is the resistance shown by a child at 1-1½ years of age rather than the timing or method of training which bears a closer connexion with enuresis.

Resistance was also noted in a relatively small number of dry siblings and controls, so that bed-wetting cannot be said to be its only outcome; encopresis is even more closely related to it, and Huschka has shown that some behaviour problems may be an alternative undesirable reaction to coercion. But even in these dry children resistance has been shown to be related to a delay in sphincter control of about four months; it is interesting to speculate whether some were on their way to becoming enuretic or encopretic but lacked the genetic factor (Hallgren, 1957) involving autonomic imbalance which would allow these conditions to develop.

The question to which no certain answer can be provided is the cause of the resistance encountered, particularly in many of the enuretics of this series. It is commonly believed that the mother is to blame, and this is probably true in so far as coercive measures play their part, but most children accept such training without demur and with no obvious side-effects. It may be the inborn personality of the child, in whom aggression and negativism are prominent features, which is more important than rigidity of method. But whichever interpretation is correct, toilet training is conducted so smoothly and effectively in the majority of children, whether enuretic or not, that it cannot be regarded as more than a contributory factor in some cases. On the evidence provided, little support can be given to those who maintain that, just as acquired (or onset) enuresis is largely determined by psychological stress after a child has become dry at night, so enuresis may persist from birth onwards because of the stress of coercive training.

Summary and Conclusions

A retrospective inquiry concerning toilet training was undertaken into 165 "wet" families comprising 225 enuretic children and 174 dry siblings, and the findings were compared with 174 "dry" families containing 384 children as controls. The results were as follows.

1. The age at which "potting" began was virtually the same in the enuretics, dry siblings, and controls (30% under 3 months, 42% between 3 and 9 months, and 28% over 9 months). It was concluded that the time of beginning training bears no relation to the problem of enuresis.

2. Strict methods were adopted in a minority of children, but were more prevalent if training began below the age of 3 months and more common in enuretics who were first-born or "only" children; nevertheless, enuresis was found less often among those trained very early. Later-born enuretics were not trained more strictly than their dry siblings or the controls. For these reasons it is doubtful whether coercive training is an important factor in the production of enuresis.

3. Children trained in the later period (over 9 months) were handled leniently as a rule, but no difference in this respect was found between the enuretic and control groups, indicating that lax methods were likewise not more conducive to enuresis.

4. Strict training was more often associated with resistance, both active and passive, in all children. Enuretics resisted much more often than the controls even if training had been lenient; most resistance was encountered if potting began after 3 months of age. It

is inferred that this resistance is more closely related to enuresis than early training, but coercive methods played some part in producing it.

5. Early training seemed to lead to earlier sphincter control, but if resisted at any training period some delay occurred not only in enuretics but in dry children as well. Possible reasons for this delay and for the resistance apparently causing it have been tentatively put forward.

It was concluded that, while toilet training has no fundamental bearing on the causation of enuresis, resistance to training is often a contributory factor.

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SOME OBSERVATIONS ON SALIVARY SECRETION AND FLUID ABSORPTION BY MOUTH

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The secretion of saliva in normal healthy subjects is under nervous control, and there is no evidence of a specific hormonal mechanism. In the resting state the output of saliva is at a low level, but a marked increase occurs when the gland is activated as the result of a wide variety of reflexes, which may be unconditioned or acquired.

Substances placed in the mouth initiate the unconditioned salivary reflex. The stimulus may be produced by inedible objects and be purely of a mechanical nature, in which case the afferent pathway is by the lingual, buccinator, and palatine branches of the fifth nerve, and the pharyngeal branches of the vagus. Movements of the tongue and jaw have similar effects. Edible substances produce their effect by stimulating the taste fibres of the chorda tympani, and of the glossopharyngeal nerve.

Mechanical stimulation of the lower end of the oesophagus causes an increase in salivary secretion by means of the oesophago-salivary reflex. Similarly, the introduction of food into a gastrostomy produces a salivary response by the gastro-salivary reflex. Both these responses depend on the integrity of the vagi.

Salivary secretion which occurs when the mouth is empty is due to a wide variety of acquired reflexes. The

thought, taste, smell, or sight of food initiates these responses in which the higher cerebral centres play an essential part.

With such a complex system of reflexes it is obvious that measurement of normal salivary secretion is a matter of some difficulty, and is subject to many pitfalls. When estimating the resting secretion, the presence of apparatus in the mouth will give misleading results, since mechanical stimulation of the oral cavity gives rise to active salivary secretion. The method employed by Becks (1939) to measure resting secretion consists in obtaining specimens in a beaker which has been placed in contact with the lower lip, the patient leaning forward to allow all saliva to drip into the vessel. This method is subject to obvious criticisms, since saliva may be swallowed and oral breathing will cause evaporation. Spealman (1943), using a similar method, has attempted to gain greater accuracy in estimating the resting secretion by ensuring that specimens were obtained between meals, at the same time each day, and in patients who were not supervised and who were in a state of mental quiet.

The results obtained by these methods, however, show wide variation in the level of secretion in different subjects, and in the same subject when specimens have been obtained on different occasions. These variations apply not only to estimations of resting secretion but also to the active secretion obtained when the salivary reflexes have been stimulated by the chewing of paraffin gum (Wainwright, 1939).

The object of this paper is to record some observations made on salivary secretion in two patients, each of whom had been subjected to a somewhat unusual surgical procedure. During the course of these observations certain other features pertaining to fluid absorption by the mouth have been noted and are recorded and discussed.

Case 1

A married woman aged 47 was admitted to hospital on April 18, 1958, suffering from carcinoma of the middle third of the oesophagus. In spite of some difficulty in swallowing solid food her nutrition was good and she was not dehydrated.

On May 5 the entire thoracic oesophagus was excised, the cardiac orifice closed, and a gastrostomy established. The cervical oesophagus was exposed on the left side of the neck and delivered so as to establish a complete oesophageal fistula just below the medial end of the clavicle. This operation was the preliminary stage of complete oesophageal reconstruction. An adhesive ileostomy bag was fitted over the opening of the cut end of the oesophagus so that all salivary secretion, together with any fluids taken by mouth, could be collected and measured accurately.

Fig. 1 shows the salivary output for the first 16 days after operation. From the first to the sixth day fluids were not given by mouth, and the volume accumulating in the ileostomy bag represented the total salivary secretion. During this period the patient was given continuous intravenous glucose-saline. From the seventh to the sixteenth day various types of fluid (orange and lemon squash, milk, and water) were given by mouth in known quantities and on different days to study the effect of these as stimulants of salivary secretion. The volume of secretion was measured by subtracting the amount taken by mouth from that accumulating in the ileostomy bag.

It will be seen that during the first and second days after operation the total output of saliva was 45 ml. and 60 ml. respectively. This low output was attributed partly to dehydration, and partly to pre-operative medication and post-operative sedation. On the third day, when the patient

no longer showed any clinical signs of dehydration, the volume of secretion rose steeply to 450 ml. and thereafter fell gradually to a level of 120 ml. during the sixth day after operation.

On different occasions during the next 10 days, while the patient was being fed through the gastrostomy, various fluids were given by mouth, and the effect of these on salivary output was recorded. It will be seen that the giving of orange squash, milk, or even water stimulates salivary secretion, but that lemon drinks provided by far and away the most marked response, the volume secreted reaching a level of 545 ml. in 24 hours. On the days when water was given the volume of secretion varied between 85 and 120 ml., giving an average daily secretion of 110 ml.

Case 2

A man aged 72 suffering from carcinoma of the lower end of the oesophagus was admitted to hospital on September 11, 1958, in a state of severe malnutrition and gross dehydration. The operative procedure carried out was identical to that described in Case 1. Specimens from the cut end of the oesophagus were collected exactly as previously.

Fig. 2 shows the results in this case, observed over a period of 19 days after operation. During the first eight post-operative days the patient was instructed to take sips of water by mouth as and when he felt inclined, and his fluid intake was measured. In addition, he was given intravenous glucose-saline. It will be seen that in the first two days after operation 140 and 120 ml. less fluid was

FIG. 1.—Case 1. Post-operative salivary secretion. It was low in the two days after operation, followed by a marked increase on the third day, when the patient was well hydrated. Note low secretion when water is given by mouth, and the marked response to lemon. O=Orange squash. L=Lemon squash. M=Milk. W=Water.

FIG. 2.—Case 2. Post-operative progress. In this very dehydrated patient the volume of fluid obtained from the oesophageal fistula was less than the volume of fluid taken by mouth on 12 out of 19 days. It is suggested that these readings indicate fluid absorption from the mouth or cervical oesophagus.

obtained from the oesophageal fistula than the patient had actually taken by mouth. A similar deficit occurred on the fifth day, and on only three occasions during the first eight days was more fluid obtained from the fistula than was taken by mouth.

At first it was thought that the deficiency was due to leaking from the ileostomy bag, although no leak was apparent. It was therefore decided to observe him for a further period, and from the 8th to the 19th postoperative day he was given sips of water amounting to 600 ml. a day, and the volume obtained from the oesophageal fistula measured. It will be seen that on only one occasion was more fluid obtained from the fistula than was given by mouth. On all other occasions a deficit varying from 10 to 290 ml. was apparent. On the 13th day complete balance was obtained. During this entire period of observation the patient continued to be in a state of dehydration.

Discussion

Collection of Saliva

The method of obtaining specimens of salivary secretion described is an unusual one, and the opportunity of obtaining them occurred quite fortuitously during the course of a staged operation for excision of carcinoma of the oesophagus and subsequent oesophageal reconstruction.

The establishment of a complete cervical oesophageal fistula ensured that no salivary secretion was lost, and obviates the criticism directed at other methods of collection where saliva may be swallowed accidentally. No apparatus was present in the mouth, so that unwanted mechanical stimulation of the oral cavity did not occur, and in addition there was no loss of salivary secretion by evaporation as the result of mouth-breathing. The fact that the vagi were completely severed distal to the origins of their cardiac branches ensured that gastrostomy feeding did not affect secretion by initiating the gastro-salivary reflex; although, of course, psychic stimuli could still occur.

Estimations of secretions were carried out over a considerable period of 16 days in one case and 19 days in the other. After the patients had recovered from the operative procedure they were able to sit up in bed, read, talk to other patients, and be quite unaware that estimations of salivary secretion were in fact in progress. In these respects the conditions under which salivary secretion was studied were as nearly normal as possible.

Volume of Secretion

Normal salivary secretion is said to amount to between 1,000 and 1,500 ml. in 24 hours (Best and Taylor, 1955), this figure being a combination of both active and resting secretion during the period of the day. From the work of Spealman (1943) the estimated resting secretion varies between 220 and 838 ml. a day, while from that of Wainwright (1939) the estimated active secretion can vary from 408 to 4,560 ml.

It will be noticed that in Case 1, although the patient's condition was good, on no occasion did the total daily salivary output rise above 545 ml. In the five days in which no stimuli were applied, the average resting secretion was only 110 ml. in the 24 hours. When active secretion was induced by giving lemon drinks the highest daily output was only 545 ml. It would appear, therefore, that previous estimations of the volume of salivary secretion have been very much too high, probably due to the method of collection of the specimens.

It will be recalled that salivary secretion has been considered an effective neutralizing agent to gastric

secretion, but, in view of the present volumetric estimations, this neutralizing effect must be less important than was thought.

Water Balance

It is generally considered that the salivary glands play a part in the regulation of the water balance of the body. When the water content of the body is adequate saliva is secreted continuously, while in conditions of dehydration the dry furred tongue indicates that salivary secretion has been reduced with a view to conserving much-needed body fluid. This function is exemplified in Case 1 in that, during the first two days after operation, when the patient was dehydrated, the total salivary output a day averaged 52.5 ml., but when dehydration was combated adequately by intravenous infusion salivary secretion rose on the third day to a level of 450 ml. In certain respects, therefore, the salivary glands respond as do the kidneys in maintaining fluid balance.

Fluid Absorption by Mouth

An extensive search of the literature has failed to produce any work on fluid absorption from the mouth, although the absorption of drugs from the oral cavity seems to be a well-established practice. While Case 1 has shown that salivary output is greatly diminished during dehydration, Case 2 goes a stage further in that the findings suggest that fluid was actually absorbed from the mouth or the cervical oesophagus. During a period of 19 days during which the patient was sipping measured quantities of water by mouth, the volume of fluid retrieved from a perfectly sealed oesophageal fistula was on most occasions less than the volume of fluid that had been swallowed. This deficit varied from 10 to 290 ml. a day. A fluid deficit was actually present on 12 of the 19 days, and, as has been emphasized, this patient was in a condition of extreme dehydration. The explanation of this can only be that fluid was absorbed from the mouth or the cervical oesophagus.

It is interesting to recall the progress of surgical patients who are under treatment with intravenous fluid combined with gastric suction. From personal observation over some years it has appeared that patients sipping fluid by mouth while gastric aspiration is being continued become hydrated more quickly than does the patient to whom no fluid is given by mouth or where fixed quantities have been inserted through the intra-gastric tube. The findings in Case 2 may well explain this observation, in that in these circumstances fluid may be absorbed by mouth and supplement the intravenous therapy already being administered.

Summary

Estimations of salivary output have been described in two cases of special interest.

The low volume of resting secretion has been emphasized and the response to various stimulations has also been recorded. The daily output of saliva is very much less than that previously accepted.

Fluid absorption from the mouth or cervical oesophagus has been shown to occur in cases of extreme dehydration.

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