activity of the oesophageal smooth muscle. We believe that the whole knack lies in the control of the cricopharyngeal sphincter, and that the oesophagus behaves as a passive tube.

It is surprising to find that a patient with no glottis can raise his intrathoracic pressure in the way shown. Such patients can, however, achieve positive pressures of 30 to 50 mm. Hg during sustained expiratory strain and considerably more during coughing. It appears that the effective resistance of the bronchioles to a suddenly applied expiratory pressure can be very high, so that in a sense air is trapped in the alveoli. Anyone who has witnessed a bronchoscopy will recall that the veins of the head and neck congest during coughing and straining even with the bronchoscope in place.

In acquiring a voice after laryngectomy the patient has to gain control of the cricopharyngeal sphincter so that he can first relax the sphincter and allow air to enter the oesophagus during inspiration, and, secondly, control the degree of contraction during speech so that there is maximum economy in the use of the air in the oesophagus and the loss of air from the lungs. To acquire a good oesophageal voice therefore comprises two stages : (1) finding the voice, and (2) learning to use the new technique economically so that many syllables can be uttered without taking a fresh breath. Finding the voice usually takes a month or two, and the skill in the use of this voice increases over several years.

Summary

Measurements of oesophageal pressure and chest movements during oesophageal speech have been made, and the oesophageal movements observed by fluoroscopy.

The mechanism is discussed. Air enters the oesophagus down to the diaphragm. It is expelled by expiratory effort, the airway resistance allowing the intrathoracic pressure to rise above the atmospheric pressure despite the presence of a tracheostomy.

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REFERENCES

Dornhorst, A. C., and Leathart, G. L. (1952). *Lancet*, 2, 109.
Negus, V. E. (1938). *Laryngoscope, St. Louis*, 48, 847.

OVERFEEDING IN EARLY INFANCY

BY

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The purpose of this paper is to record the number of times a diagnosis of overfeeding was made in the first two months of life in a series of healthy infants fed along orthodox lines, and to assess, by observing subsequent events, how valid this diagnosis proved to be.

Review of Literature

Overfeeding has been regarded as the main source of dyspepsia in infancy ever since Aristotle attributed convulsions to this cause. Pemell (1653), amongst others, handed down the classical views, but Cadogan (1748) was the first to appreciate that the breast-fed baby should " have as much as it will take out of both breasts at each time," whereas he pitied those who were " stuffed with pap till they spue." The word " overfeeding " has been used indiscriminately to mean faulty feeding or overloading with a suitable food—two very different conditions. The prevalence of gastro-enteritis in the nineteenth century stimulated Rotch (quoted by Morse, 1935) to dispense graduated milk mixtures for healthy babies as carefully as he prescribed a dangerous drug. For the same reason Cautley (1897) advised two-hourly feeds, but in 1915 Truby King objected that this method caused overfeeding. King's unbalanced views, which still influence many people to-day, are exposed in the following passage from his daughter's book (Mary King, 1941) : " Overfeeding, especially in the breast-fed baby, is the commonest and most frequent cause of digestive and nutritional disturbances in early infancy. It occurs far more often than is realized in the first weeks. Overfeeding is much more serious than underfeeding, because the results are very far-reaching, and may gravely undermine the baby's digestion and nutrition."

Many modern textbooks still state that overfeeding may lead to vomiting, diarrhoea, loss of weight, and death, yet there is not a single authentic case history to be found in the literature illustrating this unlikely sequence of events. Budin (1907) described five non-fatal cases, four of which were probably really infections. Pritchard (1929), Brackett (1947), and others have tried unsuccessfully to link pyloric stenosis with overfeeding. Smith (1939), determined to denounce overfeeding, provided questionable evidence. Many warning statements are to be found, but few supporting facts. In contrast, there is ample published work on self-regulatory feeding (Weinfeld and Floore, 1930 ; Davis, 1935 ; Gesell and Ilg, 1937 ; Aldrich and Hewitt, 1947) demonstrating the safety of this method. Indeed, 20% of Aldrich and Hewitt's series demanded only four feeds daily when orthodox methods would have provided five. They make no mention of overfeeding in their paper, which seems to become a problem only for those who take active steps to avoid it. If the infant is allowed to determine his own requirements overfeeding takes care of itself.

Present Investigation

The mothers of a series of healthy infants were given an appointment, on leaving the maternity ward, to attend the " well babies' follow-up clinic " during the second month for a check-up. Four-fifths (503) of those given appointments kept them, and 80% of the babies born to primiparae and 66% of the others had been taken to an infant welfare clinic on at least one occasion in the meantime.

At the first interview at the follow-up clinic each mother was asked whether her baby had been diagnosed as overfed since leaving hospital ; a definite diagnosis was considered to have been made if steps had been taken to reduce the size of the feed. On the basis of this definition, no fewer than 71 infants (14%) had already been treated for this condition. In a further 47 cases the possibility of overfeeding had been discussed, and 12 artificially fed infants had been changed from a full-cream to a half-cream formula on the grounds of qualitative rather than quantitative overfeeding. The question of overfeeding was therefore raised for 130 (26%) of the babies before they were 2 months old. None of the 503 infants attending the follow-up clinic were regarded as overfed at the time, but it was learned that several were subsequently so diagnosed on returning to their own welfare clinic.

For the 71 definite cases the mode of feeding at the time the diagnosis was made was as follows: Breast-fed, 51 infants ; bottle-fed, 16 ; and breast+bottle, 4. Thus 72% of these were wholly breast-fed, which is a little higher than the incidence for the whole series at the age of 2 weeks. There had therefore been no tendency to attribute

overfeeding to the unrestricted use of artificial-milk mixtures. The main symptoms leading to the diagnosis were :

Excessive gain or intake	19	infants
Colic and/or diarrhoea	12	,,
Frequent green stools	11	,,
Vomiting and/or posseting	11	,,
Crying	8	,,
Facial skin lesions	4	,,
Failure to gain	2	,,
Others	4	,,
Total	71	,,

It will be realized that many of these symptoms commonly occurred together, but the group of 19 good gainers and feeders had virtually no other symptoms.

The diagnosis was reviewed at the follow-up clinic in the light of the infants' subsequent behaviour after a reduction in the size of the feed had been made or attempted, and the 71 infants were reclassified as follows :

Probable past history of overfeeding	6
Possible ,, ,, ,,	11
Normal healthy infants	25
Underfed or unsatisfied	15
Crying infants	10
Neonatal infections	4

In only just over 1% of the original series had overfeeding definitely occurred. The 11 doubtful cases were difficult to classify conclusively because of the nature of the retrospective inquiry, but in most cases other explanations for the symptoms seemed more probable, though the original diagnosis has been accorded the benefit of the doubt. The reasons for the diagnostic errors in the remaining cases are discussed below.

A past history of underfeeding was also inquired into, and 122 infants (24%) had been so diagnosed. It is interesting to compare by whom the original diagnosis had been made in the underfed and overfed groups :

Diagnosis made by	No. of Infants in	
	Overfed Group	Underfed Group
Infant welfare clinic	49	26
Mother	8	85
General practitioner	9	5
Health visitor	4	2
Maternal grandmother	1	4
Total	71	122

Thus in 69% of the overfed group the infant welfare worker made the diagnosis, whereas 70% of the underfed group were originally spotted by their mothers. Pritchard (1914) observed that it was "very difficult to convince the lay mind that rosy cheeks and a fine weight record can be of unfavourable augury." Apparently welfare-clinic workers are still more easily disturbed by these signs than the mothers of such babies.

Discussion

Restlessness, frequent green stools, crying, vomiting, and failure to gain weight are symptoms common to both underfeeding and overfeeding (Toverud, 1925). Indeed, in nine cases the original diagnosis had been changed to underfeeding when the symptoms had been worsened by a reduction in the size of the feeds. It is therefore only by a careful follow-up that the validity of the diagnosis can be checked, and in this investigation in only 6 out of 71 cases was it definitely upheld. Of these six, five were being awakened for three-hourly feeds and were happier when allowed to sleep on, as they would have been on a self-demand regime. The sixth was troubled with screaming, vomiting, and the passage of frequent undigested motions, which dramatically improved when only one breast was given at each feed. The mother had had similar difficulties with her first two babies. This case constituted the only one in which a self-regulated intake would have failed, but the symptoms were never alarming.

The 25 infants reclassified as normal and healthy were simply babies in whom overfeeding had been suspected because of an excessive gain or intake, or mild digestive symptoms. Ignorance of the range of normal values in early infancy has largely been responsible for these diagnostic errors.

Excessive Gain.—Evidence has recently been compiled (Wickes, 1952) to show that the generally accepted rate of gain of 1 oz. (28 g.) daily or less underestimates the ability of the average young baby to grow. At some clinics this rate of gain was regarded as optimal rather than average, and attempts were made to limit the feeds of all who exceeded it, whereas at others a "good start" was condoned or encouraged. Hence overfeeding in most cases is found to be a matter of opinion rather than a real disorder.

Excessive Intake.—The orthodox feeding formula—2½ oz., or 50 cal., per lb. (156 g., or 110 calories per kg.) expected body weight a day—also attempts to level all infants down to a standard rate of gain regardless of the one who, because of defective absorption or wasteful metabolism, needs a larger intake. Hungry babies receiving the calculated quantity are often thought to be crying with the discomfort of an overloaded stomach rather than with the pangs of unsatisfied hunger. Mackay (1941) noted that in practice it is common to find that an underfed infant has been diagnosed as overfed, and this is particularly so in the early weeks.

Frequent stools occur in healthy young babies, in underfeeding and overfeeding, and with alimentary or parenteral infections ; the clinical differentiation of these conditions is not easy, but the effect of altering the size of the feed usually reveals the correct diagnosis. Gordon (1951) has shown that a bowel action with every feed is a normal feature of early infancy, and the average number of motions passed daily falls as the infant grows older. Many healthy breast-fed babies passed occasional green motions without apparent cause or harmful effect.

Vomiting and Posseting.—In 11 infants this had led to a diagnosis of overfeeding, but a reduction in the size of the feed had aggravated the symptoms. Variot (quoted by Cran, 1913) was one of the earliest to appreciate that underfeeding may cause vomiting, and Wood (1952) has discovered this anew. Organic causes for vomiting must not be overlooked, and the real danger lies, not in overfeeding, but in making that diagnosis when some other condition is present.

Crying and Colic.—Crying is common in the first three months of life. In most cases it is due to underfeeding, but in 10 cases attempts to overcome it by increasing the feeds failed. Persistent crying occurs on self-demand regimes, is often referred to as "three months' colic," and is usually attributed to wind. Levine and Bell (1950), however, believe that these infants have an unsatisfied sucking urge, and they find that most are pacified with the dummy. The wind theory receives support from the observation that a baby with colic cries vigorously, draws up his knees, and belches on being lifted ; but a hungry baby will behave in exactly the same way. Moreover, the dummy should increase the colic by encouraging aerophagy, yet in most cases it has the reverse effect.

Other Symptoms.—A number of other symptoms and signs were erroneously attributed to overfeeding. The miliary sebaceous cysts which Gordon (1949) found in about 40% of normal infants at this age were incriminated in four cases. In two cases a failure to gain was ascribed to overfeeding, presumably on the basis that diarrhoea resulted in defective absorption ; but Chung and Viscorová (1948) have shown that in infective diarrhoea more food by mouth leads, on balance, to increased absorption in spite of the passage of more frequent stools. It seems likely that the same principle would apply in the absence of infection.

Conclusion

It is as yet inadequately realized that a baby may be hungry even if he is gaining at, say, 12 oz. (340 g.) a week. Unsatisfied hunger may lead to marasmus and death, but

there is no evidence that true overfeeding ever does. Ignorance and fear, coupled with a misguided desire at welfare clinics to standardize the infants to a rate of gain which is below average and suboptimal, led to the diagnosis in most of my cases. On the other hand, the mothers, when allowed to behave naturally, were quick to recognize underfeeding, because they had to live with their hungry babies.

It is difficult to induce a baby to take a feed against its will, but occasionally simple overloading results in transient vomiting. The obese, pale, flabby baby, with his predisposition to respiratory infections, provides a combination of constitutional factors and an unbalanced diet. Adequate feeding leads to contentment rather than obesity, whereas underfeeding is apt to have far-reaching consequences, both physical and psychological, for the developing infant. The vehemence of the protestations of some medical men and women against the dangers of overfeeding suggests that their views are charged with emotion, perhaps derived from their own feeding experiences in infancy and childhood.

Summary

In a series of 503 healthy infants a definite diagnosis of overfeeding had been made in 71 (14%) and had been suspected in a further 59 (12%) between the ages of 2 and 8 weeks.

Of those infants whose feeds were reduced for this reason 72% were fully breast-fed at the time the diagnosis was made.

Retrospective inquiry definitely supported the original diagnosis in only six cases, five of which were being force-fed. In none were the symptoms alarming.

The commonest cause for the diagnostic errors lay in ignorance of the normal characteristics of early infancy with regard to the rate of gain, frequency of bowel action, and the reasons for crying and vomiting.

A conflict of interests exists between infant-welfare clinics and mothers. Of the overfed group 69% were first so diagnosed at the clinics, whereas 70% of the underfed babies were first so regarded by their mothers.

The literature does not contain factual evidence to support the view that true overfeeding is ever dangerous. Faulty feeding in years gone by, incorrectly referred to as overfeeding, has been responsible for the persistence of the traditional objections to allowing the baby to feed to repletion.

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REFERENCES

Aldrich, C. A., and Hewitt, E. S. (1947). *J. Amer. med. Ass.*, **135**, 340.
Brackett, A. S. (1947). *Yale J. Biol. Med.*, **19**, 155.
Budin, P. (1907). *The Nursling.* Translated by W. J. Maloney. London.
Cadogan, W. (1748). *Essay upon Nursing and Management of Children.* London.
Cautley, E. (1897). *Feeding of Infants.* London.
Chung, A. W., and Viscorová, B. (1948). *J. Pediat.*, **33**, 14.
Cran, D. H. D. (1913). *Lancet*, **1**, 1659.
Davis, C. M. (1935). *Amer. J. Dis. Child.*, **50**, 385.
Gesell, A., and Ilg, F. L. (1937). *Feeding Behavior of Infants.* Philadelphia.
Gordon, I. (1949). *Arch. Dis. Childh.*, **24**, 286.
—— (1951). *Lancet*, **1**, 1203.
King, M. T. (1941). *Mothercraft*, 8th ed., p. 76. Sydney.
Levine, M. I., and Bell, A. I. (1950). *J. Pediat.*, **37**, 750.
Mackay, H. M. M. (1941). *British Medical Journal*, **1**, 841.
Morse, J. L. (1935). *J. Pediat.*, **7**, 303.
Pemell, R. (1653). *Treatise of the Diseases of Children.* London.
Pritchard, E. (1914). *The Infant: Nutrition and Management*, p. 90. London.
—— (1929). *British Medical Journal*, **1**, 373.
Smith, C. H. (1939). *Med. Clin. N. Amer.*, **23**, 569.
Toverud, K. U. (1925). *Amer. J. Dis. Child.*, **30**, 642.
Weinfeld, G. F., and Floore, F. B. (1930). Ibid., **40**, 1208.
Wickes, I. G. (1952). *Arch. Dis. Childh.*, **27**, 449.
Wood, B. S. B. (1952). *Lancet*, **1**, 28.

SELF-DEMAND FEEDING IN A MATERNITY UNIT

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Self-demand feeding of infants has for some time been advocated as preferable to feeding at fixed regular intervals on the grounds that fixed intervals, being unnatural, do not give full scope to the smooth development of the normal infant/mother relationship, especially during the first few weeks of the infant's life (Simsarian and McLendon, 1942; Winnicott, 1948). More recently it has also been shown to be accompanied by more satisfactory breast-feeding and a more rapid gain in weight of the infant than occurs on a fixed feeding schedule (Illingworth *et al.*, 1952). In a trial carried out in 1949 in a large maternity hospital certain other points of importance emerged. We feel that they are complementary to recent papers and therefore worth recording.

An infant who is being fed on demand may require as many as ten or even twelve feeds in a period of twenty-four hours during the first ten days of life. Such frequent feeding, which is usually also at irregular intervals, may not give rise to insuperable difficulties at home, where only one infant has to be considered, but might be expected to interfere not a little with the established routine and care of mothers and babies in large maternity units, especially with routine ward procedures such as meals, swabbings and dressings, bed-pans, supervision of breast hygiene and feeds, and changing of babies' napkins, all of which are usually arranged at fixed times.

Experiment

An experiment was conducted in the Mill Road Maternity Hospital, Liverpool, of 115 beds, the main aim of which was to assess the practicability of self-demand feeding in such a unit. Secondary aims were to observe, if possible, any psychological influence of the method on the mothers and any effect it might have on the establishment and maintenance of breast-feeding and the rate of gain in weight of the infants. Self-demand feeding was instituted in two 22-bed wards in the unit and was practised for a period of four months. In one ward the paediatric registrar carefully supervised both the staff and the mothers. He personally instructed each mother in what was expected of her. In the other ward only the sister and staff were instructed, and it was left to them to put the scheme into effect.

The regime was as follows. The baby was placed in his cot at the foot of his mother's bed some three to four hours after birth, and it was explained to the mother that it was her responsibility to listen for his cry and to pick him up and feed him when she thought that he was hungry. It was further explained to her that she need not worry about the baby forming irregular habits—he would settle down into a regular rhythm quite soon. She was also told that she was at liberty to cuddle and play with him for a time after feeding and at other times if she so desired. In order that we might know how often the babies were being fed the mothers