

INVITED REVIEWS

The Effective and Rational Treatment of Secretory Otitis Media

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In the absence of any acute otological symptoms including pain and temperature, a middle ear effusion in association with hearing loss has been designated by various names, i.e. catarrhal otitis, exudation otitis, serous otitis, nonsuppurative otitis, glue ear, and currently the most fashionable terms, otitis media with effusion and secretory otitis media. A middle ear effusion without inflammatory clinical manifestations is, however, not an otitis; but rather, a sequela to an otitis of more than one possible cause. It may also be associated with atelectatic tympanic membranes, barotrauma, Wegener's granulomatosis, and carcinoma of the nasopharynx. The most important reason for using the appropriate nomenclature is for the sake of a more precise communication and of a better insight into this entity and its treatment: the term 'otitis' may suggest an active inflammatory process that requires anti-inflammatory treatment, which is usually not the case in the presence of a banal middle ear effusion. The most appropriate term for middle ear effusion in general is "sequela to otitis media" as middle ear effusions in children are mainly a sequela to viral otitis media, while those seen in younger children (1-2 years old) are mostly secondary to bacterial otitis media. Last but not least, chronic secretory otitis media is not a sequela to a previous middle ear inflammation and its etiology is still obscure.

The historian Lord Acton (1834-1902) coined the phrase: "Facts are sacred, but interpretations are optional." In fact, we fail only too often to examine the pertinent data and at times take our (or others') interpretations or theories at face value. In order to evaluate effectively the traditional clinical treatments for secretory otitis media (SOM), it might be correct at first to separate the facts from the theo-

ries that have been put forward over the years with regard to the nature and medical treatment of SOM. As a second step, we should ask ourselves what we want to achieve with our treatment and then, what can actually be achieved with the means that are available today. In other words, what kind of a pathological process do we want to influence and what can be achieved to this end?

As SOM is, in most cases, a self-limiting disease, it is important to know first what its natural history is, that we would like to influence therapeutically and whether it is a single pathological entity. Secretory otitis media is basically characterized by the presence of an effusion in the middle ear in the absence of acute inflammatory signs.^[1] The name otitis media is misleading as it may also embrace acute otitis media and should be better dropped. The middle ear effusion often appears after acute otitis media or an upper respiratory infection and contains proteins similar to those found in an inflammatory exudate, and, in addition to regular plasma proteins to the amount of about 7.5 mg%, it also contains other proteins, i.e. glycoproteins and a higher content of gamma globulins which turn it quantitatively into a more abundant protein-wise effusion (11.5%) than that found in transudates. The meaning of these facts is that the middle ear effusion is not the result of an *ex-vacuo* mechanism. It is not secondary to an Eustachian tube obstruction.

Then, new questions emerge: what produces this inflammatory effusion and why does it not disappear? The normal lining of the middle ear was traditionally considered to be made up of a flat epithelium devoid of cilia or of mucus-producing cells. However, this turned out to be erroneous when it became obvious that the physiological mucosa of the inferior part of the middle ear is made up of a modified respiratory mucosa,^[3] with active cilia beating towards the Eustachian tube.^[4] This respiratory lining includes mucosal cells and sometimes even small glands that produce mucus which is swept (under physiological conditions) by the cilia towards the Eustachian tube and then into the nasopharynx. Histological studies of temporal bones from patients with SOM have shown that many of these mucosal cells undergo a metaplastic transformation from the normal into many more mucus-forming cells and glands.^[5] This metaplastic mucosa produces an excessive amount of mucus, which may fill the middle ear with an effusion, often having a glue-like character. It is the middle ear effusion that impedes the sound waves from reaching the inner ear, resulting in hearing loss. However, with time, the metaplastic mucosa of most ears usually undergoes a spontaneous reversion to a normal mucosa, resulting in cessation of producing mucus, after which the ear assumes its

former appearance of a 'gas pocket' that affords a favorable environment for the transmission of sounds. Hence, treatment of SOM should be focused on achieving two basic aims, namely to get rid of the effusion in the middle ear, and to influence the mucosa not to produce an effusion. The effusion may stay in the middle ear for days, weeks, months, or even years, thereby bringing about an average hearing loss of 25 dB, it may reach 40 dB or above, as well. Actually, 95% of the ears will clear their effusion in one to four months. In infants, the middle ear effusions may lie in the background of recurrent acute otitis media. Thus, our therapeutic approach should include speeding up the removal of the effusion and preventing it from forming again.

Originally, a disorder of the Eustachian tube was thought to be responsible for the basic process seen in SOM.^[6] It was postulated that a primary 'lesion' might block the Eustachian tube or narrow its lumen, or alternatively, some hypothetical 'malfunctioning' of the Eustachian tube might prevent air from entering the middle ear. Under these circumstances, a vacuum would be created in the middle ear, producing a sucking effect on the mucosal blood vessels that would result in the filling of the middle ear with a transuded substance; hence the classical *ex-vacuo* theory.^[6] But, as was pointed out above, the biochemical composition of the effusion excludes its *ex-vacuo* origin. It was also reasoned that interference with the Eustachian tube function by blockage, narrowing, or 'malfunction' would hamper the passage of the middle ear effusion through the Eustachian tube into the nasopharynx.

The wide acceptance of this theory and its repeated appearance in relevant articles somewhat overshadowed the need for unbiased and rigorous inquiries into the basis thereof. However, once the attention was focused on the Eustachian tube, histological studies of the tube and its lumen showed that the tube was not obstructed. Moreover, the diameter and the cross-sectional area of the lumen were not found to be narrowed at any site along the entire length of the Eustachian tube in patients with SOM, compared to normal controls.^[7] These findings were further substantiated by direct fiberoptic vision.^[8] Histological studies showed that the main inflammatory finding of the mucosa in SOM, as in acute otitis media, was that concerning the middle ear

itself,^[9] the Eustachian tube only being affected secondarily and to a minor degree.

Despite the fact that many children who suffer from SOM have enlarged adenoids, it has been known for quite a long time that many other children normally have enlarged adenoids, without the presence of diseased ears and exuded material. In addition, quite a few children who suffer from SOM have no adenoids at all. Indeed, most chronic SOM cases as well as practically all adult patients suffering from SOM have no adenoids simply because of previous operations to remove their adenoids or of spontaneous disappearance.

The first meaningful data showing the lack of a major effect of adenoids on mucus clearance from the middle ear came from a study comprising four groups of children with SOM, each of which was subjected to different treatments (Table 1).^[10,11]

In the first two groups, the patients were treated with adenoidectomy. All had a ventilating tube being inserted into the tympanic membrane with (group A) or without (group B) aspiration of the mucus from the middle ears. In the remaining two groups, adenoidectomy was not performed. Following a paracentesis, a ventilating tube was inserted into the tympanic membrane with (group C) or without (group D) aspiration of the mucus from the middle ears. In the two groups in which the mucus was removed, insertion of the ventilation tube was preceded by aspiration.

Within five days after the operation, hearing was measured in all the patients and, surprisingly enough, was found to be similar in all the groups (Table 1). On microscopic examination of the ears, most of them were found to be free of an effusion. The same appearance was observed by viewing the middle ear cavity and the external ear through the aerating ventilating tube. The common denominator for all the groups was the ventilating tube. Addition of adenoidectomy or aspiration of the effusion did not exert a significant effect on the outcome.

However, a year and a half later, a small difference in terms of a more improved hearing emerged in patients treated with adenoidectomy. Although this finding, as discussed later, suggested certain implications as to the nature of SOM, it was clear that the adenoids, as a whole, were not involved in the clearance of mucus from the middle ear. Since the presence or absence of aspiration and adenoidectomy were not associated with the immediate improvement in hearing seen within the first few days after the operation, this could solely be accounted for the evacuation of the effusion through the ventilating tube.

The mechanism of the process in question was experimentally demonstrated by Hilding^[12] who filled an isolated hen trachea with mucus and closed one end of the trachea with a cork into which a manometer was inserted. The mucus was seen to stream forward, then slowed down after a while, and finally, its movement stopped. At this point, the manometer showed a negative pressure that was generated behind the mucus plug. When the mucus was at rest, Hilding made a small hole in the pipe leading from the manometer to the trachea. This promptly released the negative pressure, after which the stream of mucus resumed. Apparently, the flow of mucus was due to tracheal ciliary motility.

Hilding's experiments throw light on what actually happens in SOM. Like the hen trachea, the Eustachian tube (and the anterior part of the middle ear) is lined by cilia and, in SOM, is filled with effusion. Indeed, the entire middle ear is filled with mucus.

Why the removal of adenoids in two groups of children was associated with a higher rate of improved hearing after a year seems to be related to an increased likelihood of children not to suffer from ascending infections from the nasopharynx into the middle ear. Indeed, there is evidence that the adenoids are an infective source for the middle

Table 1. The results of different treatments in four groups of children with secretory otitis media (116 ears)

Group	No. of ears	Adenoidectomy	Ventilation tube	Aspiration	Air-bone gap (dB)		
					Preoperative	Postoperative	Long-term
A	27	+	+	+	33.75	9.5	9.5
B	23	+	+	—	33.0	8.4	10.0
C	32	—	+	+	32.5	8.3	12.7
D	34	—	+	—	30.2	6.2	12.7

ear, contributing to the occurrence of otitis media or SOM. By restriction fragment mapping analysis of genomic DNA, bacteria cultured from the nasopharynx and the middle ear were found to be identical or indistinguishable from one another, suggesting spread of the bacteria from the nasopharynx to the middle ear.^[13] Thus, by removing the adenoids, we do not cure SOM; but to some extent, we increase the chance to prevent its recurrences through eliminating a possible source of infection.

Secretory otitis media is basically a sequela of otitis media, or of an upper respiratory infection, either of which can be detected by means of the patient's history, histological examination of the middle ear, and analysis of the middle ear effusion. As with any mucosal inflammation such as bronchitis or rhinitis, SOM is also associated with an inflammatory exudate, often mucoid in type. Normally, the mucociliary system sweeps the mucus or an inflammatory exudate from the middle ear into the Eustachian tube, and then, into the nasopharynx. Yet, this process is impeded in the presence of an excessive inflammatory exudate that fills both the middle ear and the Eustachian tube. The perpetuation of ciliary activity against the heavily blocked Eustachian tube results in a negative pressure in the middle ear (remember Hilding's experiment). This negative pressure will inevitably increase in an environment where the available gas is continually absorbed through the middle ear lining into the tissues, and no gas can re-enter the middle ear because of the mucus obstructing the Eustachian tube.

The therapeutic answer is the ventilating tube. When a small hole is created in the eardrum, the fresh air will equalize the middle ear pressure with the air pressure outside, the vacuum (negative pressure) will be released, and the ciliary motility will now be able to force the mucus to move through the Eustachian tube and the nasopharynx. All this was achieved when a paracentesis was performed. The ventilating tube helps keep this small hole open and maintain a stable entrance of the fresh air for a relatively long time.

How can we influence medically this inflammatory process and the sequence of events? Can we prevent it? Can we control the reactive production of excessive effusion or limit the duration of its production? Can we influence and revert mucosal

metaplasia? Can we speed up medically the clearance of mucus?

When the natural history of SOM is examined, it is found that most ears will resolve, sooner or later unaided. Usually, the mucosa will stop exuding and synthesizing excessive mucus, and the effusion produced will be cleared from the middle ear spontaneously.

There is, of course, little point in treating very short-lived situations, but there is a good reason for treating those associated with long-standing hearing losses. Let's remember, there is no solid evidence that the effusion itself adversely affects middle ear tissues. What is mainly at stake is the hearing.

It is difficult to predict the length of time an effusion will linger in the middle ear; so far, the only parameter that has been shown to be correlated with the prognosis of SOM is the degree of mastoid pneumatization. Ears with a relatively good pneumatization have a much better prognosis and a shorter course of SOM than ears with a small mastoid cellular complex.^[13-18] The exact reason for this eludes us for the moment.

After analyzing 803 infants and children with SOM as well as 103 adults with SOM, we have realized that we are dealing with three entities.

SOM A – Children whose average age is close to two years show a recent history of acute otitis media and their effusion contains a meager amount of bacteria in only 17% of the specimens which cytologically also presents mainly polymorphonuclears.

SOM B – Children whose average age is circa five years often have a history of an upper respiratory infection without preceding acute otitis media. Their effusion is sterile in all the cases and contains a relatively small amount of cells, mostly lymphocytes.

The third group is composed of chronic SOM cases, defined as SOM, which require two or more ventilating tubes. Their effusion is always sterile and does not contain inflammatory cells at all.

Theoretically and practically, there are seven processes to which we would like to direct our therapeutic efforts to prevent or cure SOM, to achieve both the cessation of mucus production and the prompt clearance of previously formed mucus.

1. Acute otitis media

As SOM is often a sequela of acute otitis media, i.e. type A, can we influence and reduce the number of cases presenting as recurrent acute otitis media?

2. Upper respiratory infections

We would like to prevent the occurrence of type B SOM by reducing the number of respiratory infections. This arises several questions: can immunization reduce the number of upper respiratory infections or can vigorous treatment of upper respiratory infections reduce the frequency of ensuing SOM or the number of SOM episodes per ear?

3. The role of antibiotics

Can treatment of acute otitis media with antibiotics prevent SOM or speed up clearance of an effusion?

4. Clearance of the effusion

Is clearance related to the degree of mucus viscosity? Are there therapeutical means to influence the mucus, the cilia, the Eustachian tube, or the pneumatic system of the mastoid?

5. Middle ear mucus

It would be very helpful if we could reverse the number of metaplastic mucus cells or reduce the period related to effective mucus formation, both of which would control and limit the formation of an exudate in the middle ear.

6. Middle ear pressure

Can we influence middle ear pressure?

7. Chronic SOM

Can we prevent the development of chronic SOM?

In essence, the questions above are brought forward to find ways to reduce the rate of SOM occurrence by medical means and to speed up the clearance of a middle ear effusion should it develop in a particular ear.

1. Prevention and treatment of acute otitis media

Most cases of acute otitis media will resolve at the same speed whether or not they are treated with antibiotics, and there is no evidence, so far, that treatment with antibiotics will reduce the number of ears with an effusion.

2. Antibiotic treatment for SOM

There is growing evidence suggesting that antibiotics have no influence on the course of SOM, and

consequently, they should not be used to treat SOM. This is especially true for type B and the chronic cases, both of which are bacteriologically sterile.

3. Upper respiratory infections

The only way to prevent upper respiratory infections is to keep the child at home away from other children in the kindergarten. This is also true for acute otitis media, but not all mothers can afford this as many have to go out to work.

4. Treatment directed towards the physical composition of the effusion

To speed up clearance through lowering the viscosity of the middle ear effusion, injection of mucolytic agents (such as urea) into the middle ear did not prove beneficial, and was abandoned. Also, *per os* medication of any mucolytic agent is no longer considered useful.

5. Treatment of the mucosa

Antihistamines are very popular agents in the medical treatment of SOM, the rationale being that they are to depress the secretion of goblet cells and glands of the middle ear mucosa. However, they were not found to influence the course of SOM.

6. Is there a treatment to improve middle ear pressure and the function of the Eustachian tube?

Active inflation of air through the nose and the Eustachian tube into the middle ear may relieve middle ear negative pressure and may improve hearing and clearance of some effusion. Indeed, many patients note improvement in their hearing following politzerization. However, this maneuver is of very limited value because the beneficial effect dissipates within about half an hour. The use of repeated insufflations, which was the routine years ago, is rarely considered today, because it offers momentary relief and has not been found to shorten the natural course of the disease. It was also thought that having a child blow up a balloon (an activity which children may be engaged to pass the time) might help, but this was found not to be the case in long-standing SOM. Finally, decongestants are widely used in SOM, in the belief that they may help reduce the hypothetical congestion of the Eustachian tube. However, it turned out that they are not beneficial.

7. Anti-inflammatory treatment and corticosteroids.

Corticosteroid administration has been advocated as an effective medical treatment for SOM, on the basis that SOM is an inflammatory and, possibly, an allergic condition. However, the therapeutic effect of corticosteroids is rather controversial and doubtful, especially in the more chronic cases of SOM, where help is most needed. Furthermore, SOM is basically not an allergic condition and corticosteroids are not innocent drugs and, therefore, their use in the treatment of SOM cannot be recommended.

In summary, it seems clear that all the medical treatments hitherto known have been found to be ineffective in reducing the frequency of SOM, in preventing the production of middle ear effusion and the synthesis of mucus, and in speeding up the clearance of effusion from the middle ear. We do not know how to medically treat and release the negative pressure in the middle ear for longer periods than the very short time afforded by politizerization. Of all known medications, none has a desirable influence on the Eustachian tube or the middle ear cilia; besides, neither of the structures has been identified as being diseased to require treatment.

Therefore, with the exception of the prudent use of antibiotics only in a minority of patients with acute otitis media and prophylactic antibiotic use when recurrent acute otitis media is the case, we basically do not have a medical treatment. Mild and short-lived SOM is best treated by expectant therapy, namely watching the child and waiting to see whether the disease will clear within a reasonable period. More obstinate cases may require something more other than medical treatment. One should remember that the only reason to treat SOM is a hearing loss which is disturbing enough to warrant active intervention, namely a ventilation tube which is mostly very effective though only for an average of six months. It may sometimes require reinsertion when it is extruded.

Long-standing chronic SOM is the most frustrating situation, and it is in this situation that antibiotics or any other medications are particularly ineffective, useless, and even detrimental.

Upon this definite denigrating attitude towards the medical methods of treatment in SOM, I can

imagine that some are ready to make a counterargument by exemplifying several cases of “favorable” results “obtained” following the administration of anticongestants, antihistamines, an antibiotic course or two, or other medications.

It is here where we should remember to refer to the natural history of SOM: these cases most probably improved not because a specific treatment had been efficacious and helpful, but because the natural history of SOM had run its course. Just like so many instances of “favorable results” that are known to occur after people’s seeking remedy from alternative medicine, homeopathic drugs, etc!

It is in the realm and particular expertise of experienced physicians to know when to wait for spontaneous recovery, when to suggest the insertion of a ventilating tube, and when to supplement this with an adenoidectomy. It is here where a specialist will feel that he/she is practicing the art of medicine and enjoying the privilege of being an experienced physician.

On what anatomical grounds can we draw a line between patients with a short history and those with a very long history (years) of effusion? Will the former suffer the same fate as do the latter? Are they going to be candidates for multiple insertions of a ventilating tube? In very young pediatric patients, SOM occurs following acute otitis media or an upper respiratory infection and usually disappears after a season or two, providing that they undergo a normal development of the skull base and mastoid pneumatization. However, those ears in which the size of mastoids lags behind normal or remains small usually have a longer history of SOM.

On the other hand, children in whom SOM appears after infancy, namely at the beginning of childhood or at the ages of four or five, have a greater tendency to develop chronic SOM, without necessarily having experienced recurrent acute otitis media before. These children are also more prone to develop atelectasis or a retraction pocket, which may eventually (in about 1%) turn into a retraction pocket cholesteatoma. The common denominator for chronic SOM and the development of tympanic membrane retraction is an underdeveloped mastoid.

The old notion that atelectasis is a sequela of SOM and that the middle ear effusion lies at the root

of the retraction of the tympanic membrane^[1] is incorrect and unsubstantiated. While infections and inflammations are at the root of acute and subacute middle ear effusions, it is the underdeveloped mastoid that is the common denominator for chronic SOM and the retraction of the tympanic membrane, and a retraction pocket cholesteatoma, as well. This became clear after observation and follow-up of 103 adult patients with SOM, many of whom had had previous upper respiratory infections or acute otitis media.^[16,17] Being adults, all these patients had mastoids that had completed their development many years ago. By the time they became affected with SOM, some of these patients had had an extensively developed pneumatization, while some had not. Interestingly enough, 40-50% of those in whom the size of the mastoid was well below that of a well-developed mastoid eventually did develop both a chronic course of SOM and retraction of the tympanic membrane. Conversely, most of the patients with a well-developed mastoid neither experienced recurrences of SOM nor developed atelectasis. Why a well-developed pneumatized mastoid is associated with a better prognosis in SOM or vice versa is accounted for by the ability of the ear to handle the development of negative pressure in the middle ear. The appearance of negative pressure in the middle ear is a multifactorial process, one factor being possibly the failure of the mastoid to serve as a buffer against negative pressures. Ears which are equipped with an efficiently working physiological buffer against pressure imbalances, i.e. a well-pneumatized mastoid, will overcome pressure-associated episodes relatively easily. Ears which are devoid of a pressure buffer, including those having a poorly pneumatized mastoid since birth, may fall prey to situations that will result in negative pressure in the middle ear, making them liable to develop chronic SOM, retraction of the tympanic membrane, and eventually, a retraction pocket cholesteatoma.

A middle ear effusion without inflammatory clinical manifestations is, however, not an otitis; but rather, a sequela to an otitis of more than one possible cause. It may also be associated with atelectatic tympanic membranes, barotrauma, Wegener's granulomatosis, and carcinoma of the nasopharynx.

The most important reason for using the appropriate nomenclature is for the sake of a more precise communication and of a better insight into this entity

and its treatment: the term 'otitis' may suggest an active inflammatory process that requires anti-inflammatory treatment, which is usually not the case in the presence of a banal middle ear effusion. The most appropriate term for middle ear effusion in general is "sequela to otitis media" as middle ear effusions in children are mainly a sequela to viral otitis media,^[19] while those seen in younger children (1-2 years old) are mostly secondary to bacterial otitis media. Last but not least, chronic SOM is not a sequela to a previous middle ear inflammation and its etiology is still obscure.

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