

Contraindication Patient assessment

2021.10.21

소 속 : 원광대학교병원 응급의학과

이 름 : 김선태



HBOT chamber

- Monoplace chamber

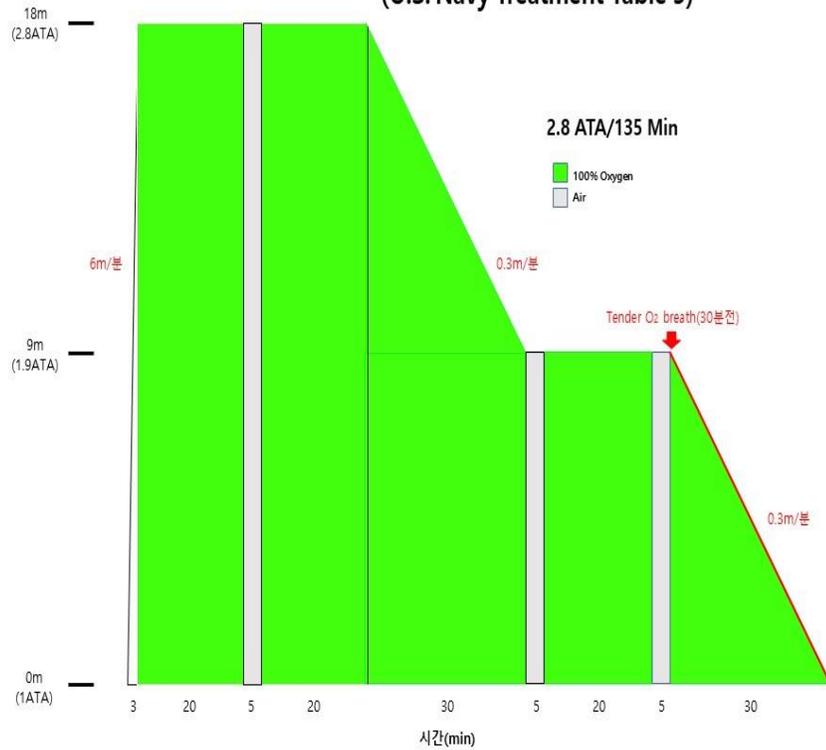


- Multiplace chamber



HBOT protocol

(U.S. Navy Treatment Table 5)

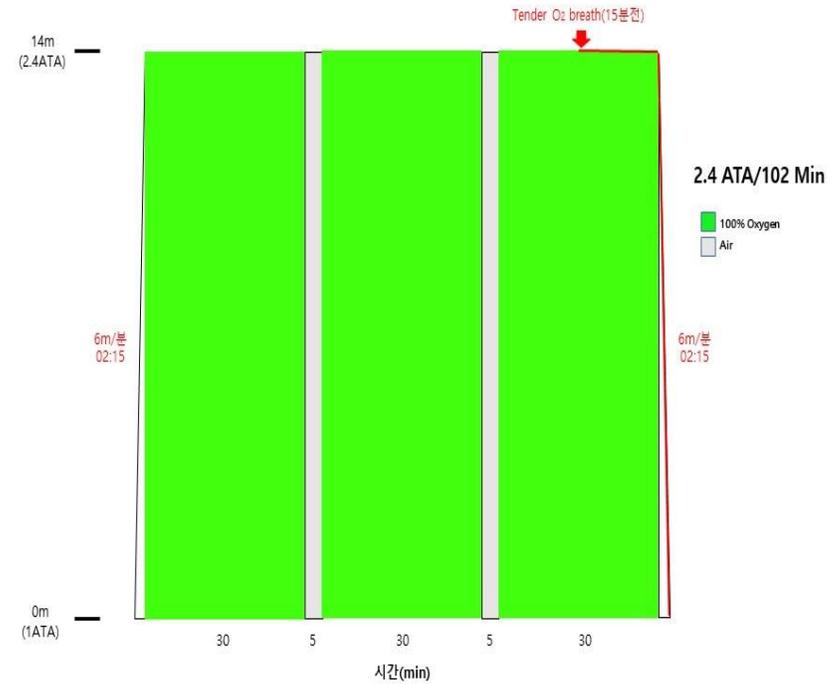


<적응증>

1. 급성 일산화탄소중독 (1st treatment)
2. 동맥혈 가스색전증
->호전 없을 시 TT-6 전환
3. 감압병(DCS) type I (pain only)
->>10분 이내 호전 없을 시 TT-6 전환
4. CRAO

*가압속도(6m/분)는 환자 적응 상태에 따라 조절

(U.S. Navy Treatment Table 9)



<적응증>

1. 급성일산화탄소중독
->반복치료 시
2. 동맥혈 가스색전증
->반복치료 시
3. 감압병
->반복치료 시
4. 상처치료
-Problem wound(DM foot, pressure sore 등)
-Compromised grafts/flaps
-Crushing injury
-Compartment syndrome
-Acute traumatic ischemia
-Necrotizing soft tissue infection
-Delayed radiation injury
-Chronic refractory osteomyelitis
-Thermal burns
5. 기타
-intracranial abscess
-SSNHL

*가압속도(6m/분)는 환자 적응 상태에 따라 조절

Indication

- 국내 16개 보험적용 적응증(2019.1.1 시행)

항목	제목	세부인정사항
자586 고압산소요법	자586 고압산소요법의 급여기준	<p>자586 고압산소요법은 동일 날 오전·오후로 나누어 시행할 경우에는 실 처치시간을 합산하여 해당항목의 소정 점수를 산정하며, 다음과 같이 요양급여함.</p> <p style="text-align: center;">- 다음 -</p> <p>가. 일산화탄소중독, 감압병(잠수병), 가스색전증, 혐기성세균감염증(가스괴저증), 시안화물중독증, 시력소실 24시간 이내 급성기 중심망막 동맥폐쇄, 수혈이 불가능한 경우의 과도한 출혈에 의한 빈혈</p> <p>나. 화상, 버거씨병, 식피술 또는 피판술 후, 수지접합수술 후, 방사선치료 후 발생한 조직괴사, 당뇨병성 족부 궤양(Wagner grade 3 이상), 치료에 반응하지 않는 만성 난치성 골수염, 두개내 농양 등에 통상 2주 이내로 실시함을 원칙으로 하며, <u>연장 실시가 반드시 필요한 경우에는 사례별 인정</u></p> <p>다. 초기 청력역치 80dB 이상의 돌발성 난청환자에서 고압산소요법을 1회 60~120분 이내로 실시한 경우 인정</p>



Contraindication

- Complication mechanism
 - Trapped gas
 - Boyle's law ($P_1V_1 = P_2V_2$)
 - Barotrauma
 - Oxygen toxicity
 - Hyperoxia → free radicals (ROS) ↑
 - CNS oxygen toxicity
 - Pulmonary oxygen toxicity
 - Oxygen-induced retinopathy
 - Pressure change
 - Inability to equalize middle ear pressure
 - Malfunction of implanted devices
 - Others
 - Systemic effect



Contraindication

- Contraindication
 - **Untreated pneumothorax**
 - Untested medical devices(pacemaker, ICD)
 - Acute severe bronchospasm
- Specific consideration
 - Pregnancy
 - No evidence for teratogenicity
 - Same criteria for emergent indication
 - Malignancy
 - Adjunct to radiotherapy
 - Treatment of radiation necrosis
- To be(benefit) or not to be(risk), that is the question!
- Relative Risk
 - COPD, emphysema c CO₂ retention
 - Recent pneumothorax
 - Hx. Of spontaneous pneumothorax
 - Chest surgery/trauma
 - Dental problem
 - Optic neuritis
 - Anticancer drug: doxorubicin(Adriamycin), bleomycin, cisplatin
 - Other drug: disulfiram, mafenide acetate(sulfamylon), amiodarone
 - Upper respiratory infection(URI)
 - Otitis media
 - Ear surgery: Tympanoplasty, Cochlear implant, mastoidectomy
 - CHF, epilepsy, uncontrolled fever, uncontrolled HTN, claustrophobia, hypoglycemia



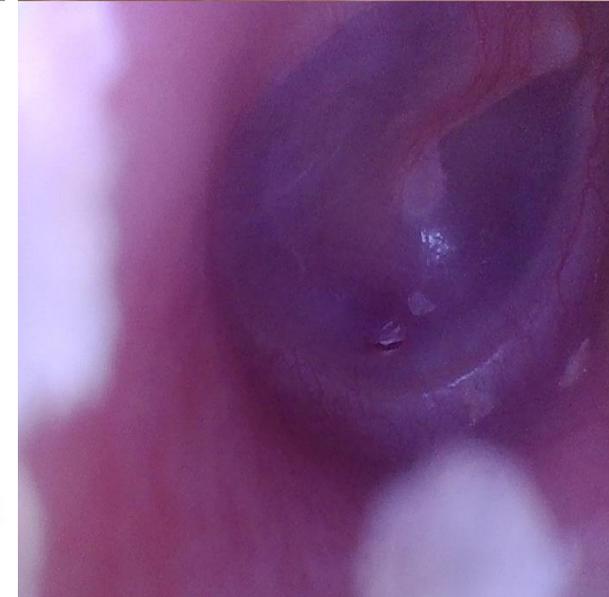
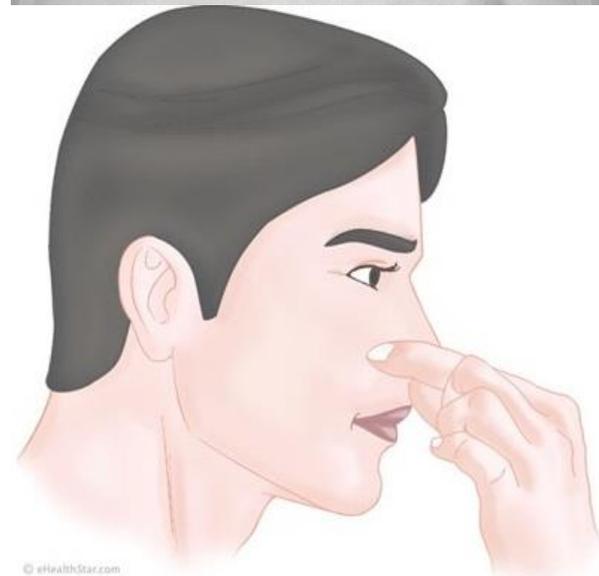
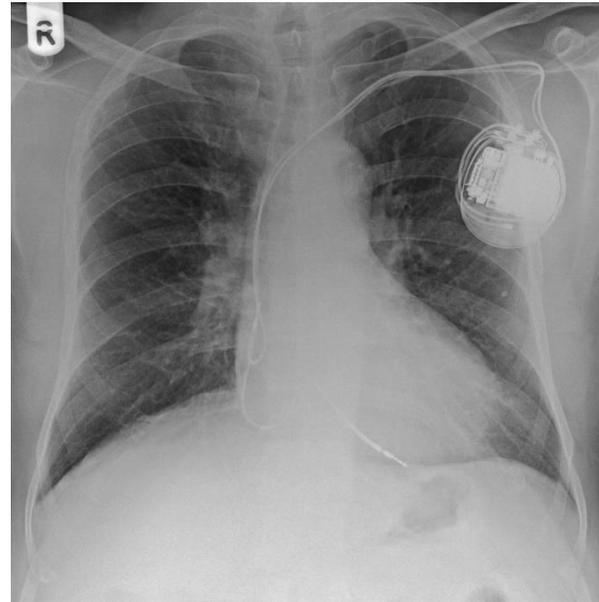
Patient assessment

- Consideration for
 - Indication & contraindication
 - Safety in chamber
 - Complaint during treatment
- Decision for
 - Protocol (pressure, time)
 - Monoplace vs multiplace
 - Inside attendant
 - Preparation for emergency



Patient assessment

- V/S
 - BP, PR, RR, SpO2, **BST**
- Past medical Hx.
 - Contraindication
 - Pneumothorax, implanted devices
 - Risk factor
 - COPD, asthma, CHF, CAD
 - Claustrophobia, psychotic disorder
 - Cataract, glaucoma, AOM, TM injury
 - Anticancer drug, OP Hx.
 - Dental problem, URI, fever, seizure
- **Check the CXR & TM**
- Education
 - Ability for Equalization
 - Valsalva maneuver, Frenzel maneuver
- Pretreatment
 - Decongestant, antipyretics, anxiolytics
 - Preventive myringotomy



Sensorineural hearing loss

2021.10.21

소 속 : 원광대학교병원 응급의학과

이 름 : 김선태

Korean Academy of
Undersea and Hyperbaric Medicine

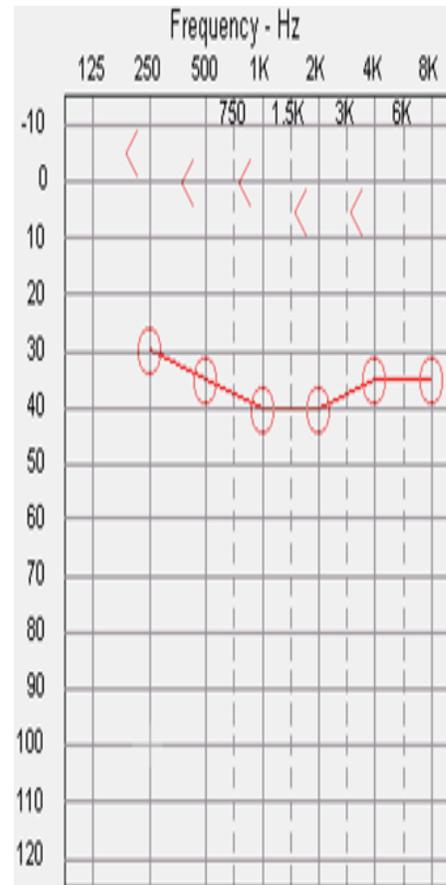


대한고압의학회

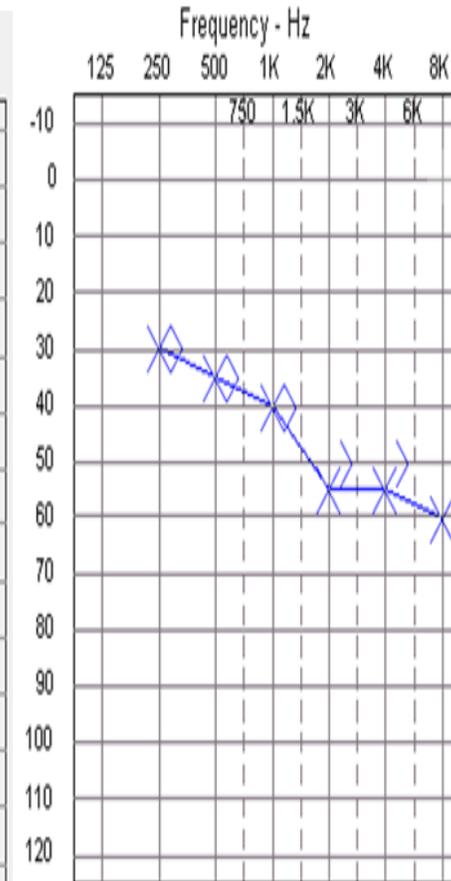
Korean Academy of Undersea and Hyperbaric Medicine

Background

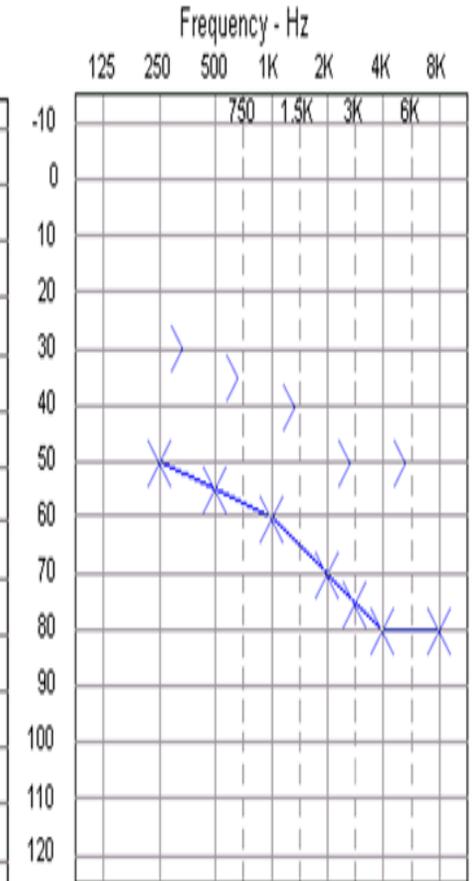
- Hearing loss
 - Conductive
 - Air conduction ↓
 - Bone conduction(-)
 - Air-bone gap $\geq 15\text{dB}$
 - Ear canal, TM, middle ear
 - Sensorineural
 - Air & bone conduction ↓
 - Air-bone gap $\leq 10\text{dB}$
 - Cochlea, auditory nerve
 - Mixed
 - Air conduction ↓ ↓
 - bone conduction ↓
 - Air-bone gap $\geq 15\text{dB}$
 - mixed



Conductive



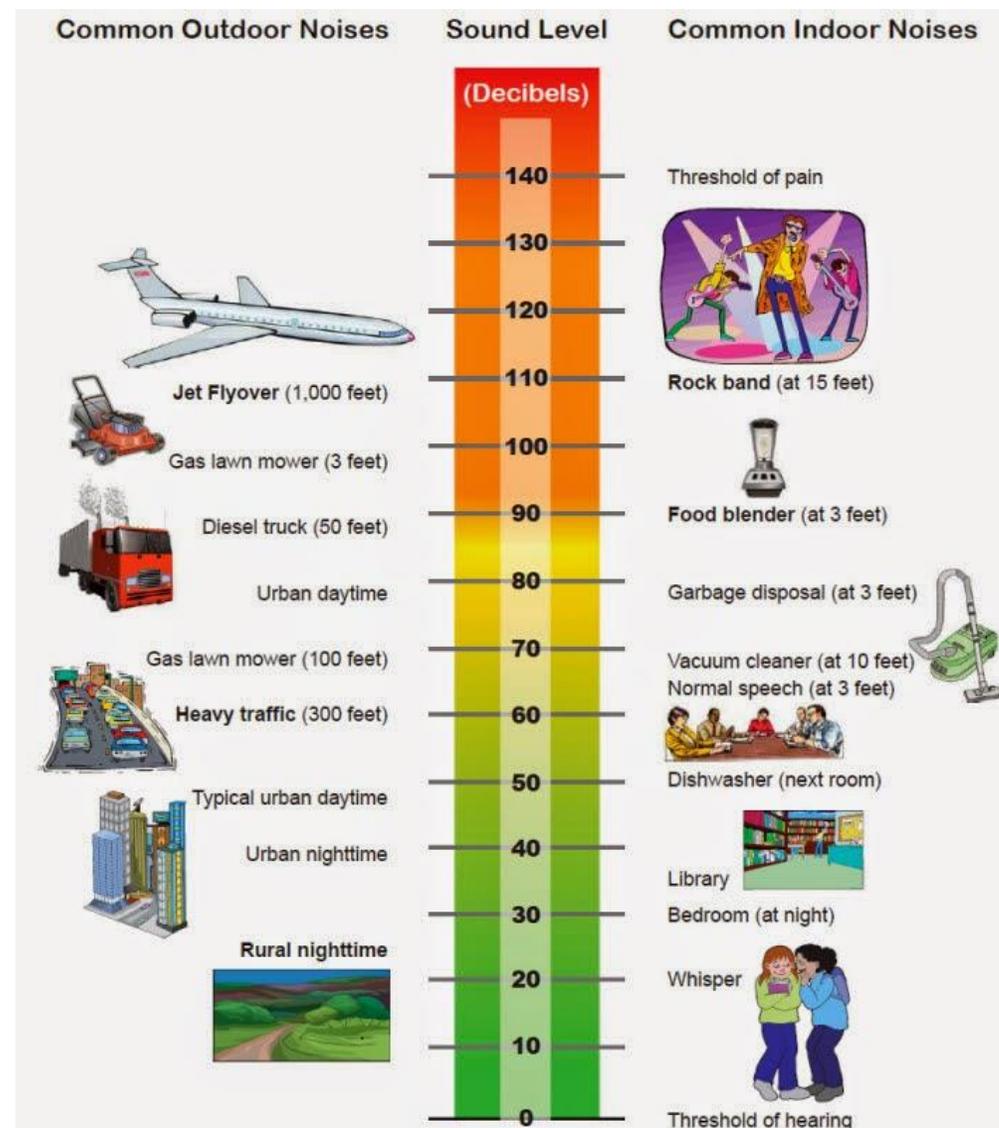
Sensorineural



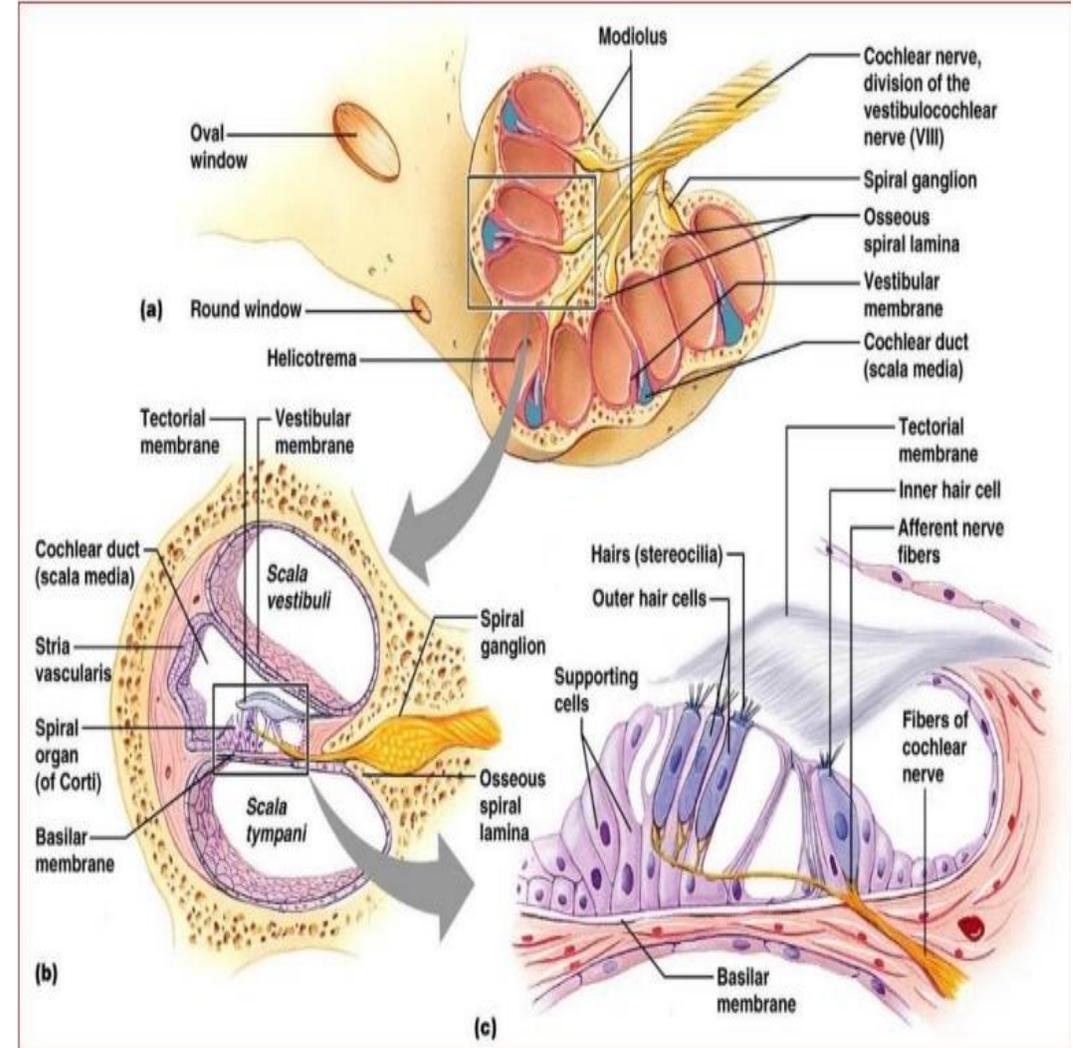
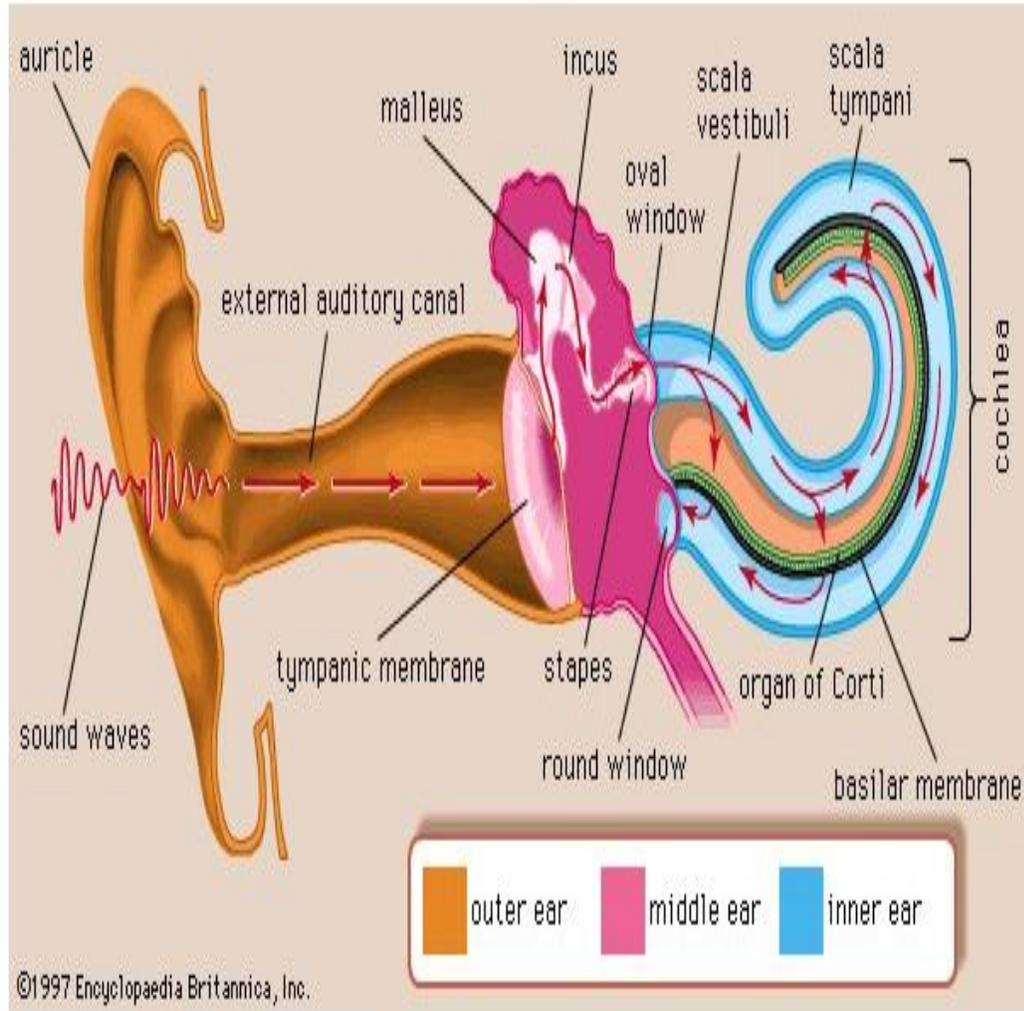
Mixed

SSNHL

- Definition
 - Abrupt onset of hearing loss
 - Sensorineural type
 - Within 3 days
 - At least 30 dB
 - At least 3 consecutive frequencies
- Associated symptoms
 - Tinnitus(40-90%)
 - Fullness(40-50%)
 - Vertigo(30-56%)
- Epidemiology
 - 5-20/100,000
 - Men = women
 - Most common age 43-53
 - Usually unilateral (bilateral <2%)
 - Spontaneous recovery 30-60%



Anatomy & auditory pathway



Etiopathogenesis

- Injury or dysfunction of cochlear hair cell, auditory nerve or tract
- Identifiable cause(10-15%)
 - Infection
 - Viral cochleitis or labyrinthitis(herpes, parainfluenza, influenza, mumps, measles, rubella, HIV)
 - Lyme disease, Tb, syphilis, fungal infection...
 - Autoimmune disease
 - Cogan`s syndrome, SLE, Wegener`s granulomatosis...
 - Vascular insufficiency
 - Stroke, TIA...
 - Acoustic Trauma or head trauma
 - Ototoxicity(toxin, drug)
 - Aminoglycoside, erythromycin, MTX, CO, toluene, organophosphate, lead, mercury...
 - Neoplasm
 - Acoustic neuroma, meningeal carcinomatosis, lymphoma...
 - Meniere disease, multiple sclerosis, hypothyroidism..
- Idiopathic(85-90%)
 - No identifiable cause
 - Cochlear ischemia or hypoperfusion d/t viral infection or microvascular damage



Treatment

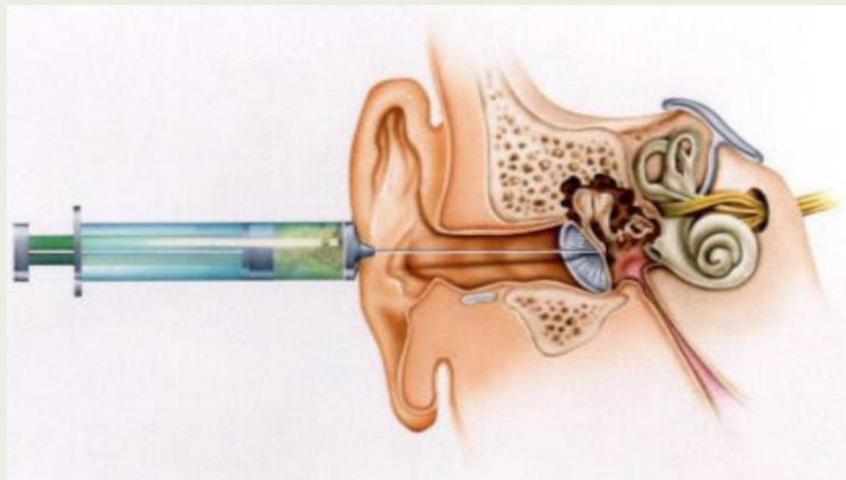
- Controversial
 - Anti-inflammatory drugs
 - Blood circulation improvers
 - Vitamins & antioxidants
 - Anticoagulant
 - Vasodilators
 - Volume expanders
 - Antiviral drugs
 - Diuretics
 - Stellate ganglion blocker(SGB)
 - HBOT
- Time to presentation correlates with hearing recovery
- The earlier, the better. → Otologic emergency!



Steroid Therapy

- The only ones recognized for their effectiveness in SSNHL
- Within 2 weeks of symptom onset
- Anti-inflammatory effect
 - Prevent & reverse cochlear damage
- Increase cochlear blood flow
- Maintain ion homeostasis
- SS(IVS or PO) and ITS

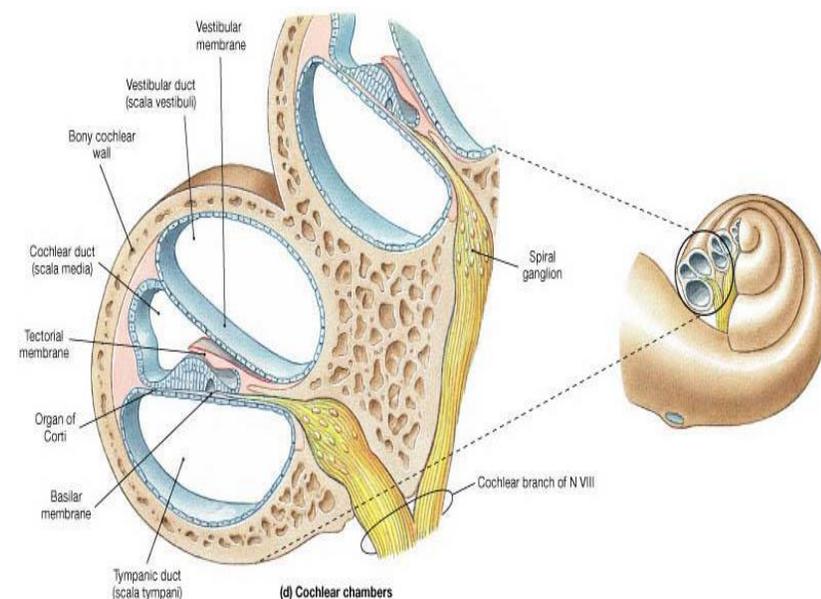
Intratympanic (IT) steroids



- Literature review of steroids
 - Oral vs. IT
 - 3 RCT's
 - Hong 2009, Dispenza 2011, Rauch 2012
 - Oral were equivalent to IT
 - Combined (Oral+IT) vs Oral
 - 6 RCT's
 - 3 no difference
 - 3 combination > oral
 - 88% vs 44% Battaglia
 - 46% vs 21% Zhou
 - 89% vs 61% Gundogan
 - Combined (Oral+IT) vs IT
 - 2 RCT's
 - Battaglia et al, 2008 –combined beneficial (87.5% vs 70.5%)
 - Lim et al, 2012 – no difference

Rationale for HBOT

- Cochlea & organ of Corti
 - Stria vascularis, organ of Corti → oxygen dependent, sensitive to ischemia
 - Not direct vascular supply but oxygen diffusion
 - Perilymph as primary oxygen source
- Increase O_2 tension in the perilymph and cortilymph
 - Perilymph $pO_2 \rightarrow 3.4$ mmHg (normobaric) vs. 9.4 mmHg (hyperbaric)
 - High perilymph O_2 concentration differences → Increase diffusion
 - Cochlear tissue oxygenation → recover ischemic injury
- Prevention of ischemic reperfusion injury
- Edema reduction
- Anti-inflammatory effects
- Best adjuvant Tx. For SSNHL
 - Combination of HBO and steroids
- Protocol
 - 2~2.5 ATA(90~120 min), 10~20 times



Meta-analysis for HBOT



**Cochrane
Library**

Cochrane Database of Systematic Reviews

Hyperbaric oxygen for idiopathic sudden sensorineural hearing loss and tinnitus (Review)

Bennett MH, Kertesz T, Perleth M, Yeung P, Lehm JP

- HBOT significantly improved hearing, but the clinical significance remains unclear
- No evidence of beneficial effect of HBOT on chronic ISSHL
- Improvement
 - 37.7 dB for severe loss
 - 19.3 dB for moderate loss
 - 15.6 dB for total

The Use of HBO₂ for ISSHL

The only Cochrane reviews regarding the treatment of ISSHL that show significant benefit of therapy are the meta-analyses involving the use of HBO₂. In the 2005 Cochrane review, 6 trials were reviewed (n = 304) and it was reported that HBO₂ did improve hearing.¹¹⁵ The 2007 Cochrane review, by the same authors, analyzed six trials (n = 308). This review found that the use of HBO₂ imparts a statistically significant mean improvement over controls at all frequencies. Specifically, HBO₂ improves hearing loss by 37.7 dB for those with severe loss, 19.3 dB for those with moderate loss, and 15.6 dB of hearing improvement overall. It also confirmed that with early presentation of ISSHL, the application of HBO₂ significantly improved hearing loss. Moreover, this update defined that the number need to treat (NNT) for one extra good outcome was 5.3.¹¹⁶ This NNT correlates well with the NNT for diabetic foot wounds treated with HBO₂ (NNT = 4) reported in the 2009 Cochrane review on the use of HBO₂ for chronic wounds.¹²⁸ This NNT is also superior to any NNT found on the NNT website, with the exception of defibrillation for cardiac arrest (<http://www.thennt.com/home-ntt/#nntgreen>). Both the 2010 and the 2012 Cochrane reviews for the use of HBO₂ for ISSHL analyzed the same seven trials (n = 392) and reported the same objective and positive conclusions.^{113,117}



Hyperbaric oxygen (HBO) therapy as an effective approach to the treatment of patients with severe idiopathic sudden sensorineural hearing loss

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ABSTRACT

Background: The potential etiology of idiopathic sudden sensorineural hearing loss (ISSNHL) is cochlear ischemia, therefore, hyperbaric oxygen (HBO) therapy is a promising treatment, particularly in patients with severe hearing loss (≥ 70 dB).

Aims/objectives: To evaluate the efficacy of HBO therapy.

Material and methods: The medical records of patients diagnosed with ISSNHL were retrospectively reviewed (≥ 70 dB). Patients received HBO therapy 14 times in addition to systemic and intratympanic steroid therapy (HBO group), or systemic and intratympanic steroid therapy only (control group).

Results: Data from a total of 82 patients (83 ears) were included in the analysis; 37 (38 ears) in the HBO group and 45 (45 ears) in the control group. After 2 weeks' treatment, hearing was significantly improved in the HBO group versus controls (weighted four-frequency average 28.1 ± 26.9 dB versus 14.8 ± 13.5 dB, respectively; $p < .05$), particularly in the low frequency groups (0.5 kHz, 1 kHz, 2 kHz; $p < .05$).

Conclusion and significance: These data demonstrate that HBO therapy is an effective initial treatment option for patients with ISSNHL suffering from severe hearing loss.

ARTICLE HISTORY

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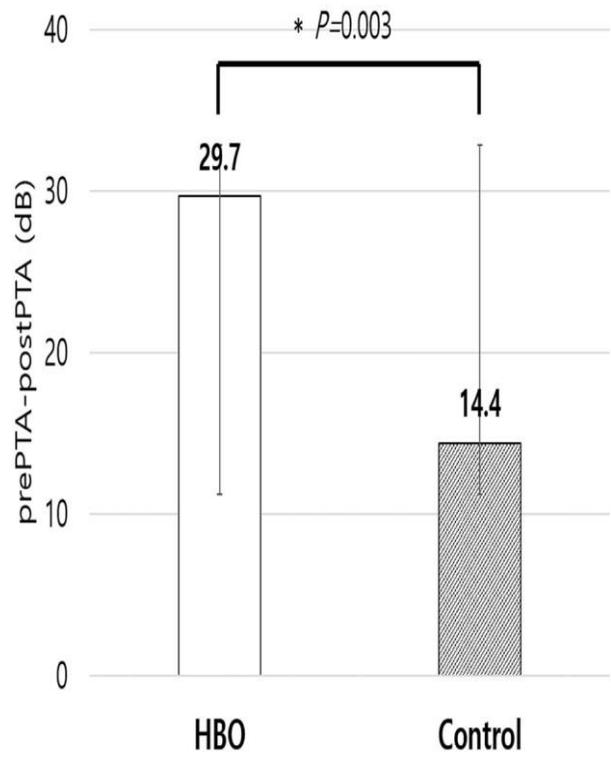
Accepted 10 January 2020

KEYWORDS

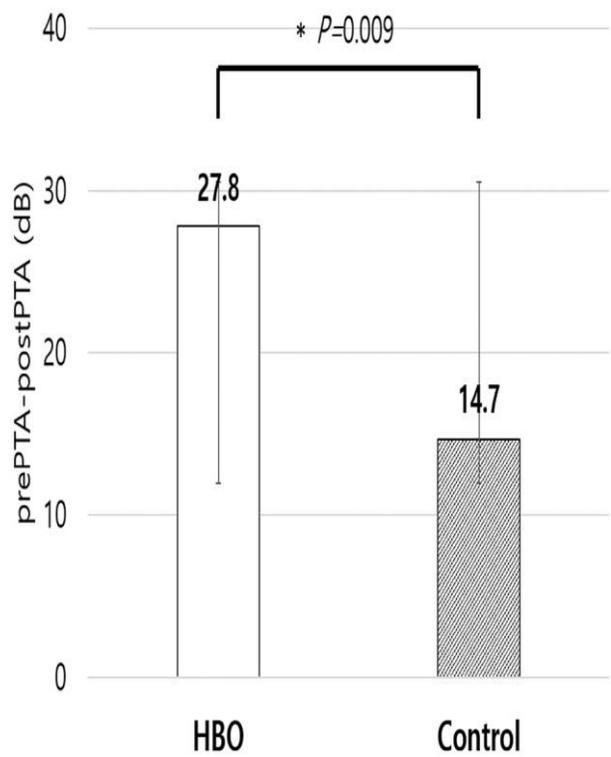
Sudden sensorineural hearing loss; severe hearing loss; hyperbaric oxygen therapy

- Measurement : Pre- and post- PTA(3FA, 4FA, W4FA)
- Treatment protocol(steroid alone vs combined HBO)
 - Methylprednisolone(PO, 48mg, 9 days->tapering for 5 days)
 - Intratympanic dexamethasone(inj., every 2 days, 5 times)
 - HBOT(1.5-3 ATA, 50min, twice per day, 7 days)
- Combination of HBO and steroid can significantly improve hearing outcome when compared with steroid therapy alone

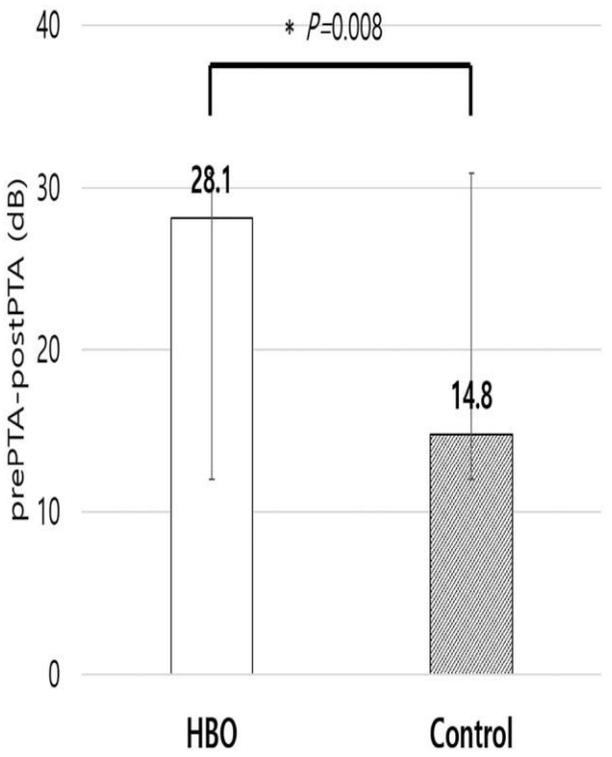




3FA



4FA



W4FA



Hyperbaric Oxygen Therapy as Concurrent Treatment with Systemic Steroids for Idiopathic Sudden Sensorineural Hearing Loss: A Comparison of Three Different Steroid Treatments

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- Measurement: pre- and post PTA(250, 500, 1000, 2000, 4000 Hz)
- Treatment protocol(SS vs SS+IT vs SS+HBOT)
 - SS(prednisolone 80mg, tapering for 10 days)
 - IT(dexamethasone 0.2-0.4mL(4mg/mL), once per week, 4 session)
 - HBOT(2 ATA, 60min, once daily, 10 days)
- Overall hearing recovery rate was significantly higher in the HBOT+SS group than in the SS and IT+SS group



Table 2. Demographics, clinical characteristics, and hearing improvements in patients with idiopathic sudden sensorineural hearing loss after treatment with hyperbaric oxygen combined with systemic steroid therapy or systemic steroid therapy alone

Improvement	HBOT + SS (n = 161)			Recovery rate, %	p value	Control (SS alone) (n = 160)			Recovery rate, %	p value
	yes	no	total			yes	no	total		
Age					1.000					0.500
≤60 years old	56	16	72	77.8		27	49	76	35.5	
>60 years old	69	20	89	77.5		25	59	84	29.8	
Gender					0.706					0.312
Female	57	18	75	76.0		22	56	78	28.2	
Male	68	18	86	79.1		30	52	82	36.6	
Grade (hearing level)					0.128					0.071
1 (<40 dB)	5	3	8	62.5		1	3	4	25.0	
2 (40–60 dB)	19	10	29	65.5		2	3	5	60.0	
3 (60–90 dB)	63	12	75	84.0		4	9	13	30.8	
4 (>90 dB)	38	11	49	77.6		10	3	13	76.2	
Vertigo					<0.001					0.020
Yes	42	20	62	67.7		13	63	76	17.1	
No	83	16	99	83.8		39	45	84	46.4	
Treatment duration					0.304					1.000
≤7 days	107	28	135	79.3		44	90	134	32.8	
>7 days	18	8	26	69.2		8	18	26	30.8	
Diabetes mellitus					0.816					0.259
HbA _{1c} ≤6.5%	100	28	128	78.1		41	93	134	30.6	
HbA _{1c} >6.5%	25	8	33	75.8		11	15	26	42.3	
Smoking history					0.572					1.000
Yes	58	19	77	75.3		27	57	84	32.1	
No	67	17	84	79.8		25	51	76	32.9	
Hypertension					0.803					0.211
Yes	21	7	28	75.0		14	19	33	42.4	
No	104	29	133	78.2		38	89	127	29.9	
Overall recovery				125 (78.3%)					52 (32.5%)	
Complete recovery				42 (26.1%)					10 (6.3%)	
Good recovery				41 (25.5%)					19 (11.9%)	
Fair recovery				42 (26.1%)					23 (14.4%)	
No change				36 (22.4%)					108 (67.5%)	

HBOT + SS, hyperbaric oxygen therapy combined with systemic steroids; SS alone, systemic steroid therapy only.

Table 3. Demographics, clinical characteristics, and hearing improvements in patients with idiopathic sudden sensorineural hearing loss after treatment with intratympanic steroid injections combined with systemic steroid therapy

Improvement	IT + SS (n = 35)			Recovery rate, %	p value
	yes	no	total		
Age					1.000
≤60 years old	8	8	16	50	
>60 years old	9	10	19	47.4	
Gender					0.094
Female	11	6	17	64.7	
Male	6	12	18	33.3	
Grade (hearing level)					0.701
1 (<40 dB)	1	3	4	25	
2 (40–60 dB)	2	3	5	40	
3 (60–90 dB)	4	9	13	30.8	
4 (>90 dB)	10	3	13	76.9	
Vertigo					0.725
Yes	6	5	11	54.6	
No	11	13	24	45.83	
Treatment duration					0.045
≤7 days	17	13	30	56.7	
>7 days	0	5	5	0	
Diabetes mellitus					0.658
HbA _{1c} ≤6.5%	15	14	29	51.7	
HbA _{1c} >6.5%	2	4	6	33.3	
Smoking history					1.000
Yes	2	2	4	50	
No	15	16	31	48.4	
Hypertension					1.000
Yes	8	8	16	50	
No	9	10	19	47.4	
Overall recovery				17 (48.6%)	
Complete recovery				5 (8.6%)	
Good recovery				6 (17.1%)	
Fair recovery				8 (22.9%)	
No change				18 (51.4%)	

IT + SS, intratympanic steroids combined with systemic steroid therapy.



Clinical practice guideline update: 2019



Guidelines Executive Summary

Clinical Practice Guideline: Sudden Hearing Loss (Update) Executive Summary

Sujana S. Chandrasekhar, MD^{1,2,3}, Betty S. Tsai Do, MD⁴, Seth R. Schwartz, MD, MPH⁵, Laura J. Bontempo, MD, MEd⁶, Erynne A. Faucett, MD⁷, Sandra A. Finestone, PsyD⁸, Deena B. Hollingsworth, MSN, FNP-BC⁹, David M. Kelley, MD⁴, Steven T. Kmucha, MD, JD¹⁰, Gul Moonis, MD¹¹, Gayla L. Poling, PhD, CCC-A¹², J. Kirk Roberts, MD¹¹, Robert J. Stachler, MD¹³, Daniel M. Zeitler, MD⁵, Maureen D. Corrigan¹⁴, Lorraine C. Nnacheta, MPH, DrPH¹⁴, Lisa Satterfield, MS, MPH¹⁴, and Taskin M. Monjur¹⁴



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Table 4. Summary of Guideline Key Action Statements.

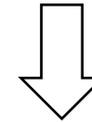
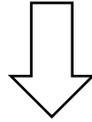
Statement	Action	Strength
1. Exclusion of conductive hearing loss	Clinicians should distinguish sensorineural hearing loss (SNHL) from conductive hearing loss (CHL) when a patient first presents with SHL	Strong recommendation
2. Modifying factors	Clinicians should assess patients with presumptive SSNHL through history and physical examination for bilateral SHL, recurrent episodes of SHL, and/or focal neurologic findings.	Recommendation
3. Computed tomography	Clinicians should <i>not</i> order routine computed tomography (CT) of the head in the initial evaluation of a patient with presumptive SSNHL.	Strong recommendation against
4. Audiometric confirmation of SSNHL	In patients with SHL, clinicians should obtain, or refer to a clinician who can obtain, audiometry as soon as possible (within 14 days of symptom onset) to confirm the diagnosis of SSNHL.	Recommendation
5. Laboratory testing	Clinicians should <i>not</i> obtain routine laboratory tests in patients with SSNHL.	Strong recommendation against
6. Retrocochlear pathology	Clinicians should evaluate patients with SSNHL for retrocochlear pathology by obtaining magnetic resonance imaging or auditory brainstem response (ABR).	Recommendation
7. Patient education	Clinicians should educate patients with SSNHL about the natural history of the condition, the benefits and risks of medical interventions, and the limitations of existing evidence regarding efficacy.	Strong recommendation
8. Initial corticosteroids	Clinicians may offer corticosteroids as initial therapy to patients with SSNH <u>within 2 weeks</u> of symptom onset.	Option
9a. Initial therapy with hyperbaric oxygen therapy	Clinicians may offer, or refer to a clinician who can offer, hyperbaric oxygen therapy (HBOT) combined with steroid therapy within 2 weeks of onset of SSNHL.	Option
9b. Salvage therapy with hyperbaric oxygen therapy	Clinicians may offer, or refer to a clinician who can offer, HBOT combined with steroid therapy as salvage <u>within 1 month</u> of onset of SSNHL.	Option
10. Intratympanic steroids for salvage therapy	Clinicians should offer, or refer to a clinician who can offer, intratympanic steroid therapy when patients have incomplete recovery from SSNHL 2 to 6 weeks after onset of symptoms.	Recommendation
11. Other pharmacologic therapy	Clinicians should <i>not</i> routinely prescribe antivirals, thrombolytics, vasodilators, or vasoactive substances to patients with SSNHL.	Strong recommendation against
12. Outcomes assessment	Clinicians should obtain follow-up audiometric evaluation for patients with SSNHL at the conclusion of treatment and within 6 months of completion of treatment.	Recommendation
13. Rehabilitation	Clinicians should counsel patients with SSNHL who have residual hearing loss and/or tinnitus about the possible benefits of audiological rehabilitation and other supportive measures.	Strong recommendation



Flowchart for the treatment of SSHNL

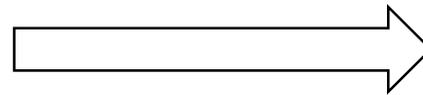
Classic Presentation of Symptoms in SSHL patients

갑작스런 청력 손실: 3 일 이내 발생, 최소 30 dB 이상, 최소 3 일 이상 지속
다른 증상: 이명, 귀 막힘, 어지럼증, 현훈



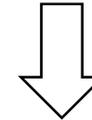
Self Referred Patient

- 병력 신체검사
- 감별진단
- SSHNL 의심 → ENT 의뢰



Patient Presents to ENT

- ENT 검사, 청력 검사
- MRI: retrocochlear pathology
- 추가 검사



Hyperbaric Medicine Consultation

- Evaluate for SSHNL selection Criteria: 1. SSHNL 확진 2. 청력 손실 중등도 이상 (40 dB 이상) 3. 증상 발현 후 14 일 이내 내원 *미국 이비인후과학회에서는 3개월까지
- Complete Exam and history: HBOT 의 금기증 평가
- Call ENT: oral prednisone(1mg/kg/day), 2~3 주에 걸친 서서히 감량, IT steroids, post HBOT 후 청력검사 스케줄
- Begin HBOT: 100% O₂ at 2.0~2.5 ATA for 90 min daily for 10 -20 sessions
- When HBOT is completed: ENT 에 재의뢰, 두 진료과의 추가 FU 계획

Indication for HBOT

- 국내 16개 보험적용 적응증(2019.1.1 시행)

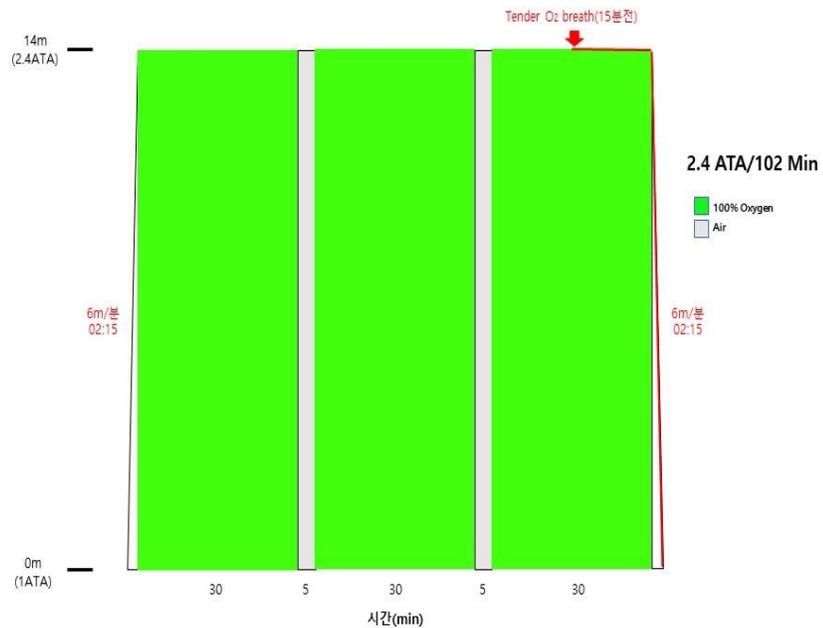
항목	제목	세부인정사항
자586 고압산소요법	자586 고압산소요법의 급여기준	<p>자586 고압산소요법은 동일 날 오전·오후로 나누어 시행할 경우에는 실 처치시간을 합산하여 해당항목의 소정 점수를 산정하며, 다음과 같이 요양급여함.</p> <p style="text-align: center;">- 다음 -</p> <p>가. 일산화탄소중독, 감압병(잠수병), 가스색전증, 혐기성세균감염증(가스괴저증), 시안화물중독증, 시력소실 24시간 이내 급성기 중심망막 동맥폐쇄, 수혈이 불가능한 경우의 과도한 출혈에 의한 빈혈</p> <p>나. 화상, 버거씨병, 식피술 또는 피판술 후, 수지접합수술 후, 방사선치료 후 발생한 조직괴사, 당뇨병성 족부 궤양(Wagner grade 3 이상), 치료에 반응하지 않는 만성 난치성 골수염, 두개내 농양 등에 통상 2주 이내로 실시함을 원칙으로 하며, 연장 실시가 반드시 필요한 경우에는 사례별 인정</p> <p>다. 초기 청력역치 80dB 이상의 돌발성 난청환자에서 고압산소요법을 1회 60~120분 이내로 실시한 경우 인정</p>



HBOT protocol in WKUH

- 2.4 ATA/114 min
- 1회/day(월-토) → 15-20회 후 PTA f/u
- Response(+) → 추가치료, response(-) → 치료 종료

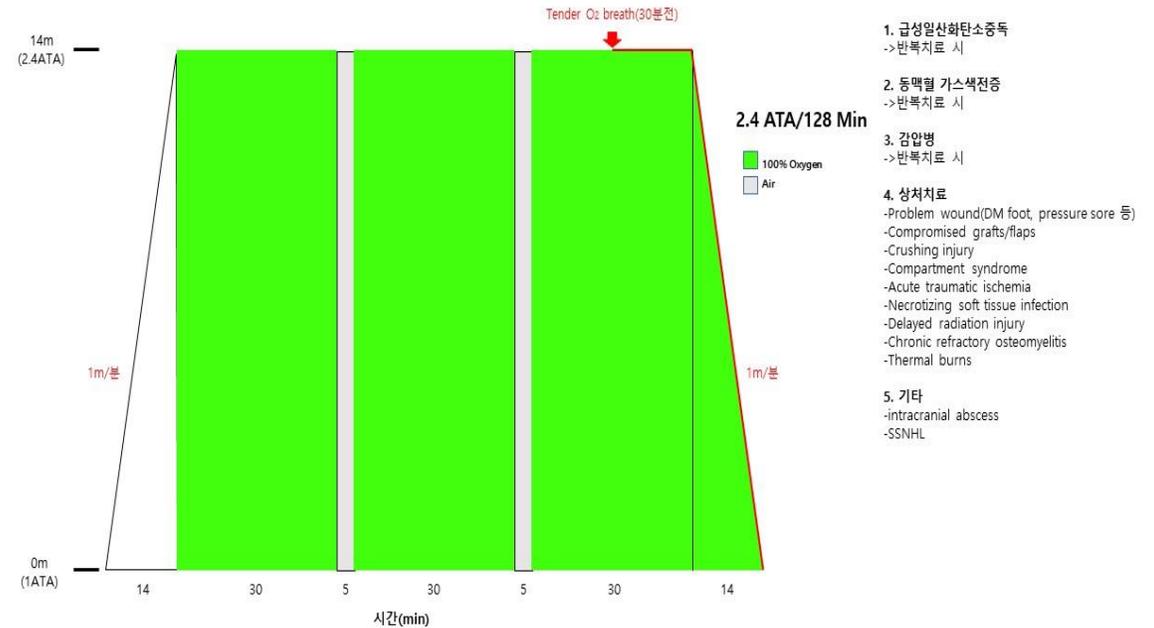
(U.S. Navy Treatment Table 9)



<적응증>

1. 급성일산화탄소중독
->반복치료 시
 2. 동맥혈 가스색전증
->반복치료 시
 3. 감압병
->반복치료 시
 4. 상처치료
-Problem wound(DM foot, pressure sore 등)
-Compromised grafts/flaps
-Crushing injury
-Compartment syndrome
-Acute traumatic ischemia
-Necrotizing soft tissue infection
-Delayed radiation injury
-Chronic refractory osteomyelitis
-Thermal burns
 5. 기타
-Intracranial abscess
-SSNHL
- *기압속도(6m/분)는 환자 적응 상태에 따라 조절

(U.S. Navy Treatment Table 9(modification))



<적응증>

1. 급성일산화탄소중독
->반복치료 시
2. 동맥혈 가스색전증
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-Thermal burns
5. 기타
-Intracranial abscess
-SSNHL

Korean Academy of
Undersea and Hyperbaric Medicine

Thank you



대한고압의학회

Korean Academy of Undersea and Hyperbaric Medicine