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Oesophageal atresia: the epitome of modern surgery

N A Myers FRCS FRACS

Department of Surgery, Royal Children's Hospital, Melbourne, Australia

Summary

With the development of modern methods of surgery, anaesthesia, and postoperative care mortality from congenital anomalies of the oesophagus, which was 100% before 1939, has fallen dramatically. Of 328 babies admitted to the Royal Children's Hospital, Melbourne, during the 25-year period 1948–72 with oesophageal atresia and/or tracheo-oesophageal fistula, the great majority (288) had a combination of proximal atresia with distal (and in one case also proximal) fistula. This group is discussed in detail; 269 were treated surgically and 189 survived the operation. Developments in treatment during the 25 years are described and current policy outlined.

Introduction

This article is based on a lecture which honoured the memory of one of the truly great fathers of modern surgery, John Hunter, who was born in Lanarkshire in 1728.

The story of John Hunter's life has been told and retold. Sigerist[1] expressed the opinion of many when he wrote: 'He occupies a leading place in the history of surgery and medicine'. Hunter's scientific approach was largely instrumental in bringing about the birth of modern surgery, which in turn enabled a remarkable change to be made in the prognosis of babies born with congenital atresia of the oesophagus and/or tracheo-oesophageal fistula. Thus before 1941 only 3 babies born with oesophageal atresia had survived, whereas today the mortality has been reduced to insignificant proportions.

That Hunter was well aware of both the anatomy and the physiology of the oesophagus is clear from a paper he read on 21st September 1790 entitled 'A Case of Paralysis of the Muscles of Deglutition, Cured by an Artificial Mode of Conveying Food and Medicine into the Stomach'[2]. He clearly described the use of an indwelling tube for feeding purposes, thereby utilizing a technique which has had an increasing place in paediatric practice in general and in the management of oesophageal atresia in particular.

Incidence

With very few exceptions, all babies born in the State of Victoria in whom the diagnosis of oesophageal atresia and/or tracheo-oesophageal fistula has been made are referred to the Royal Children's Hospital, Melbourne. Information is also available regarding the total number of births each year in the State of Victoria and the incidence of oesophageal anomalies found at necropsy. This latter information comes from a perinatal death survey held under the auspices of the Con-

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sultative Council on Maternal Mortality. Analysis of the combined data indicates that in our community the incidence of oesophageal atresia and/or tracheo-oesophageal fistula is of the order of 1 in 4,500 live births.

Clinical material

During the 25-year period from 1948 to 1972 328 babies were admitted to the Royal Children's Hospital with oesophageal atresia and/or tracheo-oesophageal fistula. All the babies were admitted under the care of one surgical unit and the early experience was reported by the then senior surgeon of the unit, Mr Russell Howard[3].

As in other reported series, the most frequently encountered anomaly has been the type described by Vogt[4] as a Type 3 (b) anomaly—that is, proximal oesophageal atresia with a distal tracheo-oesophageal fistula. Although for many years the policy was to follow the Vogt classification, the present approach is to use descriptive terms, in this way following the policy suggested by Waterston *et al.* in 1962[5]. The types of anomaly which occurred in this series are indicated in Table I.

TABLE I *Oesophageal atresia and/or tracheo-oesophageal fistula, Royal Children's Hospital, Melbourne, 1948–72*

Type of anomaly	*No. of patients*
Oesophageal atresia	25
Oesophageal atresia with tracheo-oesophageal fistula	291
Proximal oesophageal atresia with distal tracheo-oesophageal fistula	287
Proximal oesophageal atresia and tracheo-oesophageal fistula with distal oesophageal atresia	3
Oesophageal atresia with fistulae from both oesophageal segments	1
Tracheo-oesophageal fistula ('H' fistula)	12

Symptomatology

There have been many excellent descriptions of the symptomatology, and particularly lucid early accounts were given by Gibson[6] in 1[illegible] and by Hill[7] in 1840.

The symptomatology will vary somewhat according to the nature of the anomaly. In the most frequently encountered anomaly with proximal atresia and distal fistula the clinical picture is usually classical. Thus there is often a history of hydramnios in the mother, and after birth the baby remains 'mucusy' and may have spontaneous attacks of cyanosis. The abdomen is distended. If fed—but the diagnosis should be made before this event—the feeding is immediately regurgitated, frequently in an explosive fashion, and this is often associated with a cyanotic episode. If there is diagnostic delay, increasing respiratory distress will develop as pneumonia becomes established and abdominal distension increases. The presence of a distal tracheo-oesophageal fistula is also responsible for progressive symptoms and signs indicative of pulmonary complications, and in a significant number of cases there is either bile-stained aspirate from the pharynx or bile-stained 'vomiting'. Ideally the diagnosis is made at an early stage, either during the course of neonatal resuscitation or, more specifically, when a definite attempt is made to diagnose or exclude the presence of oesophageal atresia when a baby is born after a pregnancy complicated by hydramnios. Although the presence of other anomalies may alert the paediatrician or paediatric surgeon to the possibility of oesophageal atresia, special reference should be made to the association with anorectal anomalies.

When pure oesophageal atresia is present without an accompanying fistula, the clinical picture is similar, but respiratory features may be delayed and the abdomen tends to be scaphoid rather than distended.

The presence of an upper pouch fistula may be suspected when early collapse and/or consolidation is present in the upper lobe of the right lung, but this is not diagnostic similar findings may occur in association other anomalies or in the absence of an oesophageal anomaly.

Tracheo-oesophageal fistula without atresia presents quite differently, not infrequently with attacks of cyanosis, especially with feeding. Marked abdominal distension is usually present but is not in itself diagnostic. Not infrequently there is considerable delay in the diagnosis of this anomaly and in this series one baby was aged 41 days and another 2 months at the time of diagnosis.

The baby with oesophageal atresia and/or tracheo-oesophageal fistula may present in a variety of ways. However, in the final analysis when there is oesophageal atresia the features will be determined initially by oesophageal obstruction and only subsequently by the respiratory complications, whereas when isolated tracheo-oesophageal fistula is present the clinical pattern relates to the respiratory symptoms consequent on the communication between the respiratory and alimentary passages.

Although latterly the diagnosis has been made earlier, a number of babies are still not diagnosed until the second, third, or even fourth day of life. A continuing programme of education of obstetricians, paediatricians, general practitioners, midwives, medical students, and trainee nurses is essential in order to obtain early diagnosis. It is axiomatic that the individual baby has a better chance of survival when the diagnosis is made as soon as possible after birth. Although a large proportion of the babies in this series—at least 62 out of 328—were born after a pregnancy complicated by hydramnios, this rarely, if ever, alerted the clinician to the possibility of the diagnosis of oesophageal atresia.

Diagnosis

Although oesophageal atresia and/or tracheo-oesophageal fistula may be suspected clinically, proof of the diagnosis rests on two investigations.

1) The attempted passage of a large (English No. 10) catheter, which in oesophageal atresia will almost invariably be obstructed 10 cm from the gum margin.

2) Radio-opaque dye studies of the oesophagus. As a preliminary a straight X-ray of the chest and abdomen is obligatory. This may show the distended upper pouch when oesophageal atresia is present and will indicate the presence or absence of a distal fistula according to whether gas is or is not present in the stomach and intestines. Although isolated examples of babies with a tracheo-oesophageal fistula without gas in the stomach have been reported—for example, by Waterston *et al.*[8]—there were no instances of this finding in the present series. Radio-opaque dye studies should be performed only under controlled conditions with image intensification in a warmed room. These studies have the advantage of outlining a proximal fistula. However, if such facilities are not available the passage of a radio-opaque catheter will suffice. Should there be very early right upper lobe pneumonia or collapse the clinician will be alerted to the possibility of an upper-pouch fistula. Dye studies are essential to the diagnosis of tracheo-oesophageal fistula of the 'H' type and may need to be repeated; the surgeon will find it of great value to be present at the time of screening, and such investigations performed in his absence may need to be repeated.

Oesophageal atresia with distal tracheo-oesophageal fistula

The only patient in this series with oesophageal atresia and fistula from both proximal and distal segments was diagnosed at, and

not before, thoracotomy and therefore this patient will be included with the 287 babies with proximal atresia and distal fistula. This group of 288 will be discussed in detail, the remaining 40 with less commonly encountered anomalies being dealt with separately and more briefly.

Period of presentation It is convenient to divide the 25-year period into 5 phases, each of 5 years duration (see Table II). Of the 288 babies, operation was performed on 269. The indications for withholding surgical treatment in the remaining 19 cases are shown in Table III. It is evident from Table II that

TABLE II *Oesophageal atresia with distal tracheo-oesophageal fistula—numbers of patients and treatment*

Phase	*Total*	*Operated*	*Not operated*
1 (1948–52)	17	16	1
2 (1953–57)	53	49	4
3 (1958–62)	68	66	2
4 (1963–67)	68	65	3
5 (1968–72)	82	73	9
Total	288	269	19

TABLE III *Indications for withholding operation*

Indication	*No. of patients*
Multiple anomalies	10
Trisomy E	4
Moribund	2
Down's syndrome	1
Gross hydrocephalus	1
Postmortem diagnosis	1
Total	19

there has been a relatively large number of cases in which operation was withheld during the past 5 years. This reflects an increasing awareness and recognition of oesophageal anomalies complicating gross multiple abnormalities with or without underlying chromosomal aberrations.

Classifiation in relation to survival In all reported series it has been evident that many factors affect survival, and the situation was well summarized by Koop and Hamilton[9] as follows: 'A review of 249 cases of esophageal atresia at The Children's Hospital of Philadelphia revealed an increased mortality with prematurity, severe pneumonia, severe associated congenital anomalies and in babies critically ill from acquired problems such as septicaemia, anoxia, etc. . . . Only about one half of the patients with esophageal atresia represent the ideal full-term baby without severe pneumonia or a severe associated anomaly'.

Waterston *et al.*[5] suggested the following classification:

A. Over 2.5 kg birth weight and well.
B. i. Birth weight 1.8–2.5 kg and well.
   ii. Higher birth weight, moderate pneumonia, and congenital anomaly.
C. i. Birth weight under 1.8 kg.
   ii. Higher birth weight and severe pneumonia and congenital anomaly.

Although it is sometimes difficult to distinguish marginal cases, this classification has the merits of clarity and simplicity.

The 269 babies in this series with oesophageal atresia and distal tracheo-oesophageal fistula who were operated upon were classified into 3 groups following this classification (Table IV). In an attempt to assess the validity of the classification these figures were compared with those from 2 other series in which a similar classification was followed (Table V). When the percent-

TABLE IV *Classification in relation to survival*

*Clinical group**	*No. treated*	*No. alive*
A	102	94 (92%)
B	96	68 (71%)
C	71	27 (38%)
Total	269	189 (70%)

*See text

TABLE V *Clinical classification—comparison with other series*

Series	*Total no. treated*	*Clinical group**		
		A	*B*	*C*
Waterston *et al.*[5]	113	38 (33.6%)	43 (38%)	32 (28.3%)
Glasson *et al.*[10]	38	11 (29%)	18 (47.4%)	9 (23.7%)
Present series	269	102 (38%)	96 (35.7%)	71 (26.4%)

*See text

TABLE VI *Survival in relation to phase of treatment and clinical group*

Phase	*Group A**		*Group B**		*Group C**	
	No. treated	*Alive*	*No. treated*	*Alive*	*No. treated*	*Alive*
1 (1948–52)	3	1 (33%)	6	3 (50%)	7	1 (14%)
2 (1953–57)	7	7 (100%)	28	18 (64%)	14	4 (29%)
3 (1958–62)	21	16 (76%)	27	16 (59%)	18	5 (28%)
4 (1963–67)	30	29 (97%)	18	14 (78%)	17	10 (59%)
5 (1968–72)	41	41 (100%)	17	17 (100%)	15	7 (47%)
Total	102	94 (93%)	96	68 (71%)	71	27 (38%)

*See text

ages are compared there seems little doubt that assessment of this series was quite valid.

Information regarding survival in each of the clinical groups is shown in Table VI. Thus 94 of the 'good risk' babies (Group A) survived, there being only 8 deaths in this group. It is not surprising that there was only 1 survival out of 3 cases in this group in the first 5-year period. At the other end of the scale there have been 70 survivals and only 1 death in patients in Group A during the past 10 years. During the period 1958–62 (21 patients, 16 survivals) the relatively high mortality can be attributed to the onset of significant Gram-negative sepsis in neonatal patients.

Recent experience with babies at moderate risk (Group B) has also been favourable, with 100% survival during the most recent 5-year period. However, there is still a high mortality in the babies adjudged to be at high risk (Group C), and even during the past 5 years the figure has still exceeded 50%. Nevertheless, 5 of the last 8 babies in this group have survived, indicating the possibility of some improvement; in 2 of the 3 babies who died congenital cardiac malformations incompatible with life were present, and the third baby weighed 1.7 kg, had established pneumonia at the time of presentation, and rapidly became septicaemic and thrombocytopenic.

Treatment Although all babies in the series were managed in one surgical unit, many different types of operation were performed; basically, however, the surgical philosophy has been 'the best oesophagus is the patient's own oesophagus'. To this end every effort has been made to achieve end-to-end anastomosis of the oesophagus, and in recent years this has been associated with a high degree of success. In the early years deaths occurred which would not occur today—possibly some of these deaths might have been avoided if different surgical techniques had been used. However, with increasing experience and the advantages of modern methods of preventing and treating respiratory failure it is justifiable to continue

a policy which aims at producing oesophageal continuity. As a corollary, oesophageal replacement will rarely be required in the baby with oesophageal atresia and a distal tracheo-oesophageal fistula.

Operations which have been performed include ligation of the fistula, division of the fistula, oesophageal anastomosis, gastrostomy, gastric division, and cervical oesophagostomy. These operations have been performed singly or in one or other combination. Anastomosis has been effected by a one-layer or two-layer technique. If the latter, the two layers have in some cases been definitive (mucosa to mucosa and muscle layer to muscle layer), but more frequently the anastomosis has been of the 'sleeve' type advocated by Haight[11].

Although there is frequently confusion when the terms primary anastomosis, delayed treatment, and staged management are used, it has been our practice to define these terms rigidly as follows:

1) *Primary anastomosis* Thoracotomy and immediate anastomosis within a few hours of admission to hospital. Anastomosis may or may not be combined with a trans-anastomotic tube or gastrostomy.

2) *Delayed treatment* By definition, the treatment of oesophageal atresia is delayed when non-operative and/or operative measures are first instituted to improve the baby's condition. This programme, which may include a suction gastrostomy but does not permit the commencement of a feeding regimen, is followed by early thoracotomy and correction of the anomaly.

3) *Staged management* This implies that an operation has been performed which will permit alimentation before alimentary continuity has been achieved. The cornerstone of staged management has been fistula division and gastrostomy, but in a few patients this was combined with cervical oesophagostomy.

In order to simplify analysis the patients have been classified into 8 therapeutic groups as shown in Table VII. One of the 269 babies has been excluded from the analysis because the only operative treatment was duodenoduodenostomy performed for an associated duodenal atresia, the baby dying before thoracotomy could be performed. It is evident from Table VII that the most frequently adopted form of surgical treatment has been primary anastomosis without gastrostomy; for the most part this anastomosis was combined with a transanastomotic tube, although in a few cases a tube was not introduced, the baby being managed entirely with intravenous fluids until oral alimentation was possible.

During the most recent 5-year period primary anastomosis has been combined in 32 cases with gastrostomy and the introduction of a transpyloric jejunal feeding tube. This technique combines the advantages of adequate gastric decompression with early feeding and, as pointed out by Kent[12], 'introduction of feedings at a distal level allows the advantages of a drained stomach to be combined with an early anabolic phase, more favourable to wound healing and to resistance against infection. Also during this period an end-to-side anastomosis has been performed in 11 cases according to the technique described by Ty *et al.*[13]

It is also clear from Table VII that there has, over the years, been a considerable change in thinking in relation to staged management. Originally, deliberate planned staging was not part of the management; occasionally staging was found to be a measure of expedience and usually the decision was made at operation, the main indications being an ill baby 'deteriorating on the table' or an unfavourable anatomical situation. Subsequently, with the increasing recognition of 'risk factors', the decision to stage was

TABLE VII *Correlation between therapeutic group and phase of treatment (numbers of patients)*

	Therapeutic group	*Phase 1 1948–52*	*Phase 2 1953–57*	*Phase 3 1958–62*	*Phase 4 1963–67*	*Phase 5 1968–72*	*Total*
1	Primary anastomosis and immediate gastrostomy	–	–	3	2	3	8
2	Primary anastomosis; gastrostomy next day	4	–	–	–	–	4
3	Primary anastomosis	6	44	39	31	12	132
4	Primary anastomosis; gastrostomy for complications	3	2	13	9	6	33
5	Delay; gastrostomy followed by primary anastomosis	2	2	3	4	3	14
6	Primary anastomosis plus jejunal feeding tube	–	–	–	–	32	32
7	Primary anastomosis end-to-side	–	–	–	–	11	11
8	Staged management	1	1	8	19	5	34
	Total	16	49	66	65	72	268*

*One patient excluded because thoracotomy was not performed

usually clinical and there seemed little doubt that staged management was definitely associated with an improved prognosis. However, with the introduction of nasotracheal intubation, designed to prevent or treat respiratory failure, the situation was reviewed and, as a result of previous experience, the following conclusions were reached in 1967: (1) fistula division and gastrostomy had been life-saving but had not been problem-free; (2) in the light of modern techniques for the management of respiratory failure new thinking was required; and (3) thoracotomy can be tolerated by very small babies. The following decisions were then made: (1) the rigid policy is no longer necessary; (2) almost all babies previously considered for staging will now be treated by thoracotomy with a view to division of fistula and oesophageal anastomosis; and (3) there will remain a few patients whose management should be staged.

With this as background it is not surprising to find that only 5 babies have been staged during the past 5 years. Although the potential value of gastric division as described by Randolph *et al.*[14] was recognized, the usual form of staging has been fistula division plus gastrostomy with preservation of the upper oesophageal segment. In a few instances cervical oesophagostomy has also been performed, but only 3 babies have subsequently had a colonic interposition operation.

Results and follow-up Of the 269 babies treated surgically, 189 have survived the neonatal period and have been provided with alimentary continuity permitting a normal feeding regimen (Tables VIII and IX). Complete follow-up has been obtained in 162 cases. Of the 124 survivors who were treated before the end of 1967, 103 have been completely followed up. There have been 8 late

TABLE VIII *Postoperative survival in relation to phase of treatment*

Phase	*No. treated*	*Alive*
1 (1948–52)	16	5 (34%)
2 (1953–57)	49	29 (59%)
3 (1958–62)	66	37 (56%)
4 (1963–67)	65	53 (82%)
5 (1968–72)	73	65 (89%)
Total	269	189 (70%)

TABLE IX *Postoperative survival in relation to therapeutic group*

*Therapeutic group**	*No. treated*	*Alive*
1	8	6 (75%)
2	4	2 (50%)
3	132	92 (70%)
4	33	24 (73%)
5	14	9 (64%)
6	32	30 (94%)
7	11	11 (100%)
8	34	15 (44%)
Total	268†	189 (71%)

*See Table VII

†One patient excluded because thoracotomy was not performed

deaths: 3 of these patients died from congenital cardiac malformation, 1 from chromosomal anomaly, and 1 from mental deficiency; the cause of 1 death was multifactorial, while 2 were 'cot deaths'.

The patients have been followed up clinically and radiologically and as a result of frequent review it has been possible to draw the following conclusions: (1) the quality of life is excellent; (2) there is a tendency towards recurrent respiratory infections in the early years of life but this slowly subsides; (3) dysphagia for solid foods is common during the early years of life, but swallowing is usually symptom-free during the teens and later years; and (4) there does not appear to be any genetic transmission of congenital oesophageal anomalies—in only one of our cases was there sibling involvement.

The development of 160 of the 189 survivors could be studied by comparing their weight at the age of 1 year with normal standards (Table X). A high proportion of babies whose birth weight was normal developed normally during the first year of life, and the weight of 64 of the 90 babies in this group was greater than the 10th percentile at the end of that year. Of 70 whose birth weight was low, however, only 35 had a weight greater than the 10th percentile at the age of 1 year.

Apart from frequent review, advice regarding eating, and the management of intercurrent and recurrent respiratory tract infections, further definitive treatment has been necessary in 89 cases, and oesophagoscopy has been performed on a further 19 patients in order to define the exact situation at the anastomotic site (Table XI). In a number of cases there were one or more episodes of foreign body obstruction, and not infrequently oesophagoscopy with removal of the foreign body was required as an emergency measure. Of the 27 patients requiring later operative procedures, 22 underwent resection of an anastomotic stricture; in the other 5 reoperation was performed for a recurrent tracheo-oesophageal fistula unassociated with a significant anastomotic stricture. Three of the patients operated on for stricture also had a recurrent tracheo-oesophageal fistula.

TABLE X *Weight at one year in relation to birth weight (numbers of patients)*

Weight	*Normal birth weight*	*Low birth weight*	*Total*
<3rd percentile	19	24	43
3rd–10th percentile	7	11	18
>10th percentile	64	35	99
Total	90	70	160

TABLE XI *Further treatment after repair of oesophageal atresia and distal tracheo-oesophageal fistula (numbers of patients)*

*Therapeutic group**	*Oesophagoscopy and dilatation*	*Oesophagoscopy without dilatation*	*Operation*	*Nil*
1	–	1	–	5
2	–	–	2	–
3	33	12	8	39
4	7	1	10	6
5	5	–	–	4
6	6	5	1	18
7	4	–	1	6
8	7	–	5	3
Total	62	19	27	81

*See Table VII

Less commonly encountered anomalies

During the period under review there were 3 babies with proximal fistula and distal atresia. In all the diagnosis was confirmed by radiography after the introduction of radio-opaque dye into the upper oesophageal segment. One of these babies was treated by end-to-end oesophageal anastomosis and another by oesophageal replacement by means of a greater curvature tube of the stomach; the third has an oesophagostomy and is awaiting a replacement operation.

There have been 12 patients with an isolated 'H' fistula. In 8 the fistula was divided via the cervical route and in 4 the primary approach was thoracic. However, in 1 of these 4 the fistula was not discovered at thoracotomy and a cervical approach was subsequently required. There have been 2 deaths in this group and experience has indicated the wisdom of always combining gastrostomy with fistula division.

Finally, there have been 25 babies with isolated oesophageal atresia without tracheo-oesophageal fistula. In 4 of these cases operative treatment was not performed and in 4 early in the series death occurred shortly after gastrostomy and cervical oesophagostomy had been carried out. In 8 cases oesophageal replacement was effected using colon or greater curvature tube of the stomach. In 7 others end-to-end oesophageal anastomosis was achieved; one of these babies died as a consequence of a surgical complication, another as a consequence of an associated anomaly. Of the remaining 2 babies in this group, one, who also had Down's syndrome, died some months after gastrostomy had been performed and the other still has a gastrostomy and a cervical oesophagostomy and is awaiting oesophageal replacement.

Conclusion

In so far as the outlook for babies born with oesophageal atresia and/or tracheo-oesophageal fistula was completely hopeless before 1939, since when there has been a reduction in mortality from 100% almost to nil, it can be accepted that the treatment of oesophageal atresia is the epitome of modern surgery. The paediatric surgeon has been able to take advantage of a wide variety of surgical and parasurgical techniques to effect this remarkable change in prognosis. The metabolic requirements of the newborn baby have been defined and can be respected; every effort is made to establish and maintain homoeostasis in these babies and to be mindful of disturb-

ances of temperature control, of calcium metabolism, and of coagulation of the blood. Problems of sepsis have been largely overcome by developments in antimicrobial therapy. Knowledge has been disseminated by the written word, by lecture, and by personal contact.

If credit should be given to one group it is appropriate to single out the anaesthetists who developed the techniques which made thoracic surgery possible and then extended them to permit thoracic surgical procedures to be carried out on babies weighing as little as 1 kg. Subsequently these techniques were adapted to the needs of the baby with respiratory failure, and with the introduction of prolonged nasotracheal intubation during the past 10 years there has been a further and considerable improvement in the prognosis. Added to this, assisted ventilation has been a valuable adjunct to therapy, particularly during the postoperative period and specifically in babies with early respiratory failure. It is now standard practice to adopt these measures—prolonged nasotracheal intubation with or without assisted ventilation —whenever and wherever necessary. Intubation has been particularly valuable in the group of babies with clinical and/or radiological evidence of tracheomalacia.

However, there is still much to be learnt from a study of babies with oesophageal atresia and tracheo-oesophageal fistula, and continuing clinical study combined with close follow-up and laboratory and clinical research programmes should result in greater understanding of the still unsolved problems and further reduction in morbidity and mortality.

Definition of a firm policy is also part of modern surgery and at the Royal Children's Hospital the present policy permits elasticity in relation to the therapeutic programme, insists that the baby be admitted directly to an intensive care unit, and aims at the early recognition and prevention of respiratory failure. Most of our patients undergo primary anastomosis, and at present this is usually combined with gastrostomy and the introduction of a transpyloric jejunal feeding tube. In view of the current high incidence of Gram-negative infections prophylactic antibiotics are administered. If staged management is necessary every effort is made, regardless of the type of anomaly, to preserve the upper oesophageal segment.

It is a pleasure to record my appreciation to Russell Howard, MD FRCS FRACS for his leadership, to Helen Noblett, Maxwell Kent, and Peter Jones, who permitted me to include their patients in this review, and to the anaesthetic staff of the Royal Children's Hospital, whose skill and devoted attention enabled so many of the babies in this series to survive. We are all indebted to the nursing staff and in particular to Sister Harden, Sister Milliken, Sister Jaffray, Sister Telfer, and Sister Wilkin, who have devoted many hours to the nursing care of these babies. I am also deeply indebted to my secretaries, Miss K O'Connor and Mrs K Richards. I also wish to record my thanks to the President and Council of the Royal College of Surgeons of England for enabling me to honour John Hunter's name with this lecture.

References

1 Sigerist, H E (1933) *Great Doctors: a Biographical History of Medicine,* p. 219. London, Allen and Unwin.

2 Hunter, J (1793) *Transactions of a Society for the Improvement of Medical and Chirurgical Knowledge,* 1, 182.

3 Howard, R N (1950) *Medical Journal of Australia,* 1, 401.

4 Vogt, E C (1929) *American Journal of Roentgenology,* 22, 463.

5 Waterston, D J, Bonham Carter, R E, and Aberdeen, E (1962) *Lancet,* 1, 819.

6 Gibson, T (1703) *The Anatomy of Humane Bodies Epitomized,* 6th edn. London, Awnsham and Churchill.

7 Hill, T P (1840) Boston *Medical and Surgical Journal,* 21, 320.

8 Waterston, D J, Bonham Carter, R E, and Aberdeen, E (1963) *Lancet,* 2, 55.

9 Koop, C E, and Hamilton, J P (1965) *Annals of Surgery,* 162, 389.

10 Glasson, M J, Dey, D L, and Cohen, D H (1971) *Medical Journal of Australia,* 1, 69.

11 Haight, C (1962) in *Pediatric Surgery,* ed. Mustard, W T, Ravitch, M M, Snyder, W H, and Welch, K J, 1st edn. Vol. 1, p. 276. Chicago, Year Book Publishers.

12 Kent, M (1970) in *Proceedings of the Paediatric Surgical Congress, Melbourne, 1970.* Vol. 2, p. 394.

13 Ty, T C, Brunet, C, and Beardmore, H E (1967) *Journal of Pediatric Surgery,* 2, 118.

14 Randolph, J G, Tunell, W P, and Lilly, J R (1968) *Surgery,* 63, 496.