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EUSTACHIAN TUBE IRRITATION

A New Concept of a Cause of Distress in Infants

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I have spent much of my working life seeing Children only in General Practice. For about 10 + years I have been especially interested in the relationship between distress in early infancy and ear problems. For some years I have been talking of the condition I call Eustachian tube Irritation [ETI], which I believe is a common cause of infant distress and is an early manifestation of ear problems in some infants. I have now seen 500 + infants presenting with distress who I believe have this condition.

To prove the theory requires a large scale controlled study that has not been possible so far.
I define a Distressed Infant as any infant whose parents believe is excessively irritable and has sleeping and/or feeding problems.

CAUSE OF EUSTACHIAN TUBE IRRITATION

I believe ETI is caused by a combination of Gastroesophageal reflux and Atopy.

GASTROESOPHAGEAL REFLUX

Reflux may be overt or covert. Overt reflux is the [usually] small curdy vomits that occur after feeds – sometimes for many hours after a feed – occasionally up to the time of the next feed. This needs to be distinguished from possetting – which is milk overflow – the fresh milk that may come up when the baby burps immediately after a feed. Possetting does not cause a problem – as the milk is virtually unchanged. The presence of curds in the vomitus indicates the milk has been mixed with stomach acid and enzymes and is thus irritant to the nasopharynx. .Covert reflux may be suspected in infants who gulp then chew and swallow, make a wry face as if they are tasting something unpleasant, have 'wet sounding' burps, or are noticed to often have a sour smelling breath or acid smell to their saliva. Frequent bouts of hiccupping may also indicate episodes of reflux.
Reflux is common in infants in the first 12 months of life - some say it is universal - and not all infants who reflux develop ETI. Many refluxers are well described as 'happy chuckers' - and the only problem their refluxing causes is the constant smell of vomitus, the increased washing load and many spots on the carpet.

However reflux is accepted as causing oesophagitis [ie inflammation of the lower end of the gullet] - causing pain on feeding, irritability and sometimes poor weight gain. Reflux is also accepted as a cause of recurrent chest infections, wheezing and sinusitis in some children. These problems may coexist with ETI. Although children with severe reflux may not gain weight adequately, most infants with ETI look healthy and are well nourished.

Reflux may be familial and recently a gene for reflux has been identified in some families where reflux has been present for several generations.
Most infants will stop refluxing when they are walking securely, some outgrow it even earlier when they are able to spend more time upright. A very small group of infants do not outgrow the reflux and these infants are more likely to have a very strong family history of reflux.

ATOPY

I use the term atopy [or allergy] to refer to people who have tissues that react excessively to an irritant.

In atopic people irritated tissues respond by producing swelling and mucus - in amounts greater than required to remove the irritant substance. The target organ for symptoms produced by atopic manifestations vary from patient to patient and with the age of the individual eg in infancy eczema may be apparent. Persistent snuffliness is not uncommon in these infants. Sleep apnoea from enlarged adenoids, loose bowel actions, asthma, hay fever, sinusitis etc may be later manifestations.
Food intolerance/sensitivity is also a manifestation of atopy. In a small proportion of infants reflux may actually be due to dairy product [and/or soy] intolerance. In breast fed infants food intolerance may be caused by particular foods in the mother's diet. Infants may also be sensitised to particular foods because of intake by the mother during pregnancy or lactation.

MECHANISM OF EUSTACHIAN TUBE IRRITATION -
the concept
I suspect that refluxing acid and digestive juices cause irritation of the nasopharyngeal tissues [i.e. tissues at the back of the nose and/or throat] near the opening of the ET. Because of the infant's atopic disposition, these tissues react excessively producing swelling and mucus. Swelling at the opening of the Eustachian tube causes difficulty maintaining normal Eustachian tube function - making it difficult for the infant to keep the middle ear at atmospheric pressure. Negative pressures develop, mucus collects in the ET and middle ear - and otitis media [ear infection] and/or effusions [fluid in the middle ear – also known as 'glue ear'] often follow - with many potential sequelae.

I suspect that discomfort results from the abnormal pressures in the middle ear and ET - especially when the infant is lying down [gravity effect] and sucking vigorously. Possibly similar to the discomfort felt when ascending or descending in a plane or going up or down a steep hill.
There is much evidence in the literature that interference with ET function is commonly followed by middle ear infection and/or effusion. This problem is well described in infants with cleft palate where the muscles opening and closing the ET may continue to function abnormally, even after surgery to close the palatal defect. ET dysfunction is thought to be the cause of the very high incidence of recurrent OM and effusions in these infants.

Infants are more likely to develop ET problems than adults because of differences in the anatomy and function of the ET eg. the ET in infants opens relatively lower than the adult Eustachian tube, runs at a smaller angle so doesn't drain especially well [this is worsened because young infants lie flat for much of the time], and contains a higher proportion of glands that produce mucus. Infants have lower levels of IgG2. This is a protein related to immune function – it is especially involved in

helping the body deal with infection from particular bacteria – those that cause ear infections, pneumonia and meningitis. Levels of IgG2 do not reach adequately protective levels until about 2 years of age, leaving the infant more susceptible to infections from Streptococcus pneumoniae and Haemophilus influenzae – 2 of the bacteria that are the most common causes of ear infections in infants and children. Haemophilus influenzae infections are less common after an immunisation for this bacteria was introduced several years ago. An immunisation for Strep pneumoniae [Prevenar] was introduced recently that is effective for infants under 2 years of age – and is now part of the government funded schedule. Children older than 2 and adults can be immunised for Strep pneumoniae with a different vaccine called Pneumovax. If used in breast feeding mothers this will give the infant some protection from Strep pneumoniae through the breast milk. I now check mothers' level of immunity to Strep pneumoniae before their next pregnancy and immunise with Pneumovax if the level is low. We need about 3 months before the next pregnancy to do the testing and the immunisation safely. [I also check whooping cough immunity levels and atopy levels. If the whooping cough immunity is low I recommend Boostrix immunisation. If the atopy level is high I suggest the mother takes probiotics for the last 6 months of the pregnancy and continue for the first few months of the infant's life also as this has been show at least to delay the onset of allergy problems in the infant].

SYMPTOMS OF ETI

The major symptoms of ETI are
Irritability
A desire to be upright
Sleeping problems
Feeding problems
Ear problems
Persistent snuffliness
Possible relief from 'non nutritive' sucking [i.e sucking without feeding].

1. IRRITABILITY

The infants may be excessively irritable, grizzle, cry or scream for prolonged periods without apparent reason.

2. DESIRE TO BE UPRIGHT

The most common position for comfort for these infants is being held up over a shoulder - the higher the better. Many prefer to have the parent standing, so there is maximum gravitational effect. Many mothers find they spend much of the day and night holding the infant in this way. One mother described her child as an 'altitude' baby. When lying down, gravity increases the discomfort in the ears.

3. SLEEPING PROBLEMS

The infant may be difficult to settle to sleep and wake frequently. Many parents nurse the infant upright over a shoulder until deeply asleep before putting into a cot or bassinet. An initial sleep of 3 or 4 hours may be followed by waking 1 - 2 hourly for the rest of the night. The baby is usually more distressed at each waking - not to mention the mother. Attempts to feed may produce more distress. Much of the night may be spent with the baby held up over a shoulder. On presentation to

me, several mothers had spent many nights sitting up in a rocking chair with the baby asleep over their shoulder as the only way to get any rest.

These infants often 'cat nap' during the day but for most, day time sleeping is less of a problem, as the infant is lying down for shorter periods.

7 to 8 months of age seems to be the critical age for establishing a normal daytime waking, night time sleeping pattern. If good sleeping patterns are not established by then, sleeping problems may persist for years - even when the original problem has been resolved.

Travelling in a car may be very distressing for some of these infants.

4. FEEDING PROBLEMS

There are 2 patterns of feeding behaviour - the first is more common.

[i] Distress on sucking

Breast feeding The infant may start to suck as if hungry then become upset and pull away. The mother may hold the baby upright or give a dummy, or both - then the infant may attempt to feed again. Some babies arch their backs and scream when offered breast or bottle.

Other infants use a technique I describe 'as feeding at a distance'. The infant takes the nipple in his/her mouth, puts a fist against the mother's chest and pushes backwards until he/she finds a distance at which he/she is comfortable. The areolar is usually not in the baby's mouth, but in this way the baby will feed comfortably. This may be quite uncomfortable for the mother, but if she tries to stop the infant pushing in this way, the baby refuses to feed at all.

Some mothers have stopped trying to breast feed because of the problems. This is very unfortunate as the infant may have problems with cow's milk and/or soy formula and the benefits from the added protection from infection with breast feeding are of great value in these otitis media prone infants.

Bottle feeding Bottle fed babies may only feed if held upright and most prefer a soft, fast flowing teat. I have seen several babies who have rhythmically squeezed the teat to reduce their own need to suck vigorously. When a new, stiffer teat was used the babies refused to suck.

However most infants can feed using a bottle if a suitable teat is found. Infants may then refuse to suck at the breast when they know they can feed without discomfort from a bottle.

[ii] Continuous breast feeding.

Some babies obtain comfort by slow, gentle sucking at the breast - and become distressed if the mother tries to remove the nipple. Some mothers are prepared to allow the baby to use this 'non-nutritive sucking' or 'fairy suck' [as one mother described it] if this keeps the infant settled, but most find it impossible or unacceptable to have the baby almost permanently attached in this way. 'Overfeeding' problems may result - causing abdominal pain and frequent loose green bowel actions that burn the skin - just to compound the distress. This is due to lactose intolerance from the extra lactose load.

Comfortable feeding is usually an early improvement with treatment of ETI.
Taking solids is not a problem for these infants.
I have a video showing the feeding behaviour of some of these infants.

5. EAR PROBLEMS

Some infants rub, poke or scratch their ears. Mothers may comment about this, but it is not always obvious to the mother because the infant is held close to them for so much of the time.

Ear infections may develop within the first few weeks or months of life. OM may be diagnosed when the baby is examined when the distress continues or increases. The first indication of an ear infection may be a discharge from the ear - seen as fluid [and/or blood] collecting in the ear lobe, or the mother may notice an unpleasant smell coming from the ear. Infants who develop ear infection in the first few months of life often become 'otitis prone' [more than 6 episodes in the first 12 months]. Recurrent infections and persistent effusions are a serious problem for these infants --- with many possible sequelae.

Some parents express concern about the baby's hearing on one or both sides, or the child may have 'failed' the Child Health Nurse's hearing check.

6. PERSISTENT SNUFFLINESS

Many infants with Eustachian tube Irritation are constantly [or intermittently] snuffly. This is suspected to be due to constant irritation of the lining of the nose from acid and enzymes in the refluxed milk. The tissues react by producing mucus. Overgrowth of bacteria normally present in small numbers in the nasopharynx may occur. Problems with persistent nasal infection may then occur – with further impact on the incidence of ear infection.

6. DUMMY 'ADDICTION'

Many infants obtain relief by sucking a dummy, fist or thumb. The suck these infants use to feed seems to be different to the suck they use with a dummy. Some infants suck their thumb long and hard enough to damage the skin, but this does not deter them. A few babies suck their own tongues or will suck mother's shoulder or any item of clothing, sheet or blanket.

Thumb sucking and use of a dummy are very common in infants. I have never heard a physiological explanation that I feel really explains why infants find this type of sucking so satisfying. I suspect that it is related to Eustachian tube pressure changes, though it may later become a habit.

As mentioned earlier some infants will only settle if allowed to remain sucking gently at the breast all the time - using mother as a 'human dummy'.

NATURAL HISTORY OF ETI

I believe ETI can occur at any degree of severity.
Reflux may start from birth or as late as 3 months of age and the infant become distressed days or weeks later. Infants may be irritable within days of birth or not become distressed until several weeks or months old.

Mild ETI.

In its mildest form, the infant may have discomfort for a few months, without ear infection developing. Perhaps they learn to 'ventilate' their ETs by dummy or thumb sucking and settle when they are taking more solids [less reliant on sucking], are able to sit up by themselves [so spend less time lying down] and the refluxing is less frequent. However, I suspect that although these infants are no longer distressed, some may later be found to have hearing loss from effusions - found when their speech development is delayed - or even later when they are not making good progress at school. By then the story of distress in infancy is not thought to be relevant.

Severe ETI

These infants may go from distress to frequent recurrences of ear infections usually with effusions. The potential sequelae for these children are far-reaching. [see below]. Usually ETI is worst in the first year of life, less severe in the second year, then less of a problem after the infant's 2 year old molars have erupted.

Infants with ETI may have severe reflux and mild allergy problems, or mild reflux with a background of severe allergy. The most severely affected infants usually have severe reflux and a strong allergic background

Infants with ETI may have other problems related to the reflux eg oesophagitis. It is not uncommon for refluxing infants to have been tried on medication for reflux, but when they continue to be distressed the treatment has been discontinued - the mother being told that the reflux is not the cause of the infant's distress.

Problems related to other aspects of the allergies and food intolerances may also be present eg. eczema, snuffliness, persistent cough, loose bowel actions etc. These children may later develop other allergy related problems eg. problems from house dust mite, pollens, food allergies and intolerances. Symptoms of hayfever, sinusitis, large tonsils and adenoids [causing snoring or sleep apnoea] may develop later.

DIAGNOSIS OF ETI

To diagnose ETI in a baby presenting with 'distress' requires some of the symptoms described; evidence of refluxing [overt or covert]; evidence of atopy, or a family history of allergic problems; typical ear drum findings and typical tympanogram appearances.

ALLERGY

In very young infants the only suggestion of allergy may be the finding of dry or sensitive skin before possibly later developing eczema. First degree relatives may have asthma, eczema, hayfever, sinusitis or food allergies. Siblings may have been 'distressed babies', had frequent ear infections, speech or language delay or have the large tonsils and adenoids that can cause sleep apnoea.
it is now thought that the chance of allergic problems in the infant increases if the mother has been given antibiotics during pregnancy or the infant has been treated with antibiotics in the first few weeks of life.

APPEARANCE OF THE EAR DRUMS

The ear drums usually look pale, dull or granular before the appearances of infection or effusion develop. I describe this appearance as looking like calico or parchment instead of silk!
This early abnormal appearance is easily missed as the drums are not red and looking at ear drums in small infants is often difficult.

TYMPANOGRAMS.

provide objective evidence of Eustachian tube problems. The graph often has mildly to moderately negative pressures [without the infant having an URTI] or a wide base and/or rounded top. These changes typically precede type B [flat line] graphs developing - indicating effusion is present. As the child's clinical picture improves [or deteriorates], the changes are reflected in the tympanogram.
In an infant younger than 5 months, if the tympanogram is normal done at a standard 226 Hz it may be useful to retest using a higher frequency tympanometer as this will overcome the problems of high compliance of the external auditory canal and drum seen in very young infants.

OTHER FACTORS making infection more likely

Although not part of ETI other conditions may compound the problem by making the infant more susceptible to infection. These include prematurity, nasal septal deviation from birth trauma, blocked tear duct, conjunctivitis, purulent nasal discharge, and perhaps use of naso gastric tubes.
If the ear infections are slow to respond to treatment and recur frequently and/or other infections are present eg. skin infections, it may be worth looking for immunity problems, as some of these are now treatable. Neutropenia and IgG subclass deficiency are not rare in these infants and are treatable. Other immunity problems may also be present but are not specifically treatable – but make using antibiotics more frequently an acceptable form of treatment. These immune function problems include complement deficiency and mannose binding lectin problems.

RISKS AND SEQUELAE OF ETI

There are many possible implications for infants with this condition;

Physical abuse or NAI [non accidental injury]

Parents become tired and stressed by this difficult baby and the infant may be at risk of injury when parents can no longer cope. Parents are often told there is nothing wrong with the baby.
Explanations for the crying include:- all babies cry; the mother does not understand the baby's signals; the baby is naughty or bad-tempered; fussy or 'high needs'; the baby has been spoilt or overstimulated by being picked up all the time or that 'bonding' has not occurred.
In this situation, together with lack of sleep, it is very easy for the mother or other carer to lose control and shake or otherwise damage the baby. A common explanation for the loss of control is 'I couldn't stop the baby crying'. The reason for the crying is rarely explored.

Personality development

Children who were labelled as 'difficult' as infants often continue to wear this label. They often lack self-esteem. Behaviour problems are common and may be due to several factors, including separation difficulties and delay in being able to communicate. Many of these children seem to be introverted, sensitive, highly intelligent children.

Family problems

Family relationships take lots of strain. Older children may resent the attention given to the baby,

although at least on the surface, some siblings may be over protective of the baby. Mothers function poorly with lack of sleep, so time spent with other children may not be good quality time. Mothers may be labelled as having post-natal depression, but depression often improves dramatically when the diagnosis is established, the baby begins to improve, and the mother has several good night's sleep. Fathers and other relatives may or may not be helpful - but everyone has lots of advice to offer which increases the mother's feelings of inadequacy.

Hearing loss or distortion may cause speech and language delay, articulation difficulties, communication and behavioural problems.

Balance problems- may be seen as delay in walking unaided, frequent falling, perceptual motor problems and later also problems playing sport.

School learning problems - may be due
[1] to current hearing problems although the ears and hearing may be normal when tested because of the fluctuating nature of the problem or
[2] developmental problems may be the aftermath of hearing problems earlier in life.
Central Auditory Processing Disorder [CAPD] may result from middle ear infections and/or effusions causing lack of 'imprinting' from distorted or reduced hearing in the first 2 - 3 years of life when brain development is at its maximum. Auditory processing problems including auditory sequencing problems, auditory memory problems, auditory discrimination problems etc may be present in children who do not have active ear disease. Children with CAPD have difficulty concentrating, difficulty learning in a noisy environment, and benefit from one - on - one teaching. These symptoms are often present in children with Attention Deficit Disorder [ADD] and some people believe that ADD may be the result of CAPD in some children. A history of distress in infancy and/or recurrent ear infections may be found on enquiring into the child's early history.

CAPD may be extremely difficult to treat – some workers in the field believe that CAPD is not curable – that children learn to compensate for the problem to more or less degrees. Others believe that the brain may still be 'plastic' enough to deal with the difficulties CAPD produces.

Although my numbers are limited I suspect that if children were already at least 8 or 9 months of age when diagnosed and treated, they are more likely to have complex school learning problems than the infants who started treatment when a few weeks of age. I believe this has important implications for early diagnosis and treatment.

Sleep problems may continue for long periods, often years. There is evidence that when sleep rhythms are not established by 7 or 8 months, the frequent waking will continue even when the original cause has gone.

TREATMENT
Infants are treated according to their individual symptoms.
Management may include:
Treatment of ETI
Treatment of ear infections / effusions
Treatment of reflux
Management of allergic problems,

Support and information

Long term follow-up

- hoping to prevent sequelae or deal with them as early as possible. Programs for auditory stimulation may be useful to prevent sequelae particularly Central Auditory Processing Disorder. Speech therapy can be started at a very early age in 'at risk' infants to try to prevent speech and language delay.

The basics of management are:

Prop the infant whenever possible - elevate the head of the cot, carry baby in sling, use of a Fraser - style chair etc.

Decongestants The type of decongestant used and dosage regime is adjusted for each baby. The literature suggests that effusions are not altered by the use of decongestants, however there is marked symptomatic improvement with a suitable regime of decongestants in most of these infants [with or without effusions being present]. A trial of decongestants is sometimes used to confirm a suspected diagnosis of Eustachian tube Irritation eg in very young infants when the tympanogram may be equivocal [using a 226 Hz tympanometer].

Antibiotics for ear infections. Treatment courses should continue until the infection is well controlled. This may require full or maintenance dose for many weeks.

Treatment of reflux may require thickened feeds [if bottle fed], occasional doses of antacids, PPIs or H2 antagonists. Prokinetic agents are rarely needed with the advent of the newer PPIs but still occasionally used by gastroenterologists for severe reflux especially if the weight gain is poor. Early introduction of low allergenic solids may be helpful for some infants.

Allergic problem management may include trials of withdrawing dairy products, soy products or other specific foods from the mother's and/or infant's diet. A full dietary family history may be useful to determine whether particular foods cause problems for close family members – helping to determine which food exclusions may be worth trying.

Reduction of risk factors for OM is also important. This may include looking at and modifying factors eg swimming in indoor heated public swimming pools; stopping contact with people who smoke; reducing contact with other infants who may have URTIs etc [i.e. changing from large Day Care to Family Day Care];; clearing blocked tear ducts [causing recurrent conjunctivitis], stopping the infant feeding while lying flat etc.

Ventilation tubes [grommets] Referral to an ENT specialist for ventilation tubes is indicated when the infant fails to respond to medical treatment, medication is not tolerated, ear infections are not controlled by antibiotics, the need for antibiotics is excessive, or effusions persist despite medication - causing hearing loss - especially before speech is established.

There is usually good, sometimes dramatic improvement after insertion of tubes, though some infants need to continue some medication as ventilation tubes do not prevent swelling and irritation at the pharyngeal end of the ET.

There is often dramatic improvement in hearing within hours or days of tubal insertion. The need for antibiotics is usually greatly decreased. Discomfort associated with feeding improves. Infants may

reduce the need for a dummy or continuous breast feeding. Most become comfortable lying flat. Improvement in sleep patterns occurs, but the end level depends mainly on the age of the child.

However most infants do not wake distressed and resettle easily. Behavioural management then is usually successful. Many infants need to be taught to settle to sleep without being held or fed. Children whose infections begin in the first weeks of life and those with difficult to control infection are most likely to need and benefit from ventilation tubes. If symptoms recur when the tubes are extruded, reinsertion may be required. Parents are usually keen for grommets to be reinserted or be inserted early if siblings develop the same problems.

Medical treatment of Eustachian tube Irritation shows gradual improvement over 10 to 14 days, but flare-ups are not uncommon - usually associated with an increase in refluxing, 'colds', teething and immunisations.

These infants and their families require time, patience and understanding in dealing with the problems - but the results are very rewarding.