



## Les surdités brusques : efficacité de l'oxygénothérapie hyperbare combinée au traitement corticoïde systémique

### Sudden deafness: the effectiveness of hyperbaric oxygen therapy combined to systemic corticosteroid treatment

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#### RÉSUMÉ

**Introduction :** La surdité brusque est une urgence neurosensorielle, nécessitant une initiation thérapeutique rapide. Les traitements sont très variés, avec des résultats disparates.

**Objectif:** Evaluer nos résultats dans le traitement de la surdité brusque et l'efficacité de l'oxygénothérapie hyperbare (OHB) combinée à un traitement corticostéroïde systémique

**Méthodes :** Nous rapportons une série de 42 patients traités dans notre service d'une surdité brusque diagnostiquée sur des arguments cliniques et paracliniques recueillis sur une période de dix ans. Une analyse statistique a été réalisée à la recherche d'une relation statistiquement significative entre l'amélioration après traitement, sans ou avec utilisation d'une OHB.

**Résultats :** L'âge moyen de nos patients était de 44 ans avec des extrêmes de 8 à 78 ans. Il s'agissait de 28 hommes (67%) et 14 femmes (33%). Nos patients ont consulté en urgence pour une surdité d'installation brutale dans tous les cas, accompagnée de bourdonnements d'oreilles aigus dans 81%. En audiométrie tonale, le seuil d'audition a varié entre 35 et 100 dB avec une moyenne de 64 dB. Le type de courbe était de type A (19%), B (7%), C (43%), D (5%) et E (26%). Les patients ayant bénéficié d'une OHB ont représenté 81% des cas, le nombre de séances a varié entre 0 et 20 avec une moyenne de 10 séances. Le seuil auditif post-thérapeutique a varié entre 10 et 100 avec une moyenne de 45 dB.

Une amélioration a été obtenue dans 81% des cas. Le gain auditif a varié entre 0 et 60 dB avec une moyenne de 20 dB. Une amélioration a été obtenue chez 30 patients traités par OHB complémentaire et chez quatre patients traités par le seul traitement médicamenteux. La comparaison de ces deux groupes a montré une différence statistiquement significative ( $p=0,013$ ).

**Conclusion :** La surdité brusque est une indication de l'OHB retenue pendant plusieurs décennies sur la base que la pression qui règne dans une chambre hyperbare participerait à la régénération des lésions observées de l'oreille interne. Notre étude soutient cette indication.

**Mot clés :** surdité, surdité brusque, traitement, oxygène hyperbare

#### SUMMARY

**Introduction:** Sudden idiopathic deafness is a sensorineural emergency, requiring rapid therapeutic initiation. The treatments are very varied, with disparate results.

**Aim:** To evaluate our results in the treatment of sudden deafness and the effectiveness of hyperbaric oxygen therapy (HBOT) combined to systemic corticosteroid treatment.

**Methods:** We report a series of 42 patients treated in our department with sudden deafness diagnosed on clinical and paraclinical arguments collected over a period of ten years. A statistical analysis was performed looking for a statistically significant relationship between an improvement after treatment and the use of an HBOT.

**Results:** The mean age of our patients was 44 years with ranges of 8 to 78 years. These were 28 men (67%) and 14 women (33%). Our patients consulted urgently for sudden onset deafness in all cases, accompanied by acute ringing in the ears in 81%. In tonal audiometry, the hearing threshold varied between 35 and 100 dB with an average of 64dB. The type of curve was: A (19%), B (7%), C (43%), D (5%) and E (26%). The patients were treated with HBOT in 81% of cases, the number of sessions varied between 0 and 20 with an average of 10 sessions. The post-treatment hearing threshold varied between 10 and 100 with an average of 45dB. Improvement was obtained in 81% of cases. Hearing gain varied between 0 and 60db with an average of 20dB. Improvement was obtained in 30 patients treated with HBOT and in 4 patients who did not receive HBOT. The comparison of these two groups showed a statistically significant difference ( $p = 0.013$ ).

**Conclusions:** Sudden deafness is an indication of HBOT retained for several decades on the basis that the pressure which reigns within a hyperbaric chamber would compensate for the observed damage of the ear. Our study supports this indication.

**Keywords:** Deafness, Sudden deafness, Treatment, Hyperbaric oxygen

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## INTRODUCTION

Sudden deafness (SD) is defined as rapid sensorineural hearing loss of at least 30 decibel (dB) on three contiguous frequencies occurring over a period of 72 hours or less (1-3). It is said to be idiopathic, after a normal clinical, audiometric, biological and imaging workup. The use of hyperbaric oxygen therapy (HBOT) in the treatment of sudden deafness has been adopted for several decades (2), based on the hypothesis that sudden deafness results from damage to the inner ear to the inner ear which would be responsible for a lack of hearing Oxygen, and the pressure which reigns within a hyperbaric chamber would make it possible to overcome this deficit by the diffusion of oxygen in the damaged anatomical structures (4). It is used to counter sudden deafness in some countries. However, there are still differences of clinical opinions on the subject, for some still the systematic use of this modality could not be justified without the support of new studies. The objective of this study was to evaluate our results in the treatment of sudden deafness and the contribution of hyperbaric oxygen therapy in their therapeutic management.

## METHODS

We conducted a retrospective study bringing together a series of 42 observations of patients treated with sudden deafness in the otorhinolaryngology department of the military hospital of Tunis over a period of 10 years (from January 2009 until December 2018). We collected all clinical, audiometric, laboratory and imaging data for each patient. The diagnosis of sudden deafness was made when the following criteria were met: the occurrence of sensorineural hearing loss without obvious cause, over a period of at least 72 hours, of at least 30 decibels, on three successive audiometric frequencies.

The initial audiometric deficit was classified according to its degree (mild deafness: threshold between 20 and 40 dB, medium: between 40 and 70 dB, severe: between 70 and 90 dB and deep: threshold greater than or equal to 90 dB) and of the curve type (Type A (Ascending), threshold at 500 Hz is at least 20 dB lower than that at 4000 Hz; type B (Plate), the thresholds at 500 and 4000 Hz have less than 20 dB of difference between them; type C (Descending), threshold at 4000 Hz is at least 20 dB lower than that at 500 Hz; Type D (Cupule), more or less

extensive scotoma centered on a frequency and type E (Cophosis or Subcophosis). The hearing recovery was assessed by comparing the initial audiogram and the post-therapy audiogram. Complete recovery is defined when the final threshold is less than or equal to 20 dB or returns to the previous state, partial recovery if improvement in threshold greater than 15 dB and failure if improvement in threshold less than 15dB or worsening.

The therapeutic protocol used included parenteral corticosteroids: methylprednisolone at a dose of 1 mg / kg / day intravenously in 1 daily injection in the morning, for an average duration of 10 days; Aciclovir at a dose of 8 mg / kg three times a day, adapting to the subject's renal function and for a period of 5 days, vasodilators for 15 days, vitamin therapy (Vitamin B 1, 6 and 12) twice a day. Hyperbaric oxygen therapy (HBOT) has been indicated if the average hearing threshold has exceeded 35db, after pre-HBOT consultation including an evaluation of tubal permeability if in doubt impedancemetry, cardiopulmonary auscultation, ECG and chest x-ray. The HBO protocol was: 1 session per day, 5 sessions per week, a dose of 2.5 atmospheres per session.

In our series, we studied the influence of HBOT on post-treatment audiometric results in order to highlight the contribution of hyperbaric oxygen therapy in the treatment of sudden hearing loss. The statistical study was carried out on SPSS 20 software. The significance level was set at 0.05.

## RESULTS

The average age of our patients was 44 years with extremes ranging from 8 to 78 years. The maximum frequency was observed in the sixth decade. A male predominance was found with 28 men and 14 women, with a sex ratio of 2. The hearing impairment was unilateral in all cases, on the right side in 64%. A peak in frequency was noted during the spring and the month of June (19%). Our patients were in 52% of cases without pathological history. Six patients were smokers with an average tobacco consumption of 15 packs a year. Sudden hypoacusis was the main reason for consultation, found in 100% of cases associated with tinnitus in 78%. In our series, the average time between the onset of hearing loss and the first consultation was 7 days with extremes ranging from 1 to 30 days. The vestibular examination performed on admission did not reveal any

peripheral vestibular syndrome, although vertigo was reported by eight of our patients. The remainder of the ENT examination revealed no abnormalities. The general examination, looking for neurological or ophthalmological involvement did not reveal any abnormalities. All our patients systematically underwent introductory tonal audiometry before admission. The mean initial hearing loss (MAP) varied between 35 and 100 dB. The average hearing threshold was 64 dB ± 22 dB. The classification of deafness is shown in Table 1. Type C curves were predominant in our series (Table 2).

**Table 1.** Distribution of patients according to the severity of deafness

	N	%
Mild deafness greater (threshold ≥30db)	11	26
Moderate deafness	16	38
Severe deafness	8	19
Cophosis (or subcophosis)	7	17

**Table 2.** Distribution of patients according to the type of audiometry curve

Type	N	%
A	8	19
B	3	7
C	18	43
D	2	5
E	11	26

MRI of the brain, ponto-cerebellar angle and internal auditory canals was performed in 71% of cases. She returned to normal in all cases. An immunological workup was performed in seven cases, looking for anti-nuclear, anti-DNA, anti-Sm and rheumatoid factor antibodies. This assessment was normal in all cases. Hospitalization of patients was systematic in all cases. The average stay was 11 days with extremes ranging from 8 to 20 days. Corticosteroid therapy for an average of 10 days was started in all patients. Hyperbaric oxygen therapy was used as a therapeutic adjunct in 81%. The number of sessions varied between 1 and 20 sessions with an average of 10 sessions ± 5.

The average time to first hearing recovery was 7 days.

It was found that the shorter the time to first hearing improvement, the better the final hearing recovery. The hearing threshold at the output varied between 10 and 100 dB with an average of 45dB. Hearing improvement was observed in 81%. Hearing recovery was complete (45%), partial (36%) and absent (19%). It should be noted that 19, among the 42 affected ears, presented a hearing threshold at the end of the treatment of less than 30dB. Hearing gain varied between 0 to 60 dB with an average of 19 dB ± 16dB.

However, in all cases of cophosis no improvement was observed. A significant relationship was noted in our study between threshold and final post-treatment hearing gain and the administration of hyperbaric oxygen therapy as an adjuvant treatment for sudden hearing loss. The results are shown in Table 3. The initiation of adjuvant treatment with HBOT was correlated with an improvement in hearing threshold at the end of treatment, the relationship was statistically significant (p = 0.013).

**Table 3.** Effect of hyperbaric oxygen therapy

	Hearing improvement		No improvement after treatment	
	n	%	n	%
Patients treated with HBO	30	71,5	4	9,5
Patients not treated with HBO	4	9,5	4	9,5

Significant statistical association, p=0.013

## DISCUSSION

Sudden deafness is a medical emergency. Several hypotheses concerning its pathogenic causes have been advanced. As a result, the optimal treatment modalities remain controversial to this day. In terms of therapeutic management, many protocols have been reported by different authors: corticosteroids are the most widely used and least discussed drugs (2), vitamin therapy through its protective antioxidant effect on hair cells which would promote tissue healing (2,4), antivirals whenever a viral origin is suspected (1), vasodilators which are not recommended by some authors (5,6) and HBOT.

Several studies focused on the therapeutic effect of HBOT in various medical fields.

Its principle is based on the therapeutic administration of 100% oxygen at environmental pressures above absolute atmosphere (ATA). The administration involves placing the patient in an airtight container, which increases the pressure inside that container, and the administration of 100% oxygen during breathing. In this way, it is possible to provide a greatly increased partial pressure of oxygen in the tissues. Typically, this treatment involves pressurizing between 1.5 and 3 ATA for a period of 60 to 120 minutes once or twice a day.

The rationale for treatment with hyperbaric oxygen in sudden deafness lies in its vasodilator effect on the organ of Corti, thus countering vascular compromise and oxidative stress which are believed to be major factors playing a role in the maintenance of deafness. This could therefore lead to a cumulative effect of the treatment besides the reduction of inflammation by the application of steroids (7).

The preferential place of HBOT in the therapeutic arsenal of SD has been announced since the first European consensus conference on hyperbaric medicine in Lille in 1994.

The treatment regimen varies from center to center: one session per day (2.5 ATA for 90 minutes) for a total of 10 consecutive days or two sessions per day for 5 days. The ECHM consensus conference (8) validates HBOT as an adjunct treatment for sudden hearing loss. This is a type 1 recommendation with a moderate level of evidence (grade B). It is recommended that HBOT be combined with medical treatment in patients with sudden hearing loss who present within two weeks of onset. It would be reasonable to use HBOT in addition to corticosteroids in patients presenting after the first two weeks but no later than one month, especially in patients with severe and profound hearing loss (recommendation type 3, level of proof C) (8). The use of only HBOT or in combination with medical therapy is not recommended in patients presenting after six months of disease onset (recommendation type 1, level of evidence C).

Our study supports the indication of HBO in the treatment of SD in combination with corticosteroid therapy, an improvement in the hearing threshold was found in 71% of cases and the statistical relationship was significant.

Comparable results have been reported in a meta-analysis including more than 100 publications (9). Alimoglu et al found significantly better complete hearing recovery

(estimated at 42.6%) in the event of treatment combining oral corticosteroid therapy with hyperbaric oxygen therapy compared with only oral corticosteroid therapy, intratympanic corticosteroid therapy and hyperbaric oxygen therapy alone.

In another study, the final post-treatment hearing gain was significantly correlated with the use of HBOT as a treatment for sudden deafness ( $p = 0.016$ ) as well as with the number of HBOT sessions ( $p = 0.01$ ) (10).

Although early application of HBOT seems like a logical advice, some issues need to be raised: are there any HBOT centers available in the area, is it cost effective, since a considerable percentage of patients recover spontaneously?

Globally, hyperbaric oxygen chambers are mainly available in a few specialized hospitals. In addition, the costs of hyperbaric treatment modalities must be considered. On the other hand, hyperbaric oxygen therapy can cause complications of varying severity. Pre-therapeutic verification of tubal patency and nasal cavity is therefore essential in order to avoid the often underestimated barotraumatic complications.

## CONCLUSIONS

The data from our studies allow us to conclude that HBOT has a beneficial effect in the treatment of sudden deafness and to suggest for any sudden deafness diagnosed within two weeks of the onset of the disease: hospitalization, intravenous corticotherapy in the absence of contraindications, for 10 days, vitamin therapy based on vitamin E and B, vasodilator treatment, antiviral treatment where a viral etiology is suspected and early hyperbaric oxygen therapy.

**Conflict of interest:** None

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