OTITIS MEDIA IN SUCKLINGS *

BY

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This subject of otitis media in infants has not received the attention it merits in this country; while there is a considerable French, American, and German literature, British references are few. That the subject is important its choice for this Centenary Meeting of the British Medical Association shows, and one of the functions of this discussion is to focus the attention of physicians on the ear as an important factor in the causation of illness in sucklings.

Why are sucklings considered worthy of discussion? The answer is that sucklings—infants in the first year of life—are delicate organisms who are learning to accommodate themselves to the environment of human life, building up a resistance to the infections that surround them. The majority succeed, but during this time three characteristics distinguish them. (a) They are peculiarly susceptible to infection both of the skin and of mucous membranes, and withstand infections badly. (b) They react to all disturbances of metabolism and infections in the same way, by disturbances of the gastrointestinal tract; they suffer from diarrhoea, they vomit, refuse food, lose weight, are restless and cry, and their temperature is often considerably raised. Diarrhoea, if severe, is a frequent cause of death, and the original cause of the diarrhoea may be undiscovered and escapes treatment. (c) They are unable to give any indication of their symptoms; they cannot tell us where their pain is.

A physician faced with an infant suffering from diarrhoea and sickness has to consider that the infant may have some hidden focus of infection, some serious disease—for example, anterior poliomyelitis, or some trivial error in diet. Post-mortem examination affords valuable evidence on the possibility of ear infection as a cause of illness. Necropsies on sucklings dying from diarrhoea and vomiting reveal lesions remote from the intestine; also it is noticed that in almost all infants, whatever the cause of death, purulent fluid is present in the middle ears. This infection has been therefore taken to be terminal, and to have no causal relation with the final illness. On the other hand, some cases show pus in the middle ear and antrum, thrombosis of the lateral sinus, and even meningitis—indicating that disease here was certainly not merely terminal, but the actual cause of the final illness.

The word "suckling" does not, I feel, confine our discussion to breast-fed infants, but includes those bottle-fed; the latter run risks of infection which the former should escape. Hygiene and proper feeding are of the greatest importance in maintaining normal health in babies. Even bottle-fed babies, kept under ideal hygienic conditions and fed correctly, escape infections of the upper respiratory tract. Dean and Daniels established a ward for study of normal infants. Newborn infants were placed in the ward and remained till the age of 2 years. They received a suitable diet and correct amounts of vitamins; the inorganic constituents of the food were regulated; and the infants were, too, in ideal hygienic surroundings. During the two years no laryngologist or otologist had to be called in to the ward. The infants were "followed up." Till the age of 7 none had a sign of dental caries. Only one case of mastoiditis occurred, and this was apparently due to accidental cutting off of fat by the mother.

However, in this country infants do not live in ideal surroundings, neither do they receive an ideal diet, and they certainly suffer from otitis media.

PATHOLOGY OF OTITIS MEDIA IN INFANTS

Anatomically the infant's middle ear offers an easier approach for infections from the nose and throat than the adult's, since the Eustachian tube is relatively shorter and broader. A suckling's skin and mucous membranes are very readily infected, especially by the streptococcus and pneumococcus. Infection in the mother or other member of the family is easily passed on to the infant, taking the form of "a cold" or pharyngitis, which may lead to otitis media. That the pharynx is inflamed is evident from the frequent association of an enlarged cervical gland and otitis media in infants. Infection in the middle ear once established may follow the usual course as in older children. Complications can follow: acute mastoiditis and even lateral sinus thrombosis and meningitis; both these latter conditions have been found at post-mortem examinations.

It is probable that infection reaches the mastoid process, or, indeed, the middle ear, through the blood stream in infants more often than in adults.

LATENT OTITIS MEDIA

It is evident that sucklings are unable to explain that they have an earache, so that otitis media easily escapes notice. This has led to the use of the phrase "latent otitis media," and much credit is due to Dr. Le Mée for emphasizing this feature of the disease in sucklings. Latent otitis media is a phrase which has two interpretations. Le Mée regards otitis media as the undiscovered cause of many illnesses in infants. He supports this view ably (a) on post-mortem examination of the ears of infants dying from various diseases, as was quoted earlier, and (b) on clinical observation.

Krassnig, on the other hand, recognizes a *real* latent otitis media without symptoms. He examined the ears of 290 infants. Of thirty-nine regarded as healthy eight were found to have suppurative otitis media; incision of the membranes revealed pus, and recovery was rapid. Krassnig also found that among 158 cases of latent otitis media with symptoms forty had no rise of temperature; in many pain was absent. He points out that deafness cannot be tested. He recognizes also the group of cases of latent otitis media of Le Mée.

THREE GROUPS OF OTITIS MEDIA

Briefly, then, we may consider three groups of cases of otitis media in infants: (1) *obvious* otitis media, with symptoms pointing to the ear; (2) *latent* otitis media, with no symptoms pointing to the ear—(a) *real*, discovered in infants apparently normal; (b) *pseudo*, with (i) general illness, crying, high temperature, and refusal of food, and (ii) diarrhoea and vomiting, so-called *parenteral*; and finally, (3) *tuberculous* otitis media.

Post-mortem investigation has shown that in the ears of all infants dead as the result of any disease there are signs of infection. Some show only redness and congestion of the tympanic lining; others, suppuration extending through tympanum, antrum, and mastoid. Lawrence performed necropsies on children dying as the result of diarrhoea and vomiting, and in some cases found otitis media, but no abnormality in the bowels. This investigation has been made in detail in the so-called parenteral otitis media.

Krassnig made a post-mortem examination of fifty-two children among 920 cases seen during a period of nine years. He found four groups of cases: (1) latent otitis media, (2) otitis media and bowel infection, (3) otitis media and mastoiditis, and (4) intracranial complications. The first two groups were latent, and the third and fourth obvious. He argues that intestinal disturbance is a cause of

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otitis media because infants admitted for the bowel complaints show normal membranes on examination; but, if the intestinal treatment is not successful, otitis media of a mild type develops and only clears up when the intestinal symptoms disappear. To refute the theory of intestinal infection from ear infection he quotes cases of bronchitis in which much sputum is swallowed but does not produce intestinal disturbance.

Though a great deal has been written about the combination of enteritis and otitis (parenteral otitis), I submit that too much stress has been laid on this group; that really it should be considered with latent otitis media; and that the enteritis is simply the reaction of the infant to the infection.

It is obvious from the foregoing that any case of illness in a suckling should lead to the examination of the ears, preferably by an expert.

SYMPTOMS AND SIGNS OF OBVIOUS OTITIS MEDIA

The first group includes few cases, and really differs in no way from any case of otitis media in older children or, indeed, in adults. Sometimes infants, usually older ones, put the hand up to the ears, roll their head, or knock it on the pillow or side of the cot. This will naturally lead to examination of the ears. Discovery of pus in the external meatus or on the pillow may give the indication of the presence of otitis media. This may have been preceded by some slight symptoms of illness, unaccustomed restlessness and crying, or may be the culminating feature of an illness during which the infant may have exhibited severe symptoms in addition to frequent crying, sleeplessness, refusal of food, vomiting, diarrhoea, loss of weight, and raised temperature, even to 104° and 105°. With the onset of discharge from the ear symptoms subside. The only symptom of note may be high temperature with loss of appetite.

Meningismus may be the first symptom of otitis media. Cases may be diagnosed as tuberculous meningitis, but recover at once on incision of the membrane. In some cases a swelling over the mastoid may be the first sign that otitis media is present. Zygomatic mastoiditis, too, is seen in infants: cases are known in which operation showed cells in the root of the zygoma in infants of 6 months. The youngest patient on whom I have operated for mastoiditis was 7 weeks old.

Examination of the tympanic membrane in infants is not always easy, in spite of the short external auditory meatus. An electric auriscope allows a really satisfactory view of the membranes, and its use may reveal changes otherwise overlooked.

Examination will show in mild cases little change, perhaps absence of the light reflex—Le Mée emphasizes the importance of this sign as an early indication of otitis. In others the usual signs of inflammation, a yellow tinge with or without dilated vessels, redness, and bulging are observed. It is to be noted that bulging of a normal membrane may occur when a child cries, and must therefore be regarded with caution.

Treatment

This follows the usual lines. Incision of the membrane should be carried out at once. Some observers fear that in doubtful cases infection may be introduced by incision, but with ordinary care I do not think this fear should be real. After incision the discharge is wiped away with pledgets of wool and drops of glyc. acid. carbol. and glycerin, equal parts, instilled into the ear. In a few days these are changed to drops of 5 per cent. argyrol. In a simple case recovery follows in one to three weeks. Should raised temperature persist and the child show symptoms of toxæmia, it will be necessary to open the mastoid antrum as in older children. Sometimes local

signs of mastoiditis develop, and, if not dealt with, other complications can occur—for example, lateral sinus thrombosis or meningitis.

The importance of speed at the operation is emphasized by all authorities, to avoid shock and reduce the amount of anaesthetic required. When it is remembered that many cases of infantile mastoiditis occur in the course of bronchopneumonia this factor of anaesthetic assumes great importance, as it does in the cases of parenteral otitis, in which the infants are desperately ill. Lierle and Potter wrote on this subject with special reference to the cases of diarrhoea and vomiting. They point out that the mortality is in the region of 44 per cent. to 67 per cent. The causes of death were: bronchopneumonia, 43 per cent.; post-operative collapse, 27 per cent.; septicaemia, 23 per cent.; and lateral sinus thrombosis, 7 per cent.

PNEUMOCOCCAL OTITIS MEDIA

This deserves separate mention, since sucklings are especially prone to pneumococcal infection. Hofman found that out of 1,008 cases in children up to the age of 14 years, 440 occurred below the age of 1 year, and 568 in children from 1 to 14 years of age. Among the 440 were 149 cases of acute otitis media, and of the 568, 146 cases. The percentage of suppurative otitis media in cases of infantile pneumonia is thus 33 per cent. in these figures (Hofman), but other observers put the figure much higher—75 per cent., and even 92 per cent. (Preysing). Hofman states that these high figures include mild cases that resolve.

Infection is generally carried by the Eustachian tube through coughing, sneezing, or vomiting, but sometimes by lymphatics or blood vessels. Evidence of lymphatic spread is found in the presence of pneumococci in the soft palate in cases of oedema of the soft palate. In support of blood-borne infection is the fact that emboli containing pneumococci have been found in the brain. The otitis may occur at all stages of pneumonia, or, indeed, may precede it. When it occurs in the early stages it is probably of septicaemic origin. Some observers state that cases of suppurative otitis media, with severe symptoms out of proportion to the local signs, should be suspected to have a central pneumonia, which may declare itself in a few days. X-ray examination of the chest may reveal a central pneumonia.

When complications of pneumonia are present the percentage of cases with otitis media rises, and the prognosis becomes more serious; especially is this the case with whooping-cough. Of twenty infants from 3 weeks to 1 year with pneumonia and whooping-cough and otitis media, eleven died. In some cases of pneumococcal otitis media meningismus may be the first sign of ear inflammation, but, on the other hand, cases of pneumonia exhibit meningitic signs (and pain in the ear) which disappear on recovery from the pneumonia.

LATENT OTITIS MEDIA

This may be divided into (1) real, in which this condition is only found accidentally, as was done by Krassnig in examination of several hundreds of infants, and (2) pseudo; as has been stressed earlier, in every sick infant the ears must be examined, and any abnormal condition of the membrane should raise the suspicion of otitis media and incision be performed. Sometimes the ears are suspect even though no change can be seen.

In some cases the membrane may show a normal appearance, even though the general symptoms raise the suspicion that the ear is the cause of the illness; and the subsequent course of the cases proves this to be so. No doubt in these cases the infection is primarily in the mastoid and is a blood-borne infection, perhaps pneumococcal, and the middle ear is secondarily infected.

ILLUSTRATIVE CASES

An Austrian observer had a case of an infant of 6 months, severely ill with high temperature, but showing no physical signs. The tympanic membranes were so nearly normal that he hesitated to open them, but did so; a very little pus escaped. The infant did not improve. He then opened both mastoids, which were found full of pus, and the infant immediately improved.

I had a similar experience with a child just over the infant's age (but this does not affect the case). He had a severe infection, probably influenzal, with a temperature of 103° to 105° for more than a week. A physician was unable to find anything wrong. The tympanic membranes were apparently normal, but nevertheless incisions were made. Even with a magnifying auriscope scarcely any secretion was seen, though twelve hours later a small amount of pus was observed in the meatus. No improvement followed, and twenty-four hours later both mastoids were opened and found to contain pus. Thereafter recovery began. It is almost certain that the mastoid suppuration was present before any otitis media, and infection may well have arrived via the blood stream. In support of this is the fact that the child had a low red cell blood count and only 6,500 leucocytes, suggesting the resistance was much lowered. It is possible this was a pneumococcal case.

The second group of pseudo-latent cases are those associated with diarrhoea and vomiting. This parenteral otitis media is to be dealt with by a subsequent speaker. I propose, therefore, only to quote a case which has recently been under my observation and which illustrates some of the typical features.

An infant of 9 months was admitted to Guy's Hospital on account of diarrhoea and vomiting. It was said to have had otitis media, from which it recovered fourteen days before admission. Diarrhoea and vomiting began one week later. The child was very ill and wasted. In the stools were found *Bacillus coli communis* and *Streptococcus brevis*. Twelve days after admission the left ear discharged pus. The following day examination showed the right membrane bulging; incision released pus, but no improvement followed. Therefore on the following day both mastoids were rapidly opened; the left one contained pus, the right antrum a little muco-pus only. The infant survived four to five days.

Post-mortem examination showed bronchopneumonia, follicular enteritis, and colitis, as well as the presence of pus in the mastoids, as at operation. No doubt the serious condition of the child led to concentration on treatment. Only discharge of pus from one ear led to examination of the ears. Even though the anaesthetic given was minimal, bronchopneumonia supervened.

TUBERCULOUS OTITIS MEDIA

It is always stated that this disease is common in infants. One observer (Logan Turner) stated that of cases of otitis media in infants under 1 year, 50 per cent. were tuberculous; others state that tuberculosis accounts for a large percentage in infants. Mygind, in 1922, in a review of 1,000 mastoid operations, found that in only 1.4 per cent. of the children were tubercle bacilli present in the pus, but considered that this figure greatly underestimated the frequency in children. All are agreed that when tuberculous otitis media does occur the prognosis is much better in the healthy than in the unhealthy. In my experience tuberculosis of the middle ear is not common in infants, and I suggest that it is a tradition to state it is so common. There is, of course, the possibility that it is getting less frequent with improvement in living conditions.

Tuberculous otitis media causes extensive destruction of the temporal bone; the facial nerve becomes involved; the labyrinth is attacked; and the glands about the ear enlarge and may break down. Sometimes both ears are affected, and double facial paralysis results. Operation may disclose so much disease that the dura mater is exposed and the labyrinth has become a sequestrum. On one occasion removal of the cochlea was followed by a

flow of cerebro-spinal fluid from the internal auditory meatus and continued for ten days; it then ceased, and the child made a good recovery. Infection is no doubt generally from milk, but not always so, since cases are seen in breast-fed infants, even with healthy mothers.

When tuberculous otitis media is diagnosed a thorough mastoid operation should be performed, and gives a very good prospect of recovery.

SENESCENCE *

BY

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Men, dogs, and horses show with age symptoms whose onset is conveniently called senescence; water voles, female plaice, sea anemones, and the bath sponge do not show senescence. I have suggested that senescence is the after-result of the mechanism which secures specific size.†

Minot concluded all cells to be senescent until they are rejuvenated by increase of nuclear substance, as effected in the ovum dividing after fertilization; the daughter cells subsequently increase cell body and return to senescence. Child writes (*Senescence and Rejuvenescence*, 1915, p. 460): "When the organism is adding to its structural substance, and transformation from more active to less active physical and chemical conditions takes place, senescence occurs"; he conditionally approves (p. 275) Minot's statement, "the rate of senescence is highest in youth and lowest in advanced life." Both views appear contradicted by the British Museum section of a giant redwood, felled with 1,335 rings of healthy wood, and by the giant cypress of Mexico (*Kew Bulletin*, 1922, p. 199), producing annual leaves and fruit in vigour, unimpaired by 5,000 years of cell division. Woodruff's paramonium culture has divided for more than twenty-one years without conjugation. Carrel's seventeen-year-old culture of cells from a chick heart, following Loeb's experiments on tumours, convinced Raymond Pearl (*Biology of Death*, p. 30) "that death is not a necessary inherent consequence of life in the somatic cell."

Pseudo-senescence and pseudo-specific size are often mere consequences of the decrease in ratio of surface to volume as size increases. Bath sponges stop growth at about thirty inches diameter, but grow on vigorously if divided with a knife into four-inch cubes (L. R. Crawshaw, *Reports on Sponge Fisheries*, Colonial Office, 1925 *et seq.*). Having no nervous system, interior cells cannot be rejuvenated by the knife. The flagellate cells must always draw in water through the surface and eject it through the large holes; with increase in size the relative diminution in surface requires higher velocity to feed the sponge, lengths of all channels are increased, and consequent friction becomes more than the flagella can overcome. Vegetative masses, aggregates of protozoa, tumours—all tend to be limited in size by necrosis of parts far removed from the surface.

For Child (p. 438), "biological importance of the relation between surface and volume rests rather upon a process of logic than upon the data of observation." But he records valuable experiments on change of size in flatworms, showing that rate of metabolism is always more rapid for the smaller worms. Analysis of his results shows that rate of metabolism varies inversely as length of the animal. His experiments prove, therefore, that rate of metabolism varies as ratio of respiratory surface to volume of tissue.

* Paper read in opening a discussion in the Section of Comparative Medicine at the Centenary Meeting of the British Medical Association, London, 1932.

† *Proc. Linn. Soc.*, 1925, p. 17, and 1926, p. 19; *Nature*, 1925, cxv, 156; British Association Report, 1927 (Leeds), p. 64.