Bacteriological Study in Stomach- and Intestinal-operation

By

Shinichi Shida

(志田 信一)

(From Prof. M. Muto's Surgical Clinic, Faculty of Medicine,
Tohoku University, Sendai)

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Succeeding Ushigome's work,¹⁾²⁾ I have undertaken bacteriological researches in 88 gastric operations (56 gastric cancers and 32 gastro-duodenal ulcers) and 62 intestinal operations. Though most of the results on gastric operations by Ushigome were obtained by the method of Billroth II, herein are presented the results of gastric operations, comparing Billroth I and Billroth II cases to supplement Ushigome's report, and the intestinal operations, not touched upon by Ushigome.

Methods and Judgment; See Ushigome's report.

I. Results of the Examination of Gastric and Intestinal Contents and the Suture Layers of the Anastomosis in Both Billroth I and II Cases

Gastric cancer cases

56 cases of gastric cancer were divided into two groups; the first consisted of 28 cases having gastric resection by the method of Billroth I (25 gastro-duodenostomies and 3 oesophago-duodenostomies with total gastric resection), and the second of 28 cases having gastric resection by the method of Billroth II (22 gastro-jejunostomies, 1 oesophago-jejunostomy with total gastric resection and 5 simple gastro-enterostomies). In the first group, the two suture layer method was adopted and in the second group, the three suture layer method was adopted as described in Ushigome's report.

In gastric and intestinal contents at the place of anastomosis there was no significant difference in percentage of positive cultures, and kinds and quantity of microorganisms in Billroth II and I cases.

In the contents of jejunum in Billroth II group no microorganisms were detected in 2 cases but some appeared in 26 cases (92.8%), in which 19 cases (67.8%) yielded positive plate-cultures and 7 (25.0%) of positive broth-cultures. *B. coli* were cultured positively in 17 cases (60.7%) and

13 of them (46.4%) were plate-positive. In about half of the cases with more than two kinds of organisms in a culture, *B. coli* was always detected.

From duodenal contents of Billroth I group, only 1 case showed no microorganisms and the other 27 (96.4%) had some, in which 20 (71.4%) were plate-positive and 7 (25.0%) were broth-positive. *B. coli* was cultured positively in 10 cases (35.7%) and 6 (21.5%) of them were plate-positive. In short, the kinds of microorganisms detected in the upper part of jejunum were analogous to that in duodenum, but *B. coli* in the latter was a little smaller both in the percentage of positive cultures and quantity than in the former.

As for the suture layer of anastomosis, the percentage of positive cultures, and kind and quantity of the organisms detected at the serosa-suture were all reduced in Billroth I and II cases from them at the mucosa-layer. For example from the serosa-suture of Billroth II cases no microorganism was detected in 13, and some organisms were seen in 15 cases (53.6%) and in which 6 (21.5%) were plate-positive and 9 (32.1%) of broth-positive. *B. coli* was detected in 9 cases (32.1%) and 2 (7.2%) of them were plate-positive. From the serosa in Billroth I cases, 10 had no microorganisms detected and 18 (64.3%) had some, in which 8 (28.6%) yielded positive plate-cultures and 10 (35.0%) positive broth-cultures. *B. coli* was detected in 6 cases (21.5%) and 2 (7.2%) of them were plate-positive.

Gastroduodenal ulcer cases

Among the 32 cases of gastroduodenal ulcer, 7 were operated by Billroth I, 19 by Billroth II, 4 by Finsterer's method and 2 had oesophago-jejunosomy after total gastric resection.

Therefore 25 cases except 7 Billroth I group cases were named as Billroth II group.

As the results of examinations gastric contents at the places of anastomosis in 25 Billroth II group cases, 8 had no microorganisms while 17 (68.0%) had some, and *B. coli* was cultured positively in 7 cases (28.0%). Among 7 cases of Billroth I group, 1 showed no microorganism and 6 (85.7%) had some, and *B. coli* was not cultured in any case. Of the intestinal contents of Billroth II group, 8 cases had no microorganisms but 17 (68.0%) had some, and *B. coli* was cultured positively in 5 cases (20.0%). And as for the intestinal contents of Billroth I group, 3 had no microorganism, but 4 (57.1%) had some, and *B. coli* was not detected in any case.

Suture layer: Examination of the serosa suture layer of anastomosis in Billroth II group, revealed 22 cases with no organism, and 3 (13.6%)

with some, but *B. coli* was not detected in any of the cases. In the serosa suture layer in Billroth I group, 5 had no organism, but 2 had some and they were all broth-positive; no *B. coli* were found. The kinds and quantity of microorganisms detected in the serosa suture layer in gastroduodenal ulcer cases were less than those in the mucous layer and the latter was nearly equal to those in the gastric and intestinal contents.

The microorganisms cultured from gastric and intestinal contents and each suture layer of anastomosis showed little difference in their kinds and quantity between Billroth I and II groups both in gastric cancer and ulcers. The most remarkable difference was noticed between the cancer and ulcer cases, as previously noticed by Ushigome. The microorganisms were much less in the ulcer than in the cancer cases and the serosa suture layers of anastomosis in the ulcer cases were very close to the aseptic condition.

II. Results of the Bacteriological Examination at the places of Enterostomies

62 cases of surgical intestinal diseases were examined bacteriologically at the place of enterostomy (29 cases of Braun's anastomosis, 10 of enterostomy, 14 of ileo-colostomy and 9 of colo-colostomy). With the exception of Braun's anastomosis, most of them were cases of intestinal stenosis or obstruction and next were cases of tumor and other kinds of surgical intestinal disease. The kinds and quantities of organisms detected are shown in Table I and II.

Intestinal contents

The intestinal contents of the oral and anal sides of anastomosis were examined separately, but no remarkable difference was seen between them in most cases of all groups. As shown in the Tables, some microorganisms were found in the contents of the upper part of the jejunum at the place of anastomosis and in the small intestine and colon. The percentages of positive cultures of *B. coli* were 79.3–75.8% in the upper part of the jejunum of Braun's anastomosis cases, 80.0% of enterostomies, 71.4% at the lower part of the small intestine, especially in the ileum, and 100% in the colon. Among them the percentage of cases in which lots of colonies were cultured, was 51.7–55.2% in the upper part of the jejunum, 70.0–80.0% in the small intestine, 71.4% in the ileum and 100–88.9% in the colon. Therefore it is clear that *B. coli* increases while other organisms decrease towards the lower part of the intestine and colon.

Suture layer

Bacteriological examinations revealed no marked difference in the

TABLE I
Microorganisms Cultured from Various Locations of
Intestine, when Anastomosis was Effected

Anastomosis	Location examined	No. of cases examined	Positiv Culture No. of cases (%)	B. coli	Strept. viridans	Strept. hemolyticus	Strept. non hemolyticus	B. alcaligenes faecalis	Gram-negative bacilli	Gram-negative diplo-cocci	Gram-negative cocci	Staph. albus	Staph. aureus	Gram-positive bacilli	Gram-positive cocci	Gram-positive diplo-cocci	B. lactium	B. subtilis	Saccharomyces	B. welchii
Braun's Anastomosis	Oral contents	29	29 (100)	23	1	2	2	2	1	0	0	2	0	1	1	2	2	2	2	3
	Anal contents	29	29 (100)	22	2	3	1	1	1	1	1	2	0	3	1	4	2	2	2	2
	I. suture layer	29	28 (96.5)	20	2	3	1	2	0	1	0	2	0	2	0	3	1	3	1	0
	Serosa suture layer	29	14 (48.2)	11	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1	0
Entero-enterostomy	Oral contents	10	10 (100)	8	0	0	0	0	1	0	0	0	1	1	2	1	1	2	0	0
	Anal contents	10	10 (100)	8	0	0	0	0	1	1	0	0	0	2	3	1	0	2	0	0
	I. suture layer	10	9 (90.0)	6	0	0	0	0	0	0	0	0	1	2	1	1	1	1	0	0
	Serosa suture layer	10	7 (70.0)	4	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0
Ileocolostomy	Oral contents	14	14 (100)	10	0	1	0	0	2	0	0	2	0	3	1	3	1	0	2	2
	Anal contents	14	14 (100)	13	0	1	0	0	2	1	0	2	0	4	1	3	1	0	1	1
	I. suture layer	14	14 (100)	12	0	1	0	0	2	1	0	2	0	3	0	2	1	0	0	1
	II. or III. suture layer	14	12 (85.7)	10	0	0	0	0	0	1	0	1	0	0	0	1	1	0	0	0
Colocolostomy	Oral contents	9	9 (100)	9	0	0	1	0	0	1	1	0	0	1	0	2	0	0	0	0
	Anal contents	9	9 (100)	9	0	0	0	0	0	1	1	1	0	1	0	1	1	0	0	0
	I. suture layer	9	9 (100)	9	0	0	1	0	0	1	1	0	0	1	0	0	0	0	0	0
	II. or III. suture layer	9	8 (88.9)	7	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0

quantity and kinds of organisms detected between the mucous suture layer and the intestinal contents at each part. But they were fewer at the serosa suture layers than at the mucous suture layers. The microorganisms in the serosa suture layers were 48.2% of Braun's anastomosis cases, 70.0% of enterostomies, 85.7% of ileo-colostomies and 88.9% of colo-colostomies. The percentages of positive culture of *B. coli* at the serosa were 37.5% in Braun's anastomosis cases, 40.0% in entero-enterostomies, 71.4% in ileo-colostomies and 55.6% in colo-colostomies. Therefore the aseptic cases at the serosa decreased at the lower part.

III. The Bacteriological Examinations and its Bearing on the Results of Operations

Peritonitis caused by imperfect suture was found in 3 cases, namely in the gastric cancers resected by Billroth I and in 1 case of gastric cancer having colo-colostomy after resection of the stomach and colon transversum. To compare the quantity of organisms detected at the serosa suture layers and the percentage of peritonitis due to imperfect suture, the cases were divided into 1) Plate-positive group, in which many micro-

TABLE II
Quantitive Observations of Microorganisms Cultured from
Various Locations of Intestine, when Anastomosis was Effected

Anastomosis	Location examined	No. of cases examined	Number of cases of					
			Cutures			Colonies on plates		
			Sterile	Broth-positiv	Plate-positiv	Scanty	Mod-erate	Fairly abundant
Braun's anastomosis	Oral contents	29	0 (1)	4 (1)	25 (22)	2 (1)	3 (4)	3 (2)
	Anal contents	29	0 (7)	4 (0)	25 (22)	0 (1)	6 (4)	2 (1)
	I. suture layer	29	1 (8)	6 (0)	22 (20)	6 (6)	10 (9)	3 (3)
	II. suture layer	29	15 (3)	6 (3)	8 (8)	3 (3)	4 (4)	1 (1)
Enterostomy	Oral contents	10	0 (2)	1 (0)	9 (8)	1 (1)	0 (0)	0 (0)
	Anal contents	10	0 (2)	1 (0)	9 (8)	1 (0)	0 (0)	0 (0)
	I. suture layer	10	1 (3)	2 (1)	7 (5)	1 (1)	0 (0)	1 (1)
	II. suture layer	10	3 (3)	2 (1)	5 (3)	1 (0)	2 (1)	0 (0)
Ileocolostomy	Oral contents	14	0 (4)	1 (0)	13 (10)	0 (0)	0 (0)	1 (0)
	Anal contents	14	0 (1)	1 (1)	13 (12)	0 (0)	0 (2)	0 (0)
	I. suture layer	14	0 (2)	1 (0)	13 (12)	0 (2)	4 (1)	3 (3)
	II. or III. suture layer	14	2 (2)	1 (1)	11 (9)	5 (4)	2 (2)	1 (1)
Colocolostomy	Oral contents	9	0 (0)	0 (0)	9 (9)	0 (0)	0 (0)	0 (0)
	Anal contents	9	0 (0)	0 (0)	9 (9)	0 (0)	1 (1)	0 (0)
	I. suture layer	9	0 (0)	0 (0)	9 (9)	0 (0)	1 (1)	3 (3)
	II. or III. suture layer	9	1 (2)	3 (2)	5 (3)	2 (2)	3 (3)	0 (0)

organisms were detected and into 2) Aseptic or Broth-positive group in which the organisms were few. The result is that 17 cases of gastro-enterostomy belonged to 1) Group and 72 to 2) Group.

In each group, 1 case of imperfect suture was found. As for bowel cases, 21 of enterostomy or colo-colostomy except those of Braun's anastomosis belonged to the Plate-positive group and 12 to the Aseptic or Broth-positive group. Among them only 1 case of imperfect suture was seen in the Plate-positive group. So, there is no particular relationship between the imperfect suture and quantity of organisms detected at its suture layers. As for the relationship between the kind of organisms and imperfect suture, 1 case of imperfect suture (Gastro-duodenal anastomosis) yielded a positive broth-culture of *Streptococcus hemolyticus*, and another (Gastro-duodenal anastomosis) yielded a positive plate-culture of Gram negative *Diplococcus*, and 1 case of imperfect suture for colonanastomosis yielded a positive plate-culture of *B. coli*, but the relation between the kind of organisms and imperfect suture is not so important because there are many cases having these kinds of organisms which recovered favourably. .

SUMMARY

1. No remarkable difference was found between Billroth I and II groups concerning microorganisms detected in the gastric and duodenal or intestinal contents or from each suture layers of anastomosis after gastric resection in gastric cancer and ulcer.

2. As for the microorganisms cultured from contents at enterostomy and ileo-colostomy, they increased in kinds but decreased in quantity in the upper part of the intestine, while they became fewer in kind in the lower part of the intestine and *B. coli* increased towards the lower part. *B. coli* was cultured in all cases from the colic contents.

3. No intimate relation was found between the imperfect suture and the organisms detected at the anastomosis, although 3 cases of suture deficiency were seen in all of the cases and the imperfect suture might be caused by some other factors.

References

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 - 2) Ushigome, Tohoku J. Exp. Med., 1952, **56**, 373.
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