THE EAR AS A MEDICO-LEGAL PROBLEM

By AHMAD EL-HAKEEM (Cairo)

IN medico-legal practice ear injuries are of very common occurrence; what is written about the subject is rather scarce. A somewhat detailed description based on an experience of about 1,300 cases might be of some benefit.

The Causative Factors of Ear Injuries

1. Violence, by using the palm of the hand, a box, or malleable objects.
2. Blast injuries.
3. Blows by heavy objects on ear or skull.
4. Falls on the head or car accidents.
5. Water pressure.
6. Caustics and burns.
7. Human bites.
8. Blows on the jaw.

The Auricle. Injuries to the auricle might include bruises, hæmatomas, and cut wounds. These are better described in surgical text-books. One has always to bear in mind the possibility of non-traumatic degenerative hæmatoma of old age which might occur spontaneously and is not associated with any bruises.

Human bites. This practice of violence is common, and to my astonishment among highly cultured people. The lesion ranges from partial loss of the auricle to its total biting, in a single act of evulsion.

Burns and caustics. Rather common in factories and chemical labs, usually the external canal is affected too. This may end ultimately in loss or deformity of the auricle.

Tear of ear-ring holes. Common among females, it is of no medico-legal significance unless complicated by serious sepsis.

End results. After healing, the physiological function of the auricle is only considered by courts, while the cosmetic as a rule is not, so astonishingly loss of a part of the auricle of a young lady, for instance, is not considered a permanent infirmity. Total loss or even loss of three-quarters is considered undoubtedly as a permanent infirmity, as in function I estimate it as less than 20 per cent. loss of the sound conducting apparatus.

In report, one has always to mention the possibility of a plastic operation.

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The Ear as a Medico-Legal Problem

The External Auditory Canal

This may be affected through the introduction of a foreign body, either intentionally or accidentally. Injury may take place during its unskilful extraction, from gun-shot wounds, or indirectly through fracture of the tympanic plate. A backward push of the mandibular condyle affected by a hard blow on the chin rarely causes any serious damage, as the presence of the posterior condylar eminence forms a shield of protection against backward displacement.

A common form of injury to the bony canal is through extension of a fissured fracture of the skull. The clinical manifestations will be swelling or laceration of the wall, usually postero-superiorly, occasional bleeding, but it is always accompanied by difficulty on mastication. Separation of the cartilaginous from the bony part of the meatus may take place without a fracture. In these last forms, one has always to consider the presence of signs of external violence.

Caustics. Splashing or pouring caustics in the external auditory meatus for disfigurement purposes is a common practice among peasants. The use of faulty ear drops may also lead to legal proceedings. Such cases may end by partial or complete atresia of the canal, with or without destruction of the tympanic membrane. These cases are in the category of permanent infirmity though, as mentioned, plastic reconstruction is possible.

Malingerers. In medico-legal practice one has always to bear in mind attempts to simulate or cause disease in the external canal, for purposes of vengeance or the claiming of indemnities. Many use irritants to produce inflammation, putting blood in the canal from other sources, chewed bread, flour, sand, etc.

The Tympanic Membrane

This is the commonest site for the most important injury encountered. Males are naturally more affected than females, the left ear is by far the one which gets the blow, as most people are right-handed.

Degrees of injury. The different degrees of injury to the membrane that may take place are:

1. *Localized congestion.* This may occur around the handle of the malleus and the circumference of the membrane.

2. *Localized ecchymosis.* This is produced by an interstitial haematoma which is usually single, in some cases two patches were seen. One has to differentiate these from inflammatory hæmorrhagic bullae as in influenza. These may undergo suppuration causing drum abscess (Fig. 18).

This traumatic ecchymosis usually produces tinnitus and disappears in about 2 weeks, leaving a slightly discoloured patch which fades gradually.

3. *Diffuse congestion.* Which has to be differentiated from acute otitis media by the usual clinical manifestations.

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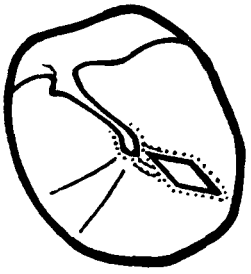


FIG. 1.
Traumatic Perforat' 1 radial type.

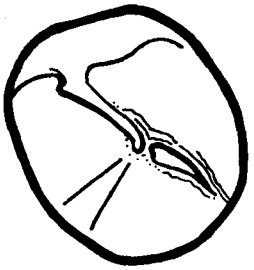


FIG. 2.
Compressed pear-shaped rupture.

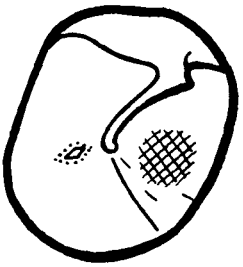


FIG. 3.
Tiny traumatic rupture and hæmatoma.

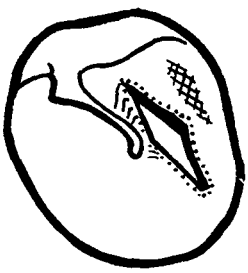


FIG. 4.
Lance-shaped rupture and hæmatoma.

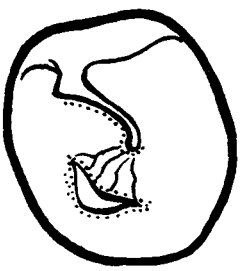


FIG. 5.
Anterior crescent rupture.



FIG. 6.
Triangular rupture.

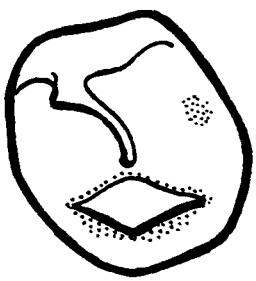


FIG. 7.
Elongated lip-like rupture and blood clot.

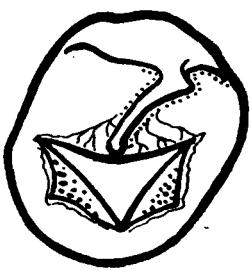


FIG. 8.
Blast rupture with everted edges.

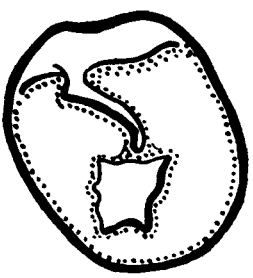


FIG. 9.
Erosion perforation after caustic ear drops.

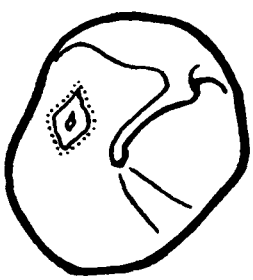


FIG. 10.
Tiny perforation amid incomplete tear.

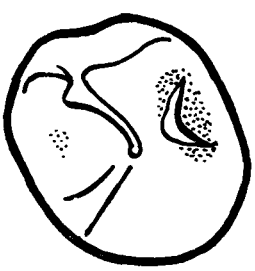


FIG. 11.
Posterior crescent rupture.

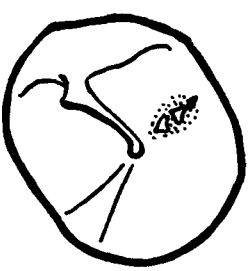


FIG. 12.
Perforation with bridge simulating two ruptures.

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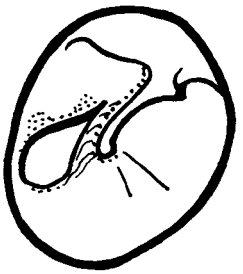


FIG. 13.
Large pear-shaped rupture.

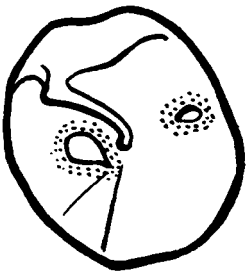


FIG. 14.
Double quadrant ruptures.

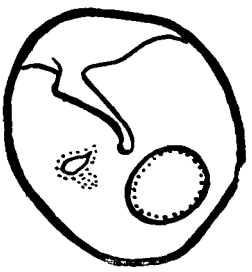


FIG. 15.
Old pathological adhesive perforation plus anterior traumatic rupture.

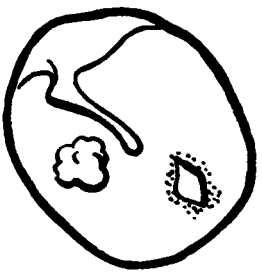
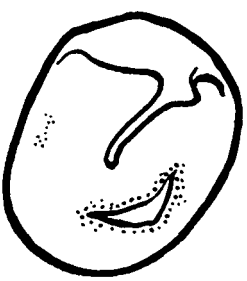


FIG. 16.
Traumatic rupture plus chronic suppurative otitis media with granulations.



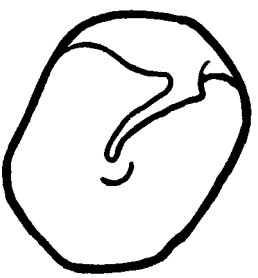


FIG. 17.
(*a*) Original site of traumatic rupture. (*b*) Healed scar near umbo.

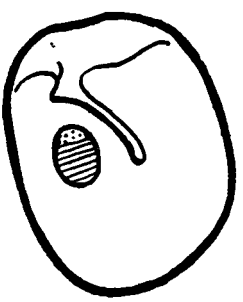


FIG. 18.
Traumatic ecchymosis undergoing suppuration (abscess of drum).

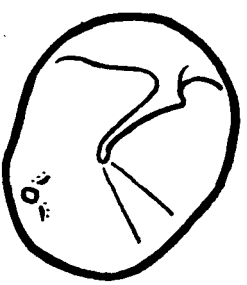


FIG. 19.
Self-inflicted perforation.

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Also, this stage of trauma to the membrane has to be differentiated from cases of barotrauma, a condition which often leads to hæmato-tympanum.

4. *Hæmato-tympanum.* Appearing as a bluish discoloration behind the membrane. In few of the cases I saw there was no evidence of fractured base, yet in such cases, mild as the symptoms may be, one has to be cautious and investigate them fully.

5. *Rupture of the membrane.* This may be brought about in four different ways:

(*a*) By direct penetration of a foreign body from the meatus or by corrosion.

(*b*) By sudden air compression, either from outside or inside. Air rarefaction is also responsible in some cases.

(*c*) By water compression.

(*d*) By extension of a fracture through the cranial bones to the membrane.

(*a*) Most of the cases seen are accidentally self-inflicted, very few intentionally. The objects are usually hair pins, toothpicks, pencils, etc., introduced to relieve itching or to remove wax. Unskilful attempts at removal of foreign bodies producing rupture of the membrane is luckily getting more rare than formerly. As the instruments in these cases are seldom clean, such ruptures rarely escape suppuration.

(*b*) *Air compression.* This is responsible for the largest number of casualties. The exciting cause may be, a blow with the palm of the hand or a fist, a fall, or an explosion nearby. I had the opportunity of seeing in my series 10 cases of blast injuries in civilians (Fig. 8). Five cases of these ended in complete healing, two cases developed suppuration, and the perforation persisted, the remaining three cases ended as dry perforations.

In one case the patient developed nerve deafness as well. Henry (1945) reported 152 cases of blast injuries in whom 17 per cent. developed suppuration, and in 4 per cent. clinical mastoiditis.

Boeman reported infection setting in in 27 per cent. of his 68 cases of blast perforations.

Compared to the ordinary perforations, these blast ruptures were of abnormally large size, affecting almost two-thirds of the membrane, with the edges distinctly everted externally. I believe the nearer to the site of the explosion the larger the perforation.

One interesting cause mentioned is the kiss suction rupture (Macleod Yearsley).

Cases of rupture due to forcible air compression from inside as in sneezing, or violent blowing of the nose are reported (Macleod Yearsley). I have seen quite a few. In test pilots, workers in caissons, etc., ruptures are uncommon now owing to improvement in the technique of pressure conditioning.

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It is said that it requires at least two atmospheric pressures to cause rupture of a healthy tympanic membrane.

(*c*) *Water compression.* The pressure of water to cause rupture of the drum, need not be so high as that required in air, as water is incompressible.

I have seen few cases of rupture after syringing the ear, this is either due to faulty technique or previous disease of the membrane. These cases are liable to legal proceedings.

An interesting case of rupture was due to forcible splashing of water against the ear while swimming. High side diving is another cause of water rupture.

Types of Perforations

1. *Incomplete tear.* Is rare. I have seen only six cases, the rupture being in the superficial skin layer of the membrane and having the same appearances of a complete one.

The use of Siegel's speculum is necessary. It may happen that a small complete rupture appears in the middle of the above mentioned incomplete tear (Fig. 10).

2. *The complete tear.* These may either follow the direction of the radial fibres, or the circular, and according to the force and density as well as the direction, any size or shape may be produced.

The edges. If a medium sized rupture is seen on the first or second day of injury, the edges will be usually congested, somewhat irregular, with a variable amount of ecchymosis, with occasional blood clots around or in the canal. The absence of the above mentioned manifestations does not exclude trauma, as I have seen cases, especially with small ruptures, with the edges sharp and clean. The eversion of edges which is sometimes present, is responsible for the serrated appearance. One important point about these traumatic perforations is the presence of at least one pointed end, a pear-shaped appearance is very common (Fig. 13). Double pointed ends, triangular and crescent shaped are the rule.

The site. The perforations are almost always in the central zone, not reaching the rim, because of the thickening of the circular layers of fibres peripherally as it nears its attachment (Gray).

Self-inflicted cases. The perforation in this type is usually situated postero-inferiorly and may reach the rim, usually of a pin-point appearance. There is often hesitation abrasions on the drum or the canal wall. These are rather rare.

Shrapnell's membrane. Traumatic ruptures never occur in this area, but one has to bear in mind the possibility of a congenital deficiency in Shrapnell's, that may be mistaken for a trauma. Congenital perforations are usually bilateral, small in size, not exceeding 1 mm. long, with thick regular lips, and often secreting mucus; there is no reaction around.

Double perforations. Indirect perforations are not necessarily single,

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occasionally they are double (Figs. 12 and 14). They may be of the same size, or one larger than the other, they may be in the same quadrant, or in two separate ones.

Rupture of both tympanic membranes. Although this might happen, injury to both ears is rare, and one has to look out for disease in such cases.

Diseased drums. Traumatic perforations may occur in diseased drums, as in the thick retracted drums of chronic catarrhal otitis media or in chronic suppurative otitis media, with polypi and granulations. In the last category, the inflammatory mass with polypi, etc., glues the small perforation during pressure, leaving the rest of the membrane tense and free to be ruptured (Fig. 16).

Wax in the canal. The impaction of wax in the canal does not prevent rupture of the drum. Every case of alleged trauma with wax in the canal should be washed out. Many cases proved to have a typical traumatic perforation. Unless the mass of cerumen is filling and totally blocking the canal, which is seldom the case, protection to the drum is not provided.

Complaint and Symptoms

1. Giddiness is a common complaint, if it occurs with such severity as to cause unconsciousness and falling, it must be instantaneous after the assault. Vomiting may occur.

2. Sensation of a report or something exploding in the ear, is not very common.

3. Pain is also complained of; it is felt immediately after the tear. If it occurs later, it denotes the onset of infection.

4. Hearing loss of some degree is present, or complained of after coming round.

5. Tinnitus is a usual complaint.

6. Passage of air on blowing the nose, occurs in some cases, hence the fallacy of provincial primary reports, depending on the water bubble test.

7. Bleeding is usually slight. In large perforations, a drop of blood may be felt externally. On examination a clot may be seen on the base of the canal, or on the membrane. If excessive, however, one must suspect other injury than mere perforation.

8. The discharge of serum which sets usually after the first day or followed by pus after the third day means secondary infection.

Healing Process

The stages of healing can be classified as follows:

1. Vascularity and exudation.
2. Healing and fibrosis.
3. Emigration and fading.

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With no secondary infection, the process of healing and repair begins on or about the third day by increased vascularity of the edges and the area around the rupture. The inner rim of the edges assumes a bluish or greyish halo, and in the meantime exudation appears at the angles. At this stage small perforations might be hidden and overlooked under such an exudate. It is a deceiving process, if the membrane is gently mopped, the perforation will be distinctly seen.

Healing proceeds gradually from the pointed ends, until it is complete in an average of three weeks. I have seen cases healing in as early as one week, others up to one year. Hence the advisability of postponing finally reporting on certain cases which tend to heal slowly.

Age has no significance, as I have seen ruptures in people above 60 healing just as well and completely as in youths.

Perforations sometimes persist in persons who intentionally inflate their ears daily by blowing the nose hard to prolong the period of healing or to cause a permanent infirmity.

I have seen this practice among prisoners.

Sometimes the process of healing, for some unknown reason, does not start at all.

Scar tissue. The scar tissue thus formed, is at first distinctly elevated, and in colour varies from white to light brown. It is peculiar that by following most of these cases, I noticed that the scars tend to migrate gradually towards the umbo (Fig. 17). So you hardly find a totally healed scar in the same position as the original perforation. A phenomenon, I suggest due to the fact that epithelium growing from the periphery towards the centre of the membrane is of lower vitality nearer the umbo.

Gradually the scar gets smaller in size and almost attains the normal lustre. Sometimes it leaves a whitish or greyish patch with fading edges and keeping the shape of the original rupture.

If the scar is situated over the area of the cone of light, it cuts it short for good.

In a few cases calcareous deposits may form.

Incomplete healing. Occasionally the fibrous layer does not respond to the healing process, and a healed perforation ultimately produces a thin flabby mobile area, composed of epithelium and mucous layers only with distinct sharp edges simulating a permanent perforation. With Siegel's speculum the mobility of the thin membrane will clearly show the healing.

Secondary infection. If this sets in, it turns the case to otitis media. In some of these cases, adhesions form between the scar and the medial wall of the middle ear.

Diagnosis. I always stress the advisability of sending traumatic cases for examination in the first few days following trauma. It will then be easy to diagnose.

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Unfortunately, most cases are sent after some time, with a request for a report. If the perforation was going dry, started to heal, or already healed, one can state in most cases its traumatic nature from the site, the appearance, and the behaviour, for some weeks or months to come.

If suppuration sets in, the landmarks of the trauma are usually lost, as infection masks the traumatic physical signs. In these cases, the history of assault should be questioned carefully. A case of otitis media is in most cases preceded by pain and fever, followed by relief by erosion and the production of a rounded perforation, which may ultimately turn oval.

The nature of the discharge is of help, sweet profuse, is in favour of trauma, foul, thick, and scanty is more on the side of disease.

Sometimes, one has to admit the impossibility of giving a decision.

Prognosis. Is in most cases favourable. Eighty per cent. healed in cases who seek early medical advice.

Unfavourable, if the perforation is of abnormally large size, if it is meddled with or the ear syringed. If there is disease or sepsis of the nose or sinuses, if it is accompanied by labyrinthine concussion, or if the case is complicated by serious cranial fracture.

Treatment. Need not be discussed fully here, but as wounds and ruptures of the drum tend to heal spontaneously, it should only be protected by sterile gauze and left alone.

The use of antibiotics, etc., has its indications.

Lesions of the Temporal Bone

Although these are mentioned in detail in surgical text-books, yet a short account of what comes under medico-legal interest will be described briefly.

1. *Mastoid region.* The injury is usually due to direct violence by heavy objects, or by gun-shot wounds. The injury might only be a hæmatoma over the mastoid region, a contused wound, a fracture, or any combination of these. A fracture might extend to the base of the skull, might be accompanied with paralysis of the facial nerve, or it might cause compression of the bony external auditory meatus, leading to permanent atresia.

2. *The Petrous portion.* This might be incorporated in fractures of the base of the skull. It might be fractured longitudinally, transversely, or just at the tip. The transverse type is usually fatal due to hæmorrhage from the internal carotid artery. The longitudinal fracture is more benign, its line of fracture occurs in the tegmen tympani and implicates the middle-ear cavity, resulting in hæmato-tympanum, rupture of the tympanic membrane, or bleeding through the eustachian tube. This fracture is very difficult to detect by X-ray. As regards the tip, the fracture is usually accompanied by Vth, or VIth nerve palsy.

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AFFECTION OF CRANIAL NERVES

The Vth, as mentioned above, can be detected by absence of the corneal reflexes.

The facial nerve is not uncommonly affected, it might show immediate paralysis due to implication of its canal by a fracture which can be discovered by X-rays, or it may be of the upper neuron type if there is contusion of the motor cortex. Spontaneous recovery is not expected in these cases. Delayed facial paralysis is due most probably to hæmorrhage in the canal compressing the nerve and causing paralysis from one to four days. The longer the delay the quicker the recovery, whose average is one to three weeks. Rarely degeneration occurs, and this requires three to four months for recovery. The terminal branches of the facial nerve may be injured by fragments of flying glass and similar missiles.

Strangely enough, I did not come across a single case of chorda-tympani affection in the cases of facial paralysis I saw.

INJURIES TO THE INTERNAL EAR

Direct injury to the internal ear is not so common. It may be affected by the introduction of a foreign body through the external auditory meatus, past the tympanic membrane, or involved in gun-shot wounds.

It may be affected indirectly by:

1. Trauma to the skull, as in car accidents or blows by hard objects producing fractured base, especially in the middle fossa, and extending into the petrous part of the temporal bone, usually causing injury to the VIIIth nerve.

Cases of depressed fractures of the temporal bone or the vault necessitating a trephine might also in many cases affect the VIIIth nerve.

A head injury, without producing a fracture, might cause concussion of the brain and VIIIth nerve together, or only localized concussion of the VIIIth nerve, and may be accompanied by hæmorrhage—this series forming the highest percentage of cases of affections of the inner ear.

2. Air compression or air rarefaction, may cause concussion or hæmorrhage of the inner ear. This may happen with no perforation of the drum.

3. Sudden high noise as in railway practice.

In all these cases one has to ascertain the previous history, as long-standing suppuration of the middle ear may have affected the internal ear.

End Results

As a rule I consider cases of perforations which heal without suppuration or adhesions or labyrinthine affection as totally cured.

Cases who had long-standing suppuration leading to delayed healing or with residual adhesions, may be left with variable degree of hearing loss, and considered as permanent infirmity.

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Unhealed perforations, even with normal hearing, are considered as permanent infirmity too.

Cases with signs of previous diseased ears, have to be carefully examined, the previous hearing loss due to disease estimated, and the new loss, if any, reported.

In testing for hearing loss a combination of audiometer, tuning forks, and whisper gives better and accurate results.

Malingerers

Before finishing this discussion, I must admit that the most difficult task was to deal with malingerers, and to report on their final condition. About 50 per cent. of all cases were honest in their answers, and happy to be cured, the rest try to exaggerate in different degrees.

Bilateral total deafness due to trauma is of a very rare occurrence. In my series I only saw two cases due to severe basal fracture. This type of claiming total deafness is often resorted to by recruits after a simple slap on the ear, to evade military service; the anæsthesia test, and putting them under close observation usually exposes them.

Summary

1. 1,300 medico-legal cases, studied and used as a basis for this paper.

2. The different traumas have been stated, the most important of which is trauma to the tympanic membrane, has been fully described, in its recent stage, process of healing and final results.

3. Investigations of malingerers has been referred to.

4. Estimation of infirmities has been suggested.

I wish to thank Dr. I. Mossallam for helping in arranging and drawing the above plate.

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