Progress in Surgery

Editors: M. Allgöwer (Basel), S.-E. Bergentz (Malmö), R.Y. Calne (Cambridge) and U.F. Gruber (Basel)

Vol. 14

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M. Allgöwer, Basel – S.E. Bergentz, Malmö – R.Y. Calne, Cambridge (GB) – U.F. Gruber, Basel

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	The Obese Patient at the Time of Surgery
51	Social Disturbances
	Somatic Disturbances.
	Psychic Disturbances
	Indications and Contraindications for Surgery
Table of Contents	The Operation
	In-Hospital Morbidity and Mortality
	Complications and Signs of Metabolic Aberrations
	Completations and signs of sectations Apertations Results
	Summary
77	References
Highly Selective Vagotomy	Priorities in the Management of the Pa J.R. Border, J. La Duca and R. Seibel, Buffa
David Johnston, Leeds	J. R. BORDER, J. LA DUCA and R. SEBEL, Buffa
Thtroduction	Ventilation Incusion
HSV Definition and Pationale	Influsion Messive Blood Lus
Operative Technique	Massive Blood Loss
Manning the Antrum	General Considerations::::::::::::::::::::::::::::::::::::
Clinical Possits of HSV	
Operative Mortelity Lesser Curve l	
Side Effects of Costrie Support	Necrosis, and Post-Operative Complications 13
Side-Effects of Gastric Surgery	15 General Considerations
Recurrent Ulceration	16 The Monnal Relationship; Cardine Outpur a
Long-Term Metabolic Problems	19 / united ar Dutflow Obstructions / 19
	r Evaluating Operations for Peptic Ulcer 20
Perforation, Haemorrhage, and Pyloric S	tenosis Danagame Tenescure Tamponade sisones
Gastric Ulcer	Ventricular West
Physiological Assessment of HSV	27 Valvatar Disorders
e Serum Gastrin	
Gastric Secretion	P&fnonary Failure
Gastric Motility and Accommodation	36 General Considerations noisnated on no
Gastric Emptying	33 Machanisms
80 Biliary Tract	34 Regional Hypoventilation
	35 Perfused Mon-Ventilated Afrechi
Faecal Fat Excretion	36 Progression of Treatment
Summary and Conclusions	R 36al Failure
References	R86ew Orecon Feilure
104	Emergency Management
104	
	Subsequent Emergency Room Management.
Surgical Treatment of Obesity	Operating Room
D. HALLBERG, L. BACKMAN and S. E.	Operating Room mloddoot , AARMAR
To #Albustion	Right Ventricle Failure-Hepatic Dysfunction
Historical Remarks	Tost Energy Consumption

Table of Contents	VI
The Obese Patient at the Time of Surgery	51
Social Disturbances	51
Somatic Disturbances	52
Psychic Disturbances	53
	54
Indications and Contraindications for Surgery	55
Kinetics of Weight Loss after Operation	59
In-Hospital Morbidity and Mortality	61
Complications and Signs of Metabolic Aberrations and their Management	63
Results	74
Summary	76
References	77
References	, ,
Priorities in the Management of the Patient with Polytrauma	
J. R. BORDER, J. LADUCA and R. SEIBEL, Buffalo, N.Y.	
Ventilation	87
Infusion	88
Massive Blood Loss	88
General Considerations	88
Mapping the Antrum Intraperitoneal-Retroperitoneal	89
Extremity Vascular Injuries Operative Mortalif Lesser Curve Necresis, and Post-Operative Complete Gundant Gun	91
Pump Failure Monailly, Lesser Cerve Infectoris, and Post-Operative Compiler	92
Side-Effects of Gastrie Surgery another Schere General Considerations	92
The Normal Relationship: Cardiac Output and Pressure:	92
Ventricular Outflow Obstruction	93
Right Ventricle Outflow Obstruction and Cardiac Output	93
Extraventricular Pressure Tamponade Stenost Stenost and Properties Uter	94
Ventricular Wall	95
Ventricular Wall Yalvular Disorders Valvular Disorders Valvular Disorders	96
Serum Gastrin.	96
Castric Secretion.	97
Pulmonary Failure	97
Gastric Emptying 33	98
Regional Hypoventilation	98
Perfused Non-Ventilated Alveoli	101
Faecal Fat Excretion Progression of Treatment 36	102
Renal Failure	102
Review Organ Failure	neeto 4
Emergency Management	
Initial	
Subsequent Emergency Room Management	
Operating Room	106
Intensive Care Unit Care	
Right Ventricle Failure-Hepatic Dysfunction	
Total Energy Consumption	111

IJΨ	Table of Contents		VII
w	vention of Infection	schanisms of Freezing La	440
Pre	General Problem of Infection	alogical Effects of Cryose	
	General Problem of Infection	nicat Application	112
er.	Surgical Wound Infections	guaga, Taga	113
44	Accidental Wound Infection	on 9 foir loffing M one fo	114
	Infection in the previously Closed Wound	the comment	115
	Pneumonia	Y 100 HD COMPANY	116
	Bladder and Renal Infection		117
	General Considerations on Systemic Infection		
Psy	chological Management		118
Ref	erences	yonacmorroidectomy	119
		SHOUSDEDEL TOO	
	Traumatic Surgery	ture of Cryosungery	114
iel .	WILLIAM H. RUTHERFORD, Belfast	Гетелоез	271
Intr	roduction	Transmirthed Reco	122
	nshot Wounds of the Head		
O u.	Ballistics		
	Dath achief alassi	roduction	122
	Time Factor	Jones Considerations	124
	Resuscitation Prognostic Signs Repair of the Skull Defect	thor's Experience with I	124
16	Prognostic Science Schedule and Leastmont Schedule	ттеорегацуе Езасира	125
	Repair of the Skull Defect	Surgical Equipment.	125
16.	Preparations during First Operation	Surgecal Fechnique	126
Du	Preparations during First Operation	asiderations on Subgice!	126
-OI	Ballistic Details	gation Fluid and Tilk S	126
	Injuries to Different Tiennes and Organs	IK versus Open Adenom	127
Do	Injuries to Different Tissues and Organs	nsideral ans on Differen	128
DOI	Physics of the Blast	поредилуе Опранов	24 (11)
	Instantiate Communication	mplications after TER	128 129
17.	Immediate Symptoms Damage to the Ear Drums	oses of Operation for Pro	129
			mrd St
174	Inner Ear		130
	Vertigo		
	Pathology	Terministration Poer	
Ho	spital Organisation for Disasters		130
	Command Structure		131
	Keeping as Close to Normal Routines as Possible		
177	Triage		131
TI.	Teams Rehearsals Rehearsals	oberative Examination a	132
47.1			132
Co	nclusion	wickly technique	133
Bib	liography	W versus Unen Adendre	133
	e in Results of TUR and Open Operations	nsiderations on Difference	Cor
18-	Cryosurgery		
81 -	JAMES FRASER, Southampton	nelusions	Cor
TI.	story		
	vsical Properties	er Vels 1–13	
ംല	VNICAL FLODEFILES		1 4X

ΗV	Table of Contents	V Table of Contents	III
M	lechanisms of Freezing Injury	Leventian of trafeenon	41
В	iological Effects of Cryosurgery		43
C	linical Application	1 Surgiced Wound Infections	48
Si	urface Tumours		49
0	ral and Maxillofacial Regions		52
N	eurosurgery	1 . Pacquagata	54
			55
0	phthalmology		56
G	ynaecology		56
			57
F	uture of Cryosurgery		57
R	eferences	Tabellahe Surgery William H. Rutherford, Belfast	58
122	Transurethral Resection of Benig	gn Enlargement of Prostatic Gland	
	KARL OLA OBRANT, Helsingborg	Junshot Wounds of the Head	
123		Ballishes 1 Pathophysiology	-
lr.	itroduction	Pathophysiology.	60
H	istorical Considerations	1 Time Factor (QUE)	61
A		ectroresection (TUR)	
125		nent Schedule 1	
125	Surgical Technique	the pair of the stant Defect.	63
26	Surgical Technique		
T	rightion Eluid and TUD Syndrome	mander 19dds }	64
٠ <u>+</u>	IID versus Open Adenomestamy	1 Bullisher Dendits	66
1	ansiderations on Difference in Besults of	TUR and 'Open' Operations 1	68
D	ostoperative Urination		70
C	omplications after TUP		70
C	hoice of Operation for Prostatic Enlarger	nent	72
S	immary		74
D	eferences		74
06.1	elelences		/4
130	To an analysis I Borneting of Borne	Pathology	
130	Transureinral Resection of Prost	atic Adenoma in Basel	
131		Command Structure thand	
		Keeping as Close to Normal Routines as	
In	stroduction	sgari I	76
Pı	reoperative Examination and Treatment S		77
E	quipment	Refreatsels	78
Si	urgical Technique	onerusion abtioversonv	80
T	UR versus Open Adenomectomy	Vadanski pas	82
			83
	omplications after TUR		84
		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	86
		1	
	dex Vols 1–13	distory	

Prog. Surg., vol. 14, pp. 1-45 (Karger, Basel 1975) gastric emptying. The muscular bag has two principal functions. Firstly, it acts as a reservoir or 'hopper', which receives, and holds the meal by means of receptive relaxation andymotography Selective Vagotomy and Highly Selective Vagotomy and fundus. Secondly, it 'mills' and grinds solid food into smooth chyme, DAVID JOHNSTON CONTROL OF THE STATE OF Of Soil University Department of Surgery, The General Infirmary, Leeds Soil 1288 Soil 1 the function of the mill is the terminal antral contraction, which permits the stomach to discriminate between solids and tiquids, liquid chyme passing onwards, while solid particles are actively retropelled of body of the stemach to undergo further triturition [Cart.son et al., 196 Emptying of a meal from the stomach is gradual and orderly being con HSV - Definition and Rationale Ololy 11 The Self Vo STREET SELECTION OF THE DELIC vistayMapping the Antrum in Tarabouth 1707, mouratago, brahgatz, edi. II A... 12 Clinical Results of HSV Operative Mortality, Lesser Curve Necrosis, and Post-Operative Complications . 13 Recurrent Ulceration ... 16 A Scoring System (Therapeutic Index) for Evaluating Operations for Peptic Ulcer 20 Perforation, Haemorrhage, and Pyloric Stenosis Serum Gastrin Description and aller research and aller research meals are greater than aller research radio Gastric Secretion 171289, atalgano yanotogay funditw. floamota and 128 heby Gastric Motility and Accommodation to Distension Att. V. 271, 202, 20. 100, JUL 33 Faecal Fat Excretion 18th Marie SRI 228qVd 10 VOITED 1510 Mings of 101V 36 Summary and Conclusions 36 References non. in T. Alarmi. A. Dunidanni dorrunz ed. robaer haz. colta 38 in the course of truncal vagotomy (TV) the parasympathetic nerve supply to the biliary tract, pancreas, small intestine and much of noticuborinfestine is also severed. It is perhaps small wonder that the clinical achieven

The stomach is first and foremost a muscular bag, which is equipped with a sphincter at either end. The cardiac sphincter prevents reflux of

¹ A full account and explanation of the section on the scoring system is in press, to be published in Gastroenterology.

JOHNSTON 2

gastric content into the oesophagus. The pyloric sphincter prevents reflux of duodenal content into the stomach and also assists in the regulation of gastric emptying. The muscular bag has two principal functions. Firstly, it acts as a reservoir or 'hopper', which receives and holds the meal by means of receptive relaxation and accommodation to distension in the body and fundus. Secondly, it 'mills' and grinds solid food into smooth chyme, which will be suitable for digestion and absorption in the small intestine. The gastric antrum is the mill of the stomach. Of central importance to the function of the mill is the terminal antral contraction, which permits the stomach to discriminate between solids and liquids, liquid chyme passing onwards, while solid particles are actively retropelled into the body of the stomach to undergo further triturition [CARLSON et al., 1966]. Emptying of a meal from the stomach is gradual and orderly, being controlled in large measure by the antropyloroduodenal segment, which is itself under the control of nerves and hormones.

All the standard operations for duodenal ulcer destroy or severely impair these principal functions of the stomach. Partial gastrectomy removes the pyloric sphincter, the antral mill and much of the body of the stomach, so that capacity for food is diminished, the meal leaves the stomach in a poorly regulated manner and bile is able to regurgitate freely into the gastric remnant. Vagotomy combined with antrectomy (V-A) has similar disadvantages: although more of the stomach remains, the accompanying vagal denervation impairs accommodation to distension, so that capacity for meals may be little greater than after resection of two thirds of the stomach without vagotomy. Complete gastric vagotomy, whether truncal or selective, with a drainage procedure (V-D), has been regarded in the past as a conservative operation because, it was said, it 'preserves the gastric reservoir'. What V-D does in fact is to destroy or bypass the pyloric sphincter, destroy or bypass the terminal antral contraction, cut the motor nerve supply to the antral mill, elevate serum gastrin concentration, and render the stomach incontinent of liquids. For good measure, in the course of truncal vagotomy (TV) the parasympathetic nerve supply to the biliary tract, pancreas, small intestine and much of the large intestine is also severed. It is perhaps small wonder that the clinical achievements of this 'conservative' operation have been so modest [Goligher et al., 1968a, b; Cox, 1968; Jordan and Condon, 1970; Postlethwait, 1973; JORDAN, 1974a].

Vagal denervation of the extragastric viscera, while technically convenient, was always patently illogical and unnecessary. Today there is much

evidence that vagal denervation of the antral mill (which is alkaline, not acid) is also unnecessary, and that destruction of the terminal antrum and pylorus with all their intricate mechanisms is equally unnecessary. In the past, the antral mill was always vagally denervated 'to cut down gastrin release'. Since the advent of radioimmunoassay of gastrin, however, it has been found that vagal denervation of the antrum does not reduce circulating gastrin levels: in fact, after TV or selective vagotomy (SV) gastrin levels increase significantly. If, on the other hand, the antrum is left innervated, but the parietal cell mass is vagally denervated, circulating levels of gastrin are no higher than after TV or SV. Hence, for the first time in the 90-year history of surgery for ulcer, there is reason to believe that the antrum, pylorus and duodenum can be left completely intact, that vagal denervation can be confined to the acid-secreting part of the stomach, the parietal cell mass, and that none of the stomach needs to be resected. The clinical significance of this is that peptic ulcers can now probably be cured with less risk to life, fewer side-effects and fewer long-term metabolic sequelae than ever was possible in the past. Such is the potential of highly selective vagotomy (HSV) without a drainage procedure, which was introduced into clinical practice in Leeds and Copenhagen 6 years ago [JOHNSTON and WILKINSON, 1970; AMDRUP and JENSEN, 1970]. In this review, HSV is compared with the standard operations for ulcer, at the physiological and clinical level.

HSV - Definition and Rationale

Definition. In HSV, only the acid-secreting part of the stomach, the parietal cell mass, is denervated [Griffith and Harkins, 1957; Amdrup and Griffith, 1969]. The main parasympathetic nerve supply to the antral mill via the nerves of Latarjet is preserved and the terminal antrum and pyloric sphincter are left intact. The hepatic and coeliac vagal fibres are also preserved as in the performance of bilateral SV.

Rationale. It is quite clear by now that the results of the standard operations for duodenal ulcer leave considerable room for improvement. For example, in the prospective random trial of partial gastrectomy (PG), truncal vagotomy and antrectomy (TV-A) and truncal vagotomy and gastro-enterostomy (TV-GJ) which was conducted by Goligher et al. [1968a] in Leeds and York, only 70% of patients were found to have achieved a really good clinical result 5–8 years after TV-GJ. The results

JOHNSTON 4

of PG and of TV-A were somewhat better, but were still far from brilliant. Truncal vagotomy and pyloroplasty (TV-P) was subsequently found to yield results which were no better than those of TV-GJ [GOLIGHER et al., 1968a, b; GOLIGHER et al., 1972]. In similar trials, Cox [1968] found no significant difference between the clinical results of TV-GJ and those of PG, while Jordan and Condon [1970], Postlethwait [1973] and Jordan [1974a] found that TV-A gave better overall results than did TV-P. Prospective random trials have vindicated the claims of Griffith [1969] and Burge [1964] that bilateral SV is followed by significantly less diarrhoea than is TV [SAWYERS et al., 1968; KENNEDY et al., 1973], but the overall clinical results after SV-D are disappointingly similar to those of TV-D [MASON et al., 1968; KENNEDY et al., 1973]. Finally, long-term follow-up of patients after TV-D indicates that loss of weight and irondeficiency anaemia are common sequelae [Dellipiani et al., 1969; Wheldon et al., 1970], and that the incidence of pulmonary tuberculosis may be as high as 7% [WHELDON et al., 1970]. These nutritional problems were found to be most severe in patients who had low levels of acid secretion after vagotomy and were least common in patients with incomplete vagotomy [WHELDON et al., 1970]. The results of V-D have thus proved disappointing. There is no evidence that V-D produces better clinical results than does V-A or PG. Its main advantage compared with these operations is that it is somewhat safer in the hands of relatively inexperienced surgeons.

It was clear that V-D, V-A and PG shared a common defect. Each of these operations destroys the normal mechanism whereby gastric emptying is regulated, so that side-effects such as dumping and diarrhoea become inevitable. It seemed to me that the results of surgery for duodenal ulcer would improve significantly if the terminal antrum and pyloric sphincter could be kept intact. This led to the formulation of the three main concepts or hypotheses upon which HSV is based:

- (1) Side-effects of gastric surgery will be minimised if well-controlled gastric emptying can be achieved through an intact pylorus. If this is to happen, preservation of the vagal nerve supply to the gastric antrum is essential.
- (2) The gastric antrum can be left innervated with impunity. Provided that it remains in the 'acid stream', it will not release excessive amounts of gastrin.
- (3) A vagotomy which is confined to the parietal cell mass preserves protective and inhibitory mechanisms which are sacrificed by TV-D.

These concepts have been discussed at length in previous publications

[Johnston and Wilkinson, 1970; Johnston et al., 1971; Johnston, 1974]. The fundamental change from orthodox thinking was the hypothesis that the vagally innervated antrum would not release excessive amounts of gastrin, provided that it remained exposed to the inhibitory influence of the 'acid stream'. This idea was based upon previous reports that vagal release of gastrin (in dogs) was very difficult to demonstrate when the antrum remained in continuity with the acid stream [Burstall and Schofield, 1953, 1954; Pe Thein and Schofield, 1959]. Also, Olbe [1966] reported that sham feeding released very little gastrin from the antrum in situ. He found that, after antrectomy in Pavlov pouch dogs, only tiny amounts of gastrin (less than one third of the threshold dose) were needed to restore the acid response of the pouch to sham feeding, to pre-antrectomy levels. Thus Olbe's findings suggested that vagal release of gastrin in the dog was relatively unimportant.

makes it esser to reserve. In addition, each of the major vessels entering

the lesser curve on its posterior moset can be

Operative Technique

This has been described in detail elsewhere [Johnston and Wilkinson, 1970; Johnston, 1975]. Little selection of cases for HSV is necessary (vide infra) and the author has treated a virtually consecutive series of patients with duodenal ulcer since January 1969. Thus the presence of very gross ulceration with considerable scarring of the duodenum is not a contraindication to the use of HSV. Addition of a drainage procedure is not required if the patient has been able to eat normally in the intervals between attacks of pain. If, however, he has clinical symptoms and signs of pyloric stenosis, a drainage procedure should probably be added, though for the past 3 years the author has been carrying out a clinical trial in which these patients are treated merely by HSV plus digital dilatation of the stenosis via a gastrotomy [Johnston et al., 1973b]. Of the 25 patients treated in this way, 2 have subsequently required re-operation because of re-stenosis, but it is a remarkable fact that gastric retention did not recur in the remaining 23 patients.

Two assistants are required, one to hold the stomach and the other to retract the liver. Good access to the upper abdomen is obtained by means of a long midline epigastric incision from the xiphoid process to 3–5 cm below the umbilicus. The edges of the wound are retracted by a self-retaining abdominal retractor. Access to the abdominal oesophagus is greatly improved if a metal hook is inserted under the xiphoid notch and

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strong traction exerted towards the head of the operating table [GOLIGHER, 1974]. This upward retraction of the rib cage is rendered more effective if the table is tilted about 15 o head up, which has the added advantage that the other viscera are induced to fall away from the stomach and oesophagus. In order that optimum access to the abdominal oesophagus may be obtained, the left lobe of the liver is next mobilised by division of the left triangular ligament, care being taken to avoid damage to the inferior phrenic vein. The diagnosis of chronic duodenal ulceration is confirmed, the stomach and oesophageal hiatus are assessed carefully, and a full laparotomy is carried out. The next step is to mobilise the distal half of the greater curvature of the stomach by division of the gastrocolic omentum outside the gastroepiploic arcades. The gastroepiploic vessels are preserved so that interference with the stomach's blood supply will be kept to a minimum. Such mobilisation of the greater curve confers the advantage that the posterior nerve of Latarjet can then usually be seen and this of course makes it easier to preserve. In addition, each of the major vessels entering the lesser curve on its posterior aspect can be ligated and divided precisely, close to the stomach, while the nerve is kept in view and thus preserved. Another advantage of this approach is that the stomach, which itself is the main 'retractor' in HSV, is easier to grip and pull upon if part of the greater curvature has been mobilised.

The next step is to identify the anterior nerve of Latarjet, which is usually easy to see as it runs down in the lesser omentum parallel to the lesser curvature and terminates by passing onto the musculature of the antrum 5 or 6 cm from the pylorus. This nerve is constant in position as it runs in company with the descending branch of the left gastric vein (fig. 1, 2). In obese subjects it may be seen more readily if the stomach is put on the stretch by traction on the greater curvature. Dissection begins just proximal to the point where the nerve passes onto the antrum and proceeds upwards along the lesser curvature. The nerve of Latarjet usually terminates in two or three major terminal branches and all of these should be preserved. Thus there is no question of measuring off any arbitrary length such as 6 or 7 cm from the pylorus and beginning the dissection there. What one does is to identify the terminations of the nerve of Latarjet and begin the dissection proximal to them. The blood vessels enter the lesser curvature above the incisura angularis in two main leashes, an anterior and a posterior. These leashes or flaps should be dealt with separately. Dissection begins near the incisura. A curved haemostat is gently insinuated beneath each major vessel, a ligature is passed, seized in the jaws of the



Fig. 1. This shows the anterior nerve of Latarjet, running down parallel to the lesser curvature, close to the vein, and terminating by crossing onto the musculature of the antral region as two major terminal branches. The nerve is fairly constant in position. Both major terminal branches are preserved in the course of HSV, the dissection commencing at the incisura, immediately proximal to the more proximal of the two terminal branches.

haemostat, drawn under the vessel and the vessel is tied in continuity on the lesser omental side and then clamped close to the lesser curvature. The vessel is then divided (fig. 3). This method is felt to be preferable to the application of two haemostats and division of the vessel between them, because it ensures that the vessel cannot slip from a clamp and retract into the fat of the lesser omentum where it cannot be pursued and clamped for fear that the nerves of Latarjet will be damaged. In addition, a haemostat placed on the lesser omental side may inadvertently crush one of the nerves

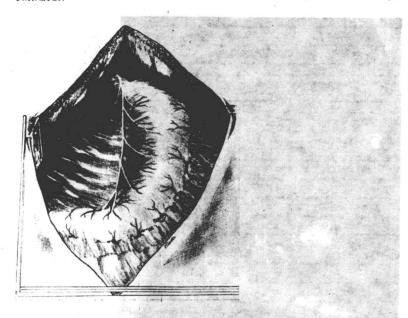


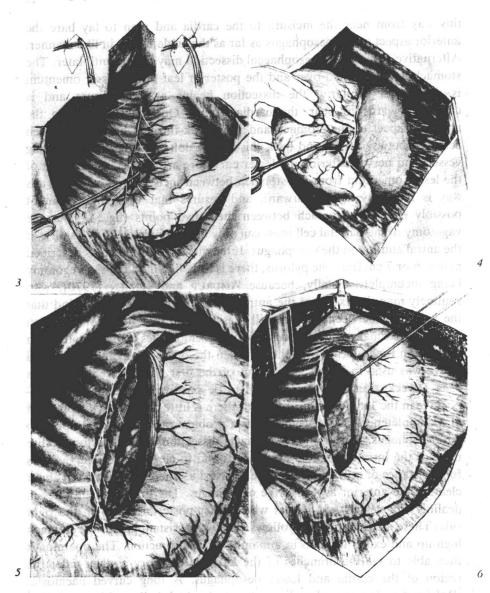
Fig. 2. This shows the anterior vagal trunk giving off hepatic fibres and continuing parallel to the lesser curvature as the anterior nerve of Latarjet. The HSV dissection begins near the incisura just proximal to the two major terminal branches.

of Latarjet or, when lifted up, it may tent up a nerve and cause it to be trapped in the ligature. Each vessel should be ligated individually, because if large bites of tissue are taken the pedicle has a broad base and the ligature is more likely to slip when strong traction is exerted on the stomach during the oesophageal dissection. Loose areolar tissue between the blood vessels is clamped in a haemostat, coagulated with diathermy and then divided. My practice is to divide the anterior leaf of the lesser omentum in

Fig. 3. The HSV dissection has begun at the incisura. The method of ligating vessels in continuity on the omental side is shown. This is done to reduce the chances of the nerve being damaged, or of a vessel slipping from a clamp and causing a haematoma in the fat of the lesser omentum.

Fig. 4. The stomach has been turned over after mobilisation of the distal greater curve, and the posterior leaf of the lesser omentum is divided between incisura and cardia, sparing the posterior nerve of Latarjet, which is shown. The gastroepiploic arcade is preserved, not divided as this picture might suggest.

Fig. 5. The lesser curve has been separated completely from the lesser omentum between incisura and cardia. Note the neurovascular bundle running to the antrum in the free



border of the lesser omentum, and the two leaves of the lesser omentum. Clearance of the oesophagus has begun. Vagotomy can be incomplete only on the oesophagus, or beyond the incisura.

Fig. 6. Traction on the rubber sling improves access to the posterolateral aspects of the oesophagus. Note that the vagal trunks with their hepatic and coeliac branches are swept upwards and to the operator's left, out of harm's way. 5 or 6 cm of oesophagus are cleared of all vessels and nerve fibres.

this way from near the incisura to the cardia and then to lay bare the anterior aspect of the oesophagus as far as the angle of His in like manner. Alternatively, the entire oesophageal dissection may be left until later. The stomach is then turned over and the posterior leaf of the lesser omentum is dealt with similarly: the dissection begins at the incisura and is carried upwards to near the cardia (fig. 4). One then returns to the anterior aspect of the stomach and if a break-through has not yet been achieved between front and back this is now done and the few remaining vessels and nerves entering the lesser curvature are divided. Separation of the lesser omentum from the stomach between incisura and cardia in this way is relatively straightforward, and ensures that vagal fibres cannot possibly enter the stomach between these two points (fig. 5). Thus the vagotomy of the parietal cell mass can only be incomplete either distally, at the antral end, or on the oesophagus. If the dissection is begun as described above, 6 or 7 cm from the pylorus, there is little likelihood of the vagotomy being incomplete distally, because AMDRUP and JENSEN [1970], who routinely map the extent of the antrum at the time of operation, find that the boundary between parietal cell mass and antrum lies 8 or 9 cm on average proximal to the pylorus and very seldom lies more distally than 6 cm from the pylorus. In addition, when the operative method described above was used in Leeds, only 3 out of the first 100 consecutive insulin tests 1 week after HSV were found to be positive and none was earlypositive in the 1st h after insulin. Thus there is little doubt that the problem of incompleteness of the vagotomy is a problem of missed vagal fibres on the oesophagus. During the oesophageal dissection, the aim is to mobilise most of the intra-abdominal oesophagus and to clear it of all nerve fibres for a distance of at least 5 cm above the cardia. There is no problem about clearing the anterior aspect to the oesophagus. The main difficulty lies in dealing with vessels and nerves which enter posteriorly and on the right side. These are dealt with as follows. The first assistant grasps the stomach high up and exerts traction in a mainly vertical direction. The operator is then able to see the branches of the left gastric artery as they enter the region of the cardia and lower oesophagus. A long curved haemostat (Roberts') is then passed under each vessel, which is ligated in continuity. clamped and divided as described above. When the cardia and the lowermost 2 cm or so of the oesophagus have been cleared in this way, it becomes possible to pass two fingers behind the lower oesophagus from its left side and to encircle it with a soft rubber tube which is then used to provide strong traction (fig. 6). More vessels and nerves are then ligated and