SURGICAL TREATMENT OF CONGENITAL PYLORIC STENOSIS

BY

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The uncertainties of the time in which we live, the possibility that all records may be destroyed, have prompted me to publish the figures and tables reproduced below. They appear to me to be of value in that they demonstrate the striking difference in the mortality of pyloric stenosis in breast-fed and bottle-fed infants. This fact has been recognized, but herewith it is very clearly demonstrated.

Table I is a list of 100 breast-fed babies operated on at the Infants Hospital, Westminster. It is a consecu-

CHART I

CHART II

—1 to 50—many of the patients were kept for days before operation. Latterly, the length of stay in hospital has tended to decrease. Most of the patients were admitted under the charge of a physician, and the duration of the period of premedication varied with the practice of the particular physician under whose care the child was placed. Patients admitted direct to my beds have been treated as emergencies, and have been operated on immediately, without any preliminary treatment other than a gastric lavage. One has been agreeably surprised at the good progress these children have made (Charts I, II, and III).

The result in this series of breast-fed infants is 100% cure. Moreover, the cure is speedy, safe, and certain. The outlook seems to be even more helpful than that of most surgical operations, since the anaesthetic risk has been entirely eliminated. The same story, however, does not

CHART III

CHART IV

tive list of the breast-fed infants either referred to me by my medical colleagues or admitted under my charge during the period reviewed. No child was ever refused operation, as no child suffering from this disease is ever too ill for operation. There were no deaths. All the children were discharged from hospital well. There were 13 girls and 87 boys. Four children did not have their birth weight recorded. Of the remaining 96, 48 were below birth weight when operated upon.

Table I shows that the earlier patients were kept in hospital longer than the later ones. The length of stay is a matter of grave import in treating sick babies, but it does not appear to be such a decisive factor in breast-fed children, provided that mother and child are both resident in the hospital. In the earlier part of the list

hold good for the bottle-fed infants. In 1938 23 children were operated on and 2 were lost.

There were certain features in common in the histories of the 5 children who died. The first child "refused the breast from birth," and was artificially fed; the second child was breast-fed for five days only; the third was artificially fed; the fourth was breast-fed for three weeks; and the fifth was not breast-fed at all. The fourth child gives what might be called a "classical history of mismanagement." The child, an only and much-wanted child, was breast-fed until it was three week old. Difficulties were then encountered as the breast milk was said to disagree with it. It was then fed on cow's milk and water. This was followed by a dried milk, and this in turn by another brand of dried milk. Then a condensed milk was used, and finally a further brand of dried milk.

TABLE I.—100 Consecutive Breast-fed Infants Suffering from
Pyloric Stenosis

No.	Age in Weeks	Sex	Birth Weight	Weight before Operation	Weight on Discharge	No. of Days in Hospital	No. of Days after Operation before Discharge	Gain in Weight
1	4	M	lb. oz. 9 7½	lb. oz. 7 14	lb. oz. 9 0	16	12	lb. oz. 1 2
2	4	F	6 0	5 7	6 5	27	15	1 9
3	4	F	6 4	5 7	6 2	15		
4	5	F	7 0	6 6	7 1	24	12	11 1
5	5	F	9 0	8 1	9 12	23	10	11 1
6	7	F	7 0	5 5	6 8	36	15	
7	7	F	7 15	5 8	7 14	14	9	4
8	10	M	7 13	8 10	9 0	22	10	
9	8	M	10 0	9 0	10 3	15		
10	8	M	8 1	n.k.	n.k.	18		
11	8	M	7 3	7 0	7 7	14		1 3
12	4	M	n.k.	6 10	7 3	14		8½
13	5	M	n.k.	6 10	7 3	9		9
14	4	M	8 3½	7 7½	8 9	30	8	12
15	4	M	6 12	6 0	6 11	14		
16	4	M	9 8	8 8	9 13	23	8	
17	8	M	7 0	6 0	7 5	12		11 2
18	6	M	8 0	6 2	8 11	18	16	
19	5	F	7 8	6 15	7 15	16	9	1 2
20	3	F	6 4	5 8	6 11	23	2	1 6
21	3	F	8 8	7 8	8 15	9		8
22	6	F	8 6	7 11	8 3	7		6
23	6	F	9 2	8 12	9 6	16	11	6
24	4	F	5 4	6 2	6 6	12		
25	2	F	7 8	5 13	6 13	10		1 0
26	3	F	7 7	7 5	8 2	14		13
27	3	F	6 6	6 7	7 9	16		
28	7	F	8 6	8 15	9 14	12		
29	9	F	6 10	7 2	7 9	8		7
30	6	M	8 4	8 3	8 10	6		7
31	7	M	n.k.	9 0	9 4	7		4
32	4	M	9 8	7 5	7 11	11		6
33	4	M	6 12	8 4	8 11	5		7
34	5	M	7 8	8 0	8 11	4		7
35	7	M	8 13	9 0	9 7	13		8
36	3	M	6 11	6 4	6 12	8		3
37	8	M	9 8	8 14	9 1	14		5
38	8	M	6 0	6 3	7 0	10		12
39	4	M	5 8	6 4	6 9	10		4
40	4	M	8 0	6 13	7 9	10		12
41	7	M	7 2	8 12	9 0	13		14
42	3	F	7 8	7 5	8 1	21	19	11
43	4	F	n.k.	6 8	7 6	9		3
44	4	F	8 6	9 3	9 14	25	10	11
45	4	F	8 5	8 4	8 7	12		9
46	6	M	6 4	5 8	6 3	10		15
47	3	M	7 0	3 9	6 2	7		5
48	3½	M	6 6	5 14	6 13	9		8
49	3	M	7 10	6 11	7 4	15		3
50	6	F	n.k.	8 9	8 14	9		5
51	5	F	6 8	6 6	6 14	12		7
52	3	F	10 2	8 3	9 6	18		1
53	4	F	7 4	6 8	6 15	15		3
54	6	M	8 6	6 3	6 15	9		12
55	9	M	6 1	7 14	8 1	9		3
56	5	M	6 13	8 7	8 13	9		6
57	4	M	7 0	8 2	8 7	5		5
58	6	F	6 0	7 0	7 2	13		2
59	5	F	8 0	9 2	9 13	11		11
60	6	M	8 0	8 12	9 2	11		6
61	4	M	8 11	8 1	8 8	15		7
62	4	M	8 2	6 15	7 2	14		3
63	3	M	8 4	7 8	8 5	9		13
64	3	M	7 12	6 11	7 11	20	20	1 0
65	3	M	10 9	8 11	9 1	8		6
66	3	M	n.k.	6 14	7 1	8		3
67	2	M	8 5	7 8	7 12	8		4
68	8	M	7 4	7 0	7 4	12		4
69	6	M	7 4	5 6	6 10	12		1 4
70	4	M	7 4	7 9	7 13	9		7
71	4	M	8 0	8 2	8 13	9		11
72	4	F	8 4	10 4	10 6	7		2
73	7	F	7 15	8 0	8 6	8		6
74	5	F	7 8	6 8	6 14	8		7
75	4	M	7 8	6 6	6 10	10		4
76	4	M	6 0	5 2	5 7	13		5
77	3	M	7 7	7 11	8 3	9		8
78	4	M	6 0	6 9	6 15	10		6
79	4	M	10 0	8 2	8 12	8		10
80	5	M	6 5	6 8	7 1	8		9
81	4	M	6 11	5 12	6 9	11		13
82	3	M	7 12	6 1	6 3	12		2
83	4	M	n.k.	5 12	6 4	11		8
84	4	M	8 0	7 15	8 9	11		10
85	8	F	8 0	6 14	7 6	5		8
86	4	F	6 12	5 6	6 0	12		10
87	6	M	7 8	7 7	7 11	8		4
88	2	M	7 0	6 6	6 14	14		6
89	5	M	6 12	7 5	7 11	8		8
90	2	M	8 2	8 2	8 15	9		13
91	5	M	7 0	6 9	7 2	9		3
92	8	M	8 7	9 9	9 11	10		7
93	4	M	6 7	6 8	7 4	8		11
94	5	M	7 12	7 3	8 1	9		14
95	5	M	7 5	7 3	7 14	10		11
96	3	M	7 5	6 1	6 5	7		4
97	2	M	7 6	6 13	7 12	21		5
98	5	M	9 6	7 8	8 5	7		13
99	5	M	8 2	7 12	8 0	7		4
100								

n.k. = Not known.

TABLE II.—List of Bottle-fed Babies in 1937

No.	Age in Weeks	Sex	Birth Weight	Weight before Operation	Weight on Discharge	No. of Days in Hospital (total)	No. of Days after Operation before Discharge	Gain in Weight
1	6	M	lb. oz. 7 0	lb. oz. 6 6	lb. oz. 6 6	8		lb. oz.
2	10	M	7 8	7 0	7 10	10	10 days after operation	
3	4	F	5 1	5 13	7 10	10	10 days after operation	
4	6	F	n.k.			10	9	10 B.-f. first 4 wks. of life
5	8	M	8 12	10 2	13 2	7	4	10 B.-f. first 5 wks. of life
6	3	F	8 8	5 12	6 4	13	10	8
7	5	F	5 5	5 6	6 5	14	11	15
8	4	F	6 8	5 1	6 0	6	5	15
9	6	M	9 8	7 14	8 3	21	9	5
10	3	M	10 0	8 8	9 9	8	9	1
11	8	M	4 2	3 8	4 9	21	20	1
12	3	M	7 12	6 15	7 11	12	9	A.B.-f. twin
13	10	M	8 8	6 14	7 10	12	12	A.B.-f. Twin
14	3	M	7 10	6 8	7 4	9	7	
15	4	F	7 12	6 11	7 8	20	19	
16	6	F	7 13	7 1	7 4	19	15	
17	4	M	6 2	5 8	6 3	16	16	
18	4	M	7 8	6 12		In hospital 18 days	Died 5 days after operation	
19	6	M	7 2	8 0	8 5	14	5	5
20	8	M	7 4	8 13	8 14	19	13	
21	8	M	3 8	3 15	5 2	27	13	1 3 7 month prem. twin
22	5	F	8 0	9 6	10 0	13	11	10
23	0	F		5 10	7 1	67	64	1 7

B.-f. = Breast-fed.

A.B.-f. = Given stored breast milk after operation.

n.k. = Not known.

TABLE III.—List of Bottle-fed Babies in 1938

No.	Age in Weeks	Sex	Birth Weight	Weight before Operation	Weight on Discharge	No. of Days in Hospital (total)	No. of Days after Operation before Discharge	Gain in Weight
1	9	F	lb. oz. 8 8	lb. oz. 8 6	lb. oz. 9 4	17	16	lb. oz. 14
2	7	F	7 8	7 13	8 8	13	11	11
3	8	M	6 13	6 8	7 5	Died 11 days after operation		
4	10	F	4 12	7 3	7 5	10	7	2
5	12	F	10 10	9 15	10 7	9	7	8
6	6	M	6 8	6 12	6 14	11	10	2
7	8	M	7 0	6 11	7 2	15	15	2
8	6	M	7 12	6 7	6 12	15	15	7
9	4	M	7 7	7 5	7 12	13	12	15
10	7	M	7 6	6 9	7 8	8	7	1
11	8	M	8 8	8 1	8 2	12	6	5
12	4	M	8 3	7 14	8 2	8	6	1
13	4	M	6 0	5 9	5 13	11	10	5
14	2	M	8 8	8 4	8 7	8	7	3
15	16	M	8 4	7 0	7 13	12	11	13
16	16	M	6 8	6 6	6 14	Died 8 days after operation		
17	5	M	7 4	8 0	8 4	12	8	4
18	6	M	7 0	7 15	8 2	12	7	6
19	6	M	6 4	6 12	7 7	9	7	3
20	7	M	n.k.	5 4	5 7	8	7	1
21	3	F	11 0	9 9	11 12	10	10	8
22	3	F	5 0	4 7	4 7	6	6	5
23	8	F	5 12	4 7	4 7	6	6	3

The child was eventually brought to the hospital when 8 weeks old, weighing 6 lb. 5 oz. It was operated on after preparation lasting three days. The infant made good progress (Chart IV) and gained weight till the sixth day following operation. It then developed gastro-enteritis and died on the eleventh day. This child should have been examined for a hypertrophic pyloric sphincter when it started to vomit while on breast milk.

A child appears to lose its immunity to gastro-enteritis if once it is taken off the breast. Never take a young infant off the breast, provided the mother is well, till the presence of pyloric stenosis has been definitely excluded. It should be regarded as axiomatic that breast milk never disagrees with an infant. This should be taught to students, nurses, midwives, and welfare and social workers of all kinds.

The advantages of a short period of treatment and early discharge from a hospital ward are unquestioned. Surgery provides this.

The problem of the control of gastro-enteritis among bottle-fed babies admitted to institutions is urgent for both physician and surgeon. Gastro-enteritis is the one danger to be feared in a child with pyloric stenosis whether medically or surgically treated, and its risk is proportional to the duration of hospital treatment. The danger is less with surgical treatment, which requires a stay in hospital of only eight days, than with medical treatment, which takes longer.

Three typical charts, I, II, and III, are the records of three infants operated on consecutively at the Infants Hospital on November 21 and 25, 1938. Two of the children were discharged on the eighth day following operation, one having gained 12 oz. and the other 14 oz. The remaining child was discharged on the ninth day, having gained 14 oz. These charts are reproduced to show the rapidity of the improvement to be expected following successful surgical intervention.

Technique

Prolonged pre-operative preparation is neither necessary nor of great value. The administration of large quantities of saline subcutaneously and intravenously is not advised. The best way to give fluids to an infant is by mouth, and the sooner the child can be placed in a position whereby it can benefit by fluid given by mouth the better. Hence the sooner operation is performed the better. The operation should be preceded by gastric lavage. The lavage is not given in an attempt to cure the chronic gastritis, as it is difficult to believe that lavage can have much effect on gastritis so long as the pylorus is obstructed. Lavage is to empty the stomach of its contents and so prevent decomposing food from entering the intestine, and to empty the stomach of gas. It should be done a quarter of an hour before operation, as a child whose stomach is full of gas is restless under local anaesthesia. Apart from this gastric lavage, no further pre-operative measures are advocated or adopted. No sedative or other form of premedication is necessary or desirable. The child is operated upon in a theatre the temperature of which is as near to 80° F. as possible. If such a theatre is not available the child should be placed on the operating table upon two partially filled rubber hot-water bottles. The temperature of the water in the bottles should be tested with a thermometer, and should be 100° F. Local anaesthesia is invariably used, and is produced by means of 1% ethocaine with or without adrenaline. Never more than 10 c.cm. of this solution is required. These are important factors in eliminating shock. A midline incision is found to be most satisfactory. 3 to 5 c.cm. of ethocaine should be placed subcutaneously along the line of the proposed incision. A little less than this quantity should be divided between the rectus of each side. The remaining 3 to 4 c.cm. should be placed deep to the linea alba—i.e., in the sub-peritoneal space. The whole procedure can be carried out through two skin punctures. It is very important not to eviscerate the child. Nothing should be allowed to leave the abdomen other than the hypertrophic pyloric tumour. This can be delivered by the use of two pairs of plain dissecting forceps. It is not necessary for the operator to put any part of the hand into the peritoneal cavity. The peritoneum and muscle coat is incised down to the mucosa and the abdomen is closed. The closure is surprisingly easy, as the peritoneum comes together without tension.

In a recently published textbook on surgery for students one finds this statement: "Speed is highly im-

portant, and the mortality will depend upon the surgeon's skill." Gentleness is more important than speed. And if the child is under local anaesthesia, and the theatre is warm, speed is of little moment. The essentials of after-treatment consist of guarding the child from the "dangers of gastro-enteritis" and the slow gradual resumption of normal feeding. Appended are feeding charts which have been reproduced from the latest edition of the Infants Hospital *Pharmacopoeia*.

Congenital Pyloric Stenosis Post-operative Feeding

Artificial Feeding: Commence Three and a Half Hours after Operation

Hours after Operation			Hours after Operation		
3½	1 dr.	7.5% glucose in half-strength normal saline	17½	1 oz.	Full-strength ½ C. & G. Milk Mixture
4	1 dr.	do.	19½	1 oz.	do.
4½	1 dr.	do.	21½	1 oz.	do.
5	1 dr.	do.	23½	1½ oz.	do.
5½	1 dr.	do.	25½	1½ oz.	do.
6	1 dr.	do.	28	2 oz.	do.
6½	1 dr.	do.	31	2½ oz.	do.
7	1 dr.	do.	Then 6 × 3 for 12 hours and thereafter increased according to directions. Water by mouth in small quantities between feeds p.r.n.		
7½	1 dr.	Half-strength ½ Cr. C. & G. Special	Formula (Full Strength)		
8½	2 dr.	do.	½ Cr. C. & G. Special ..	2½ dr.	
9½	3 dr.	do.	Dextrimaltose ..	1 dr.	
12	4 dr.	Full-strength ½ Cr. C. & G. Special formula	Water ..	2½ oz.	
13½	6 dr.	do.	Lactic Acid (B.P.) ..	10 drops	

Breast Feeding: Commence Three and a Half Hours after Operation

Hours after Operation			Hours after Operation		
3½	1 dr.	7.5% glucose in half-strength normal saline	12	6 dr.	Breast milk
4	1 dr.	do.	13½	1 oz.	do.
4½	1 dr.	do.	15½	1 oz.	do.
5	1 dr.	do.	17½	1 oz.	do.
5½	1 dr.	7.5% glucose in half-strength normal saline + ½ dr. breast milk	19½	1 oz.	do.
			21½	1 oz. 2 dr.	do.
			24½	1 oz. 2 dr.	do.
			27½	1½ oz.	do.
			30½	1½ oz.	do.
6½	1 dr.	7.5% glucose in half-strength normal saline + 1 dr. breast milk	33½	1 oz. 6 dr.	do.
			36½	1 oz. 6 dr.	do.
			39½	2 oz.	do.
7½	1 dr.	do.	Then six or seven feeds three-hourly. Baby put to breast if condition allows two to three days after operation.		
9	3 dr.	Breast milk			
10½	4 dr.	do.			

Summary

A series of 100 consecutive operations on breast-fed infants for pyloric stenosis is reported without a death.

A similar series of 46 operations on bottle-fed infants resulted in 5 deaths, all from gastro-enteritis.

The practical implications of these results are discussed, and it is pointed out that statistics comparing medical and surgical treatment of pyloric stenosis are worthless unless accompanied by information as to the method of feeding.

I should like to thank the physicians at the Infants Hospital for allowing me to publish the records of the patients admitted under their care.

Stockholm has a scheme for collecting and distributing mother's milk for sick children. At a special centre at the principal milk distributing company nursing mothers who have more milk than their children require are examined free of charge by a physician, including x-ray examination of the lungs, blood tests, etc., and are supplied with sterilized bottles into which the milk is pressed directly from the breast. The milk is paid for at the rate of 4 kronor (4s.) a litre and as little as 1/4 litre or even less a day is accepted. The bottle is left at the nearest of the milk company's shops and taken by the company to the centre, where the contents are examined, pasteurized, and then placed in refrigerators.