OPERATIVE COURSE OF DIGITALIZED SURGICAL PATIENTS

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In 1947, Wiggers (1) stated "the possibility that proper cardiac stimulants used in proper dosage and at the proper time may reverse the circulatory failure, when transfusions fail to do so, should not be regarded as a closed problem."

This paper is based on an inspection of the records of the operative course of 17 patients who were given digitalis. Particular emphasis is placed on the 15 who received it during operation. Admittedly, this is a small series. Two reasons prompted the choice of this time for presentation: first, the long period of time necessary to accumulate a large number of cases illustrating this point and, second, the possibility of a smoother operative course if the internist and the anesthetist appreciate each others' problems.

With the exception of three upper abdominal procedures (emergency operations for bleeding duodenal ulcers), all are intrathoracic cases, either cardiac or pulmonary. However, the integrity of the circulation in patients with heart disease is tested daily in those patients subjected to surgical intervention so that the scope of the impressions gained in these cases need not be limited. There are, of course, more opportunities for strain on the circulation, myocardial and peripheral, during thoracic procedures.

What are examples of strain that operative treatment imposes upon the circulatory system? First, anesthetic agents themselves, in addition to other pharmacologic actions, depress the myocardium (2) and, not infrequently, disturb cardiac rhythm. Operative position, by gravity or compression, can diminish venous return. Hypoxia from respiratory obstruction or reduction in effectively aerating lung tissue depresses the myocardium. Carbon dioxide excess can cause cardiac dilation (3). Trauma and alterations in blood volume impose an added burden, as do various reflexes that lower the blood pressure, alter the heart rate, or cause bronchoconstriction. Another factor is the frequent necessity to use either assisted or controlled respiration. This replaces a normally negative pressure inspiratory phase with a positive pressure and, with it, the possibility of a decrease in venous inflow and cardiac output.

* Read at the Knoxville Academy of Medicine, January 1952.
The renal suppression that occurs during operative procedures, while more apparent during the postoperative period, can influence the integrity of the circulation. If these factors are superimposed upon an existing disease of the oxygen transport system, whether it be heart or lungs, a strain is produced on a myocardium that may not in itself have the necessary reserve.

What criteria were selected for the assumption that a depressed myocardium contributed to a deteriorating circulation? First, susceptible individuals—those who because of age, presence of pulmonary or heart disease, or prolonged hemorrhage had, at least, a diminished reserve; second, a progressive decline of the blood pressure and narrowing of the pulse pressure in spite of apparent adequate blood replacement; third, a slow capillary filling; fourth, the absence of any obvious factor such as high concentration of anesthetic agent or hypoxia, and fifth, the frequency of a slow pulse rate. In the 1951 Annual Review of Physiology (4) several authors were quoted who emphasized that the presence or absence of slowing did not play a role in the hemodynamic improvements following digitalis. A pale type of cyanosis was often seen even in the presence of a patent airway. A cold but dry skin was the usual occurrence. The veins were full and there was often an obvious venous backflow. When the chest and particularly the pericardium were open, direct observation of the cardiac action was informative. Excess fluid in the pleural or pericardial cavities or palpable evidence in the lung parenchyma was suggestive of circulatory congestion. What might be called therapeutic tests were the exaggerated circulatory depressions seen from small concentrations of anesthetic agents or such drugs as demerol® or procaine amide and the transient, diminished or absent circulatory responses to such pressor drugs as neosynephrine®.

The preparation of digitalis used in this series was cedilanid® or lanatoside C, a pure crystalline glycoside of digitalis lanata (5). Dosage in most cases was 0.8 mg. In those patients previously digitalized, 0.4 mg. was employed. Harrison (6) stated that the digitalizing dose varies with the individual but ranges from 0.8 mg. to 1.6 mg. Cedilanid was chosen in preference to ouabain and acetyl strophanthidin because of its probable superiority in "low output" failure of which mitral stenosis could be an example (7). Its slower action than ouabain (8) did not seem to be a disadvantage since the desired effect was noticed in from five to fifteen minutes. Enselberg (9) considered acetyl strophanthidin too toxic for general clinical usage.

The pharmacologic actions of digitalis will not be reviewed but reference is made to Lendle's conclusions (10) that it causes an increase in systolic power, increase in cardiac output, decrease in oxygen consumption for unit of work done, and better assimilation of carbohydrate and lactate. Some observers (11) reported a decreased cardiac
output and size in the normal heart and a lowered ventricular efficiency, (12) but others (13) reported no change in cardiac output. Those holding the former views are in the majority.

Although it is not in the scope of this presentation to discuss the preoperative use of digitalis or to raise the question of early versus late cardiac failure, it does seem that a heart subjected to the potential strains previously enumerated is not a "normal heart." Also, as Wiggers (1) has pointed out, circulatory failure leads to myocardial failure. If conventional signs, such as a markedly increased cardiac rate, basilar rales, palpable liver, and so forth, are waited for during a surgical procedure, the optimal time for digitalization will be missed because these signs usually will not appear.

In this connection it may be well to remember Dry's (14) remarks that all candidates (35 up to November 1951) for mitral commissurotomy at the Mayo Clinic had been digitalized preoperatively and that the cardiac rate is frequently deceiving as far as cardiac failure is concerned. Incidentally, in the 35 commissurotomies done, there were at that time only 2 deaths. This is a far better average than usually reported.

In addition to the decrease in size and output in the normal heart, a further disadvantage is the possibility of cardiac arrhythmias, usually ventricular in origin. It might appear that this might further contribute to those arrhythmias produced by cardiac manipulation, but this is not necessarily the case. Since it has not been the policy routinely to take electrocardiograms; proof is lacking at this time, but the impression now gained through observation of the exposed heart, is that they are more frequent in hearts not digitalized. Indeed, digitalis can decrease or abolish ventricular extrasystoles (3). A further opinion is that the improvement in systolic power and cardiac output far outweighs the disadvantage of possible cardiac arrhythmias.

In addition, with the judicious use of procaine amide, the physician can manage ventricular arrhythmias more easily than a decreased cardiac output.

**Case Presentations**

**Case 1.—**The patient was a 29 year old white man who had rheumatic heart disease with mitral stenosis. The preoperative study consisted of diagnostic procedures and no particular medical regimen was considered necessary. Mitral commissurotomy was performed. The progressive deterioration of the circulation during the first part of the procedure and the improvement following the administration of 1.6 mg. of cedilanid may be noted. Except during actual valvular manipulation, when asystoles, arrhythmias and drops in blood pressure frequently appear, the operative course was smooth, and the postoperative course was satisfactory. Administration of digitalis was discontinued the second postoperative day because of electrocardiographic evidence of auricular premature beats. The patient was discharged from the hospital markedly improved.
Case 2.—A 64 year old white woman had an aortic aneurysm, residual hemiplegia and laryngeal nerve paralysis. The operative procedure was aortic aneurysmorrhaphy. The steady deterioration in circulation and the marked improvement in its integrity after use of 0.8 mg. of cedilanid may be noted on the chart. The postoperative course was satisfactory.

Case 3.—A 53 year old white man had slight emphysema; a clinical diagnosis had been made of pulmonary carcinoma, metastatic in origin. The contemplated procedure was lobectomy. The operative course was not unusual until a somewhat rapid, severe drop in blood pressure occurred at the point indicated on the chart. The precipitating factor was thought to be occlusion of the left bronchus by retraction. No change in status occurred with rest, and 0.8 mg of cedilanid was administered. The sustained improvement may be noted. The postoperative course was satisfactory the first week, but during the second week digitalis and quinidine were required because of auricular fibrillation and cardiac failure. The subsequent course was satisfactory.

Case 4.—The patient was a 38 year old white woman. A clinical diagnosis had been made of rheumatic heart disease with mitral stenosis. Mitral commissurotomy was performed. Again, the steady decline of pressure and narrowing of pulse pressure were noted and a very definite, though not so marked, improvement was seen after administration of cedilanid. The pericardial sac
contained 150 to 200 cc. of fluid. Even during the valvular manipulation, circulatory disturbances apparently were minimal. The postoperative course was satisfactory except for the development of auricular flutter on the seventh postoperative day. Digitalis was again used, supplemented with quinidine. The patient was discharged improved but still continues on oral digitalis therapy.

**Tabulation of Results with 17 Digitalized Patients**

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Times Used</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Number Improved</td>
<td>12</td>
<td>70.6%</td>
</tr>
<tr>
<td>No Noted Change</td>
<td>3</td>
<td>17.6%</td>
</tr>
<tr>
<td>Unable to Evaluate</td>
<td>2</td>
<td>11.8%</td>
</tr>
<tr>
<td>Deaths in Series</td>
<td>6</td>
<td>35.3%</td>
</tr>
</tbody>
</table>

The chart is a tabulation of the results obtained with cedilanid in 17 patients. In the 3 cases in which the drug produced no change, it was used prophylactically. One of these 3 patients was moribund at the end of the procedure and 200 cc. of blood was given intra-arterially. There was almost immediate marked, sustained improvement. Since Page (quoted by Wiggers (1)) has shown the beneficial effect of previous digitalization in arterial transfusions,
this may have been a fortunate circumstance. The part played by the hypotension and the viability of the ruptured duodenal stump with ultimate death about one week after operation is a matter of conjecture.

The remaining two patients were given digitalis preoperatively and 0.4 mg. of cedilanid was administered during the operative procedure. Whether the drug was implicated in the complications described later is not known.

Of the 6 deaths, 2 were operative. One occurred during a pneumonectomy in a patient who, probably, would be placed in Class IV of Courmand’s emphysema classification. He also had pulmonary abscesses and necrosis. The other occurred during an aneurysmorrhaphy in a patient who had a markedly enlarged heart, auricular fibrillation and the aneurysm. Better general operative management might have prevented these deaths. Again, it is doubtful whether the further administration of digitalis contributed to the death.

The third death, about seven hours after operation, was the result of hemorrhage at the operative site. The role of hypotension, although not marked, must be considered because of its potentiality to mask operative hemorrhage.

The fourth death took place on the eighth postoperative day in a patient with an aortic aneurysm, following a sudden change in position, from sitting to reclining.

The remaining 2 deaths occurred on the fifth and eighth days, respectively, after operation. One was the result of a rupture of the duodenal stump following gastrectomy and in the other cause was not determined at autopsy.

SUMMARY

Clinical experience with the use of cedilanid in 17 surgical patients is presented. Since circulatory depression should be avoided because of dangers of suboxygenation, masking of operative hemorrhage, increased incidence of thrombosis and other sequelae, appropriate therapy is indicated if blood replacement fails. It has been shown that digitalis is of benefit in that it results in a smoother operative course that permits sufficient depth of anesthesia and adequate replacement of fluid. The advantages of intravenous administration outweigh the disadvantages. Furthermore, it is the opinion at present that withdrawal of digitalis before cardiac surgical procedures in an individual who needs it is open to serious question and probably not justified. It also has been shown that the conventional signs of myocardial depression usually are absent during surgical procedures. One case was presented in which the drug may have been of value when arterial transfusion was given.

In conclusion, attention is drawn to the fact that prevention of circulatory deterioration is more desirable than its treatment, and that intravenous digitalization introduces another variable in operative management at a time when these extraneous factors should be kept at a minimum.

REFERENCES

(Continued from page 158)

Friday, April 10, 1953

Muscle Relaxants and Their Antagonists—Stuart C. Cullen, M.D., Professor of Surgery, Chairman Division of Anesthesiology, University Hospitals, State University of Iowa, Iowa City.

Newer Analgetic Agents and Their Antagonists—Curtiss B. Hickcox, M.D., Associate, Department of Anesthesiology, Hartford Hospital, Hartford, Connecticut.

Complications of Spinal Anesthesia and Their Treatment—Morris J. Nicholson, M.D.

Round Table—Complications to the Nervous System—Spinal and Nerve Injuries.

Morris J. Nicholson, M.D.—Moderator
E. M. Papper, M.D.—Anesthesiologist
Henry W. Dodge, Jr., M.D.—Neurosurgeon
Angus Wright, M.D.—Pathologist
Clarence J. Berne, M.D.—Surgeon

Round Table—Malpractice.

Douglas H. Batten, M.D.—Moderator
Stanley N. Barnes, J.D.—Judge of Superior Court
Harold Hunter, LL.B.—Trial Attorney
Louis Regan, M.D., LL.B.—Legal Consultant
John Feldman, M.D.—Industrial Surgeon
Charles F. McCuskey, M.D.—Anesthesiologist