A Comparative Study of Experimentally Produced Dumping Syndrome After Billroth I and Billroth II Partial Gastrectomy *

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Introduction

THE comparative incidence and severity of the dumping syndrome (weakness, sweating, drowsiness, dizziness, and/or diarrhea occurring during a meal or within an hour after the meal) following Billroth I and Billroth II types of partial gastrectomy has been a controversial subject in the literature. While many authors have reported a lower incidence of the dumping syndrome after the Billroth I type gastrectomy, others have been of the opinion that the over-all incidence of the dumping syndrome is essentially the same after either type of partial gastrectomy but that possibly the severity of dumping may be somewhat less after the Billroth I operation.

To obtain further information concerning this controversial subject a comparative study of experimentally produced dumping syndrome after Billroth I and Billroth II partial gastrectomy was made based on the observation of Machella [2] that the dumping syndrome can be reproduced experimentally in partially gastrectomized subjects by the oral administration of hypertonic solutions and the observation of Roberts *et al.*[3, 4] that an acute drop in circulating plasma volume is an etiologic factor in the production of the dumping syndrome.

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Method

Nine patients were studied following Billroth I partial gastrectomy and 12 patients were studied after Billroth II partial gastrectomy. The duration of time between surgery and experimental study varied from two months to 36 months in the Billroth I group (average—eight months) and from two months to 36 months in the Billroth II group (average—18 months). The estimated extent of gastric resection was 75 per cent for all patients. (All but a few of the subjects were operated on the senior author's service where the extent of gastric resection is routinely estimated by objective methods.) A standard stomal length of 4 cm. was utilized in both the Billroth I and Billroth II series.

The experimental studies were performed with the subjects in a sitting-up position since it is well known that the symptomatology of the dumping syndrome is usually considerably less in the recumbent position. One hundred fifty cc. of 50 per cent glucose was administered orally to each subject after an overnight fast.

Serial changes in plasma volume were determined with I^{131} human serum albumin using the method previously described by the authors and their associates.[1] (This method compares changes in plasma volume without reference to absolute plasma

TABLE 1. *Comparison of Dumping Syndrome After Billroth I and Billroth II Partial Gastrectomy*

Subject	Age (years)	Height (inches)	Clinical: Symptoms of Dumping	Clinical: Severity	Experimental: Symptoms of Dumping	Experimental: Max. Per Cent Decrease of Plasma Volume	Experimental: Interval Since Surgery (months)
Billroth I Partial Gastrectomy							
1. G. M.	36	70	Sweating	Mild	Drowsiness Sweating	7.1	6
2. R. N.	30	69	Sweating Weakness	Severe	Sweating Weakness Abdominal cramps Urge to defecate	8.3	2
3. F. W.	42	67	Sweating	Mild	Drowsiness Weakness	10.0	6
4. J. W.	22	68	Sweating	Mild	Dizziness Drowsiness Weakness	10.0	7
5. T. W.	51	67	None	—	Drowsiness Weakness	10.0	6
6. J. L.	61	68	Sweating Weakness	Mild	Sweating Weakness Abdominal cramps Urge to defecate	10.2	3
7. J. O.	62	70	None	—	Diarrhea Sweating Weakness Syncope Abdominal cramps	10.3	6
8. J. M.	48	71	None	—	Drowsiness Sweating Weakness	11.9	2
9. G. S.	60	70	None	—	Drowsiness	20.4	36
Billroth II Partial Gastrectomy							
1. J. E.	39	71	Sweating	Mild	Sweating	5.3	36
2. R. N.	30	69	Sweating Weakness	Severe	Sweating Weakness Abdominal cramps Urge to defecate	6.2	24
3. A. H.	32	71	Diarrhea Weakness	Mild	Dizziness Drowsiness Sweating Urge to defecate	6.9	27
4. C. M.	46	70	None	—	Sweating Weakness	7.2	2
5. S. J.	48	70	Diarrhea Sweating Weakness	Severe	Sweating Weakness Urge to defecate	7.8	2
6. A. J.	65	69	Sweating Weakness	Mild	Sweating Weakness Abdominal cramps Urge to defecate	8.6	3
7. E. R.	38	68	Diarrhea Sweating	Moderate	Drowsiness Sweating Weakness	10.5	36
8. R. R.	38	69	Sweating Weakness	Moderate	Weakness Syncope	11.3	36
9. W. R.	37	74	Diarrhea Sweating	Severe	Weakness Abdominal cramps	11.5	24
10. W. P.	38	76	Diarrhea Drowsiness Sweating	Moderate	Sweating Weakness Abdominal cramps Urge to defecate	13.2	5
11. F. K.	27	69	Diarrhea Sweating	Mild	Drowsiness Sweating Urge to defecate	14.3	3
12. J. S.	40	69	Sweating Weakness	Severe	Drowsiness Sweating Weakness Syncope	21.7	24

Moderate Dumping = Patient lies down after meal to relieve symptoms.
Severe Dumping = Incapacitating for work.

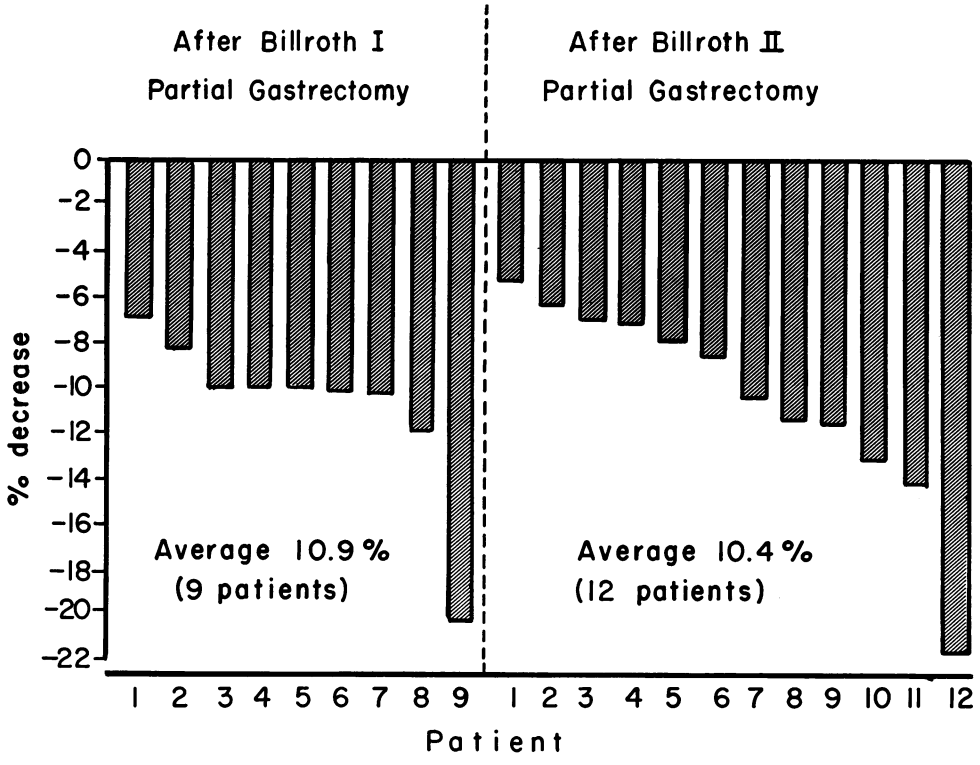

FIG. 1. Maximal plasma volume decrease in experimentally produced dumping syndrome.

volume values and consequently, in our opinion, is not so susceptible to possible compounding of the error intrinsic in determining absolute plasma volumes.)

Results

The pertinent clinical data and experimental results noted in these studies are summarized in Table 1. The maximal plasma volume decrease noted in each subject is graphically represented in Figure 1.

Incidence and Severity of Dumping Syndrome Present Clinically: At least minimal symptoms of the dumping syndrome were present clinically in response to the patient's usual dietary regimen in five of the nine Billroth I subjects (four mild and one severe) and in 11 of 12 Billroth II subjects (four mild, three moderate and four severe). (The symptoms were classified as moderate if the patient found it necessary to lie down after meals in order to relieve the symptoms and as severe if there was significant loss of time from work because of the dumping syndrome. Obviously, this latter classification is also dependent upon a number of psychological factors among which are the desire and necessity to work.)

Incidence and Severity of Experimentally Produced Dumping Syndrome: Oral administration of the hypertonic glucose solution produced symptoms of the dumping syndrome in all of the gastrectomized patients studied regardless of whether or not the dumping syndrome was present clinically in response to the patients usual dietary regimen. However, in three of the five subjects in whom the dumping syndrome was not present clinically the experimentally produced dumping symptoms were mild (Billroth I subjects 5 and 9 and Billroth II subject 4). The symptomatology of the dumping syndrome which was produced experimentally was judged to be

severe in seven of the nine Billroth I subjects and in ten of the 12 Billroth II subjects. Thus, extreme drowsiness verging on somnus, extreme weakness progressing to syncope in some patients, abdominal cramps, urge to defecate, and diarrhea commonly occurred in response to the hypertonic test solution. In only one subject who had even mild clinical symptoms of the dumping syndrome were the experimentally produced symptoms not severe (Billroth II subject 1). In general the dumping symptoms produced experimentally were considerably more severe than those observed clinically in response to the ingestion of a meal. The severity of the dumping symptoms produced suggests that the hypertonic solution used (150 cc. of 50 per cent glucose) was an extreme and possibly unphysiologic stimulus for the production of the dumping syndrome.

Percentage Plasma Volume Decrease (Billroth I vs Billroth II.): No significant difference was noted experimentally between the average percentage plasma volume decrease in the Billroth I group and the Billroth II group. (We had anticipated that a lesser plasma volume decrease might occur with the Billroth I group.) It is interesting to note that subject R. N. who had severe clinical symptoms of the dumping syndrome and severe symptoms of experimentally produced dumping syndrome with a plasma volume decrease of 6.2 per cent after a Billroth II partial gastrectomy had comparably severe clinical and experimental symptoms of dumping with a plasma volume decrease of 8.3 per cent after he had been converted to a Billroth I type partial gastrectomy.

Correlation Between Magnitude of Plasma Volume Decrease and Severity of Dumping Syndrome: Some inconsistency was noted between the magnitude of the plasma volume decrease observed experimentally and the severity of the dumping syndrome produced experimentally or present clinically. For example, Billroth I subject 9 who had no clinical symptoms of the dumping syndrome and did not have severe symptoms of dumping experimentally had by far the greatest plasma volume decrease in the Billroth I group (20.4 per cent).

The percentage plasma volume decreases noted in four patients in whom only mild dumping symptoms were produced experimentally were 5.3 per cent, 7.2 per cent, 10.0 per cent, and 20.4 per cent. (In three of these patients no dumping symptoms were present clinically and in the other patient only mild symptoms were present clinically.) The percentage plasma volume decreases in the other 17 patients in whom severe dumping symptoms were produced experimentally ranged from 6.2 per cent to 21.7 per cent. However, within this latter group there did not appear to be any consistent, clear-cut, correlation between the magnitude of the percentage plasma volume decrease and the severity of the dumping symptoms present clinically or produced experimentally.

This lack of complete correlation between the magnitude of plasma volume decrease and the severity of the dumping symptoms may indicate, as Webber *et al.*[6] have recently suggested, that the fall in plasma volume is not an important factor in the etiology of the dumping syndrome. On the other hand, the inconsistency may only be indicative of some individual variability in the sensitiveness of the sympathetic system to the stimulation of acute decreases in plasma volume. The observation of Walker *et al.*[5] that the infusion of a plasma volume expander prevents the development of the dumping syndrome in response to the ingestion of hypertonic solutions supports the view that an acute decrease in plasma volume is an important factor in the etiology of the dumping syndrome.

Conclusions

1. A comparative study was made of experimentally produced dumping syndrome

after Billroth I and Billroth II partial gastrectomy.

2. Oral administration of 150 cc. of 50 per cent glucose solution produced dumping symptoms in all of the patients studied regardless of whether or not the dumping syndrome was present clinically. In general, the dumping symptoms produced experimentally were considerably more severe than those observed clinically in response to the ingestion of a meal.

3. No significant difference was noted experimentally between average plasma volume decrease in the Billroth I group and the Billroth II group.

4. There was some inconsistency between the magnitude of the plasma volume decrease observed experimentally and the severity of the dumping syndrome produced experimentally or present clinically.

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