptoms, and any definite history of urinary tract infection or catheterization was recorded. Semi-quantitative cell counts, as described by McGeachie and Kennedy (1963), were performed on clean midstream specimens of urine, the examination being carried out within two hours of collection. In all cases the urinary cells were stained by the method of Prescott and Brodie (1964) to differentiate between white cells and tubular cells. Each patient was seen again 24 to 48 hours after operation; urinary symptoms were recorded and the cell count was repeated. Urine volumes were recorded, and patients who excreted less than 600 ml of urine between 24 and 48 hours after operation were excluded.

In 62 consecutive patients in the group urine was sent for bacteriological examination before and after operation. Delays in transmission of specimens to the laboratory were minimized, and bacterial counting was done by the method described by McGeachie and Kennedy (1963).

In a further group of 14 patients (4 males and 10 females) fully quantitative cell counts were done before and after operation. These were carried out on accurate three-hour urine collections kept acid to litmus and refrigerated during the collection. The cells were counted by the method of Houghton and Pears (1957) after staining by Prescott and Brodie's method (1964). Bacterial counts were performed concurrently on all of these specimens.

A further group of 46 patients (23 males and 23 females) aged 9 to 80 years undergoing minor surgery on the ear, nose, or throat were studied in addition to the 152 general surgical patients.

Results

The staining technique of Prescott allows the counting of white blood cells, red blood cells, tubular cells, and squamous epithelial cells. A considerable difference was found between rates of excretion preoperatively and postoperatively only for white cells; no further reference will be made to the other types of cell counted.

In the general surgical group, of the 81 males only 5 (6%) had a urinary white cell count above the normal range preoperatively, and 9 (11%) had an abnormal cell count postoperatively, including all the five originally abnormal. Of the 57 females of this group 6 (10.5%) showed an abnormal cell count preoperatively, but 33 (61%) were abnormal postoperatively.

As shown in the Table, seven of the nine males with an increased white cell excretion postoperatively gave a history of urinary tract infection or of catheterization. The relation of history of urinary infection or catheterization in the females is also shown in the Table. The age distribution of all patients with an abnormal postoperative white cell count is given in Figs. 1 and 2.

Bacterial counts were carried out in 39 consecutive male patients. No bacterial count of more than 100,000 organisms

Correlation Between Past History and an Increased Urinary White Cell Excretion Postoperatively in 81 Males

<table>
<thead>
<tr>
<th>Past History</th>
<th>No.</th>
<th>Males</th>
<th>Cell Count</th>
<th>Females</th>
<th>Cell Count</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Negative</td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>+</td>
<td>8</td>
<td>73</td>
<td>7</td>
<td>7</td>
<td>49</td>
</tr>
<tr>
<td>-</td>
<td>73</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>1</td>
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</table>
per ml. was obtained preoperatively and only one post-
operatively. This was associated with an abnormal cell count. In
the 38 male patients who were negative bacteriologically two
abnormal cell counts were obtained postoperatively, associated
with negative cultures. Both patients had been given antibiotics
since the day of operation.

Of the 23 consecutive female patients in whom bacterial
counts were done four had above 100,000 organisms per ml.
preoperatively and five postoperatively (the latter five includes
the previous four), all of the positive postoperative counts being
associated with normal urinary white cell excretion. A further
five patients had increased white cell excretion postoperatively,
but negative culture; three of these five had been receiving
antibiotics since operation.

In the 14 patients in whom fully quantitative cell counts
were done the upper limit for normal white cell excretion rate
was chosen as 400,000 cells per hour; this is higher than most
authors suggest (Adliss, 1926; Rofe, 1955; Houghton and
Pears, 1957; Hutt et al., 1961). Of the 10 female patients so
examined only one had an abnormal cell excretion rate pre-
operatively, and this was associated with a bacterial count in
excess of 100,000 organisms per ml. (Fig. 3). Postoperatively
there were five cases with abnormal white cell excretion, four
of which were associated with positive bacterial counts. Of
the four male patients in whom fully quantitative cell counts
were done none showed increased white cell excretion either
before or after operation (Fig. 4).

In the additional group of 46 patients who were studied while
undergoing minor surgery of the ear, nose, or throat, none of
the 23 males had positive cell counts or bacterial counts at any
time. Of the 23 females four showed an abnormal rise in
urinary white cell excretion after surgery, and three of them
gave a past history of urinary tract infection.

In the whole group of 198 patients only four females com-
plained of urinary symptoms postoperatively, and in each case
this was associated with increased white cell excretion. There
was no evidence that type of surgery or duration of anaesthesia
had any influence on the numbers of patients showing increased
white cell excretion or significant bacteriuria.

Discussion

This study has shown that in many patients undergoing
surgery unrelated to the genitourinary system there is a marked
rise in urinary white cell excretion postoperatively. Further-
more, this phenomenon was noted in 61% of the females
studied, but in only 11% of the males. The rise in the females
is highly significant (P<0.001). The increased white cell excre-
tion rate was confirmed in a small number of cases by fully
quantitative cell counts, and bacterial counting suggested that
in most cases it was accompanied by significant bacteriuria
(>100,000 organisms per ml.). There did not appear to be any
relation between type of surgery or duration of anaesthesia
and the increased white cell excretion. Almost all of the male
patients who showed increased white cell excretion post-
operatively had a history of previous urinary tract infection or
of catheterization; this relation was less definite in the females.

With unexpected findings of this nature the accuracy of the
techniques used must always be questioned. The increased
white cell excretion was detected by the semi-quantitative tech-
ique of McGeachie and Kennedy (1963), which does not take into
account the volume of urine passed. It is obviously
possible that oliguria might give false-positive results, but all
oliguric patients were excluded from the study. Almost all
of the patients studied passed more than 1 litre of urine between
24 and 48 hours after operation, and at this urine volume the upper
limit of normal for the McGeachie and Kennedy method
corresponds to a urinary excretion of 350,000 white cells per
hour; the authors themselves established that the method gives
few false-positive results. Fully quantitative cell counts con-
ferred the findings, 400,000 white cells excreted per hour being
taken as the upper limit of normal, as is
generally accepted (Hutt et al., 1961; Kennedy
et al., 1964). The use of the differential staining
techniques described by Prescott and Brodie
(1964) ensured that the cells counted were white
cells and not the otherwise indistinguishable
small renal tubular cells.

Prescott (1966) suggested that the normal
urinary white cell excretion rate for males is
much lower than for females, and it might be that
this would explain the sex differences noted in the present study. However, almost none of
the males showed any rise at all in white cell
excretion rates, while the vast majority of females
who are recorded as showing positive cell counts
were clearly above the upper limit of normal even for females. The fact that we have observed this marked sex difference would
mitigate against another possible explanation of post-
operative rise in white cell excretion, the use of
analgesics, which may increase urinary cell
excretion. In addition, Prescott (1965) showed that the increased cell count after analgesic ingestion was due to a rise
in renal tubular cell excretion, and not leucocytes. Finally, bacterial
counting strongly suggests that the cases in this series which
showed a rise in white cell excretion very often had significant
bacteriuria also.

Houghton and Pears (1957) studied variations in the rate of
leucocyte excretion in the urine of normal subjects; they found
no differences with age or sex, and only slight differences with
posture and time of collection. On the other hand, Prescott
(1966) showed a marked sex difference, considerable variation
from patient to patient, and even no rise in the same
patient. It must be remembered, however, that these differences
were all within the normal range. Other documented reasons
for increases in urinary leucocyte excretion above the normal
range are urinary tract infections, during fever in pneumonia
(Goldring, 1931), in pregnancy (Elden and Cooney, 1935), and
after vigorous exercise (Roberts, 1935). None of these
situations was applicable to the present study.

The cause of the abnormalities recorded in this paper remains
certain. The marked sex difference, the fact that males
showing a rise in white cell excretion postoperatively almost
all had a previous history of urinary tract infection, and the
association of pyuria and significant bacteriuria all suggest that
the phenomenon is related in some way to urinary tract infec-
tion. It might be suggested that pooling of urine in the bladder
postoperatively contributed to the significant bacteriuria or even to
the pyuria, but the collections were not made on the first
postoperative day, and it is unlikely that this would explain the marked sex difference. It is highly unlikely that over 60% of apparently normal women had latent urinary tract infection, but perhaps the changes we have observed are in some way related to the unknown cause underlying the increased susceptibility of the female to urinary tract infection.

Summary

Semi-quantitative urinary white cell counts were performed in 198 patients before and after surgery. A significant rise in white cell excretion rates was found in 61% of the females but in only 11% of the males. The results were confirmed in a further group of patients by means of fully quantitative cell counts, and bacterial counting showed that this pyuria was often associated with significant bacteriuria. The possible significance of these findings is discussed.

REFERENCES


Use of Diazepam in Treatment of Severe Convulsive Status Epilepticus


During the past three years diazepam (Valium) has been used extensively, both in Europe and in the U.S.A., chiefly as a tranquilizing agent but also as an anticonvulsant (Gross and Kallienbäck, 1963; Goldstein, 1963; Trolle, 1965). Until recently there have been comparatively few published accounts of its use in the treatment of status epilepticus. One of the earliest was that of Naquet et al. (1965), and others were by Gastaut et al. (1965), Iborra (1965), Piqué and Henking (1965), Revol et al. (1965), Bamberger and Matthes (1966), and Lombroso (1966).

In common with chlordiazepoxide (Librium) and nitrazepam (Mogadon), diazepam is a member of the benzodiazepine group of drugs. It has tranquilizing, muscle relaxant, and anticonvulsant actions. In experimental animals its depressant action has been found to act mainly on structures in the limbic system, including the hippocampus, amygdala, and reticular formation (Randall et al., 1961; Morillo, 1962; Hernández-Péón et al., 1964; Schallek et al., 1964; Schallek and Kuehn, 1965). It has also been shown that seizures arising in the amygdala in rats can be prevented by the prior administration of this drug (Eidelberg et al., 1965). The literature relative to this subject has been extensively reviewed by Boyer (1966).

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We report here the use of diazepam in the treatment of nine severe cases of convulsive status epilepticus.

Material and Methods

There were four males and five females, whose ages ranged from 11 to 53 years (Table 1). In practically all cases the epilepsy was of long standing and probably associated with gross brain damage. In at least six of the nine patients there was a probable source of seizure discharge in one or other frontal lobe, and in several instances there had been previous episodes of convulsive status epilepticus.

After admission to hospital all patients were at first given diazepam in 10-mg. doses (1 ampoule), either intravenously or intramuscularly as required. When it became apparent that the drug had only a transient action it was given as an intravenous infusion, initially in a dosage of 100 mg. in 1 litre of physiological saline. Latterly, intravenous infusions of 100 mg. of the drug in 500 ml. of saline were given.

All patients had the usual nursing care, with particular attention to respiratory function and to fluid and electrolyte balance. Whenever it was thought necessary tracheostomy and controlled respiration were employed. Tests for liver function were carried out in Cases 5–9. In most of the patients EEG studies had previously been carried out with resulting location

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Sex and Age</th>
<th>Origin of Seizure Discharge</th>
<th>Duration of Epilepsy and Associated Findings</th>
<th>Aetiology</th>
<th>Precipitating Factors</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>F 17</td>
<td>R. frontal</td>
<td>Since infancy</td>
<td>Unknown</td>
<td>Meningo-encephalopathy of unknown cause</td>
</tr>
<tr>
<td>2</td>
<td>M 35</td>
<td>Primary subcortical</td>
<td>Since birth. Mental retardation</td>
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</tr>
<tr>
<td>3</td>
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<td>Since birth. Mental retardation</td>
<td>Unknown</td>
<td>Change in anticonvulsant regimen</td>
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<tr>
<td>4</td>
<td>F 19</td>
<td>? R. frontal</td>
<td>Since birth. Mental retardation</td>
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</tr>
<tr>
<td>5</td>
<td>F 15</td>
<td>R. frontal</td>
<td>Since birth. Mental retardation</td>
<td>Unknown</td>
<td>Reduction of anticonvulsants during drug detoxication</td>
</tr>
<tr>
<td>6</td>
<td>F 18</td>
<td>L. cerebral hemisphere</td>
<td>Since birth. Mental retardation</td>
<td>Unknown</td>
<td>Pneumonia and withdrawal of anticonvulsants</td>
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<tr>
<td>7</td>
<td>M 12</td>
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<td>8</td>
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</tr>
<tr>
<td>9</td>
<td>F 53</td>
<td>R. frontostemporal</td>
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<td>? Meningitis</td>
<td>None</td>
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TABLE I