Sudden Sensorineural hearing loss, central retinal artery obstruction, Acute peripheral arterial insufficiency & end-stage wounds/critical limb ischemia

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순천향대학교 부천병원 응급의학과
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Learning outcomes

Participants should be

Able to

- Anatomy
- Definition of disease
- HBOT indication

보험고지 사항

자 586 고압산소처치의 수가산정방법(안) - 2016.9.1 적용예정

변경전	변경후(안)
고압산소처치를 동일 날 오전·오후로 나누어 시행할 경우에는 실 처치시간을 합산하여 자586 고압산소처치 해당항목 소정점수를 1회만 산정하며, 각 적용증별 수가 산정방법은 다음과 같이 함. - 다 음 - 가. 일산화탄소중독, 감압병(잠수병), 가스 색전증, 혐기성세균감염증(가스괴저증), 시안화물중독증에 고압산소처치 시는 자586 해당항목 소정점수 산정 나. 화상, 버거씨병, 식피술 또는 피판술 후, 수지접합수술 후, 방사선치료 후 발생한 조직괴사 등에 고압산소처치 시는 처치시간 1시간 이내는 자586가 소정점수를 산정하고, 1시간 초과 시는 자586가 소정점수의 200%를 산정함. 단, 통상 2주 이내로 실시함을 원칙으로 하되, 연장실시가 반드시 필요한 경우에는 사례별로 인정함. 〈신 설〉	고압산소처치를 동일 날 오전·오후로 나누어 시행할 경우에는 실 처치시간을 합산하여 자586 고압산소처치 해당항목 소정점수를 1회만 산정하며, 각 적용증별 수가 산정방법은 다음과 같이 함. - 다 음 - 가. 일산화탄소중독, 감압병(잠수병), 가스 색전증, 혐기성세균감염증(가스괴저증), 시안화물중독증에 고압산소처치 시는 자586 해당항목 소정점수 산정 나. 화상, 버거씨병, 식피술 또는 피판술 후, 수지접합수술 후, 방사선치료 후 발생한 조직괴사 등에 고압산소처치 시는 처치시간 1시간 이내는 자586가 소정점수를 산정하고, 1시간 초과 시는 자586가 소정점수의 200%를 산정함. 단, 통상 2주 이내로 실시함을 원칙으로 하되, 연장실시가 반드시 필요한 경우에는 사례별로 인정함. 다. 초기 청력 역치 80dB 이상의 돌발성 난청환자에서 고압산소처치를 1회 60~120분 이내로 실시한 경우 인정하며, 처치시간에 따라 자586 해당항목 소정점수를 산정함.

고압산소처치	금 액	응급환자 시행금액 (50%가산)
30분 초과 ~ 1시간까지	19,490원	29,230원
1시간 초과 ~ 1시간30분 까지	22,060원	33,090원
1시간30분 초과 ~ 2시까지	25,270원	37,910원

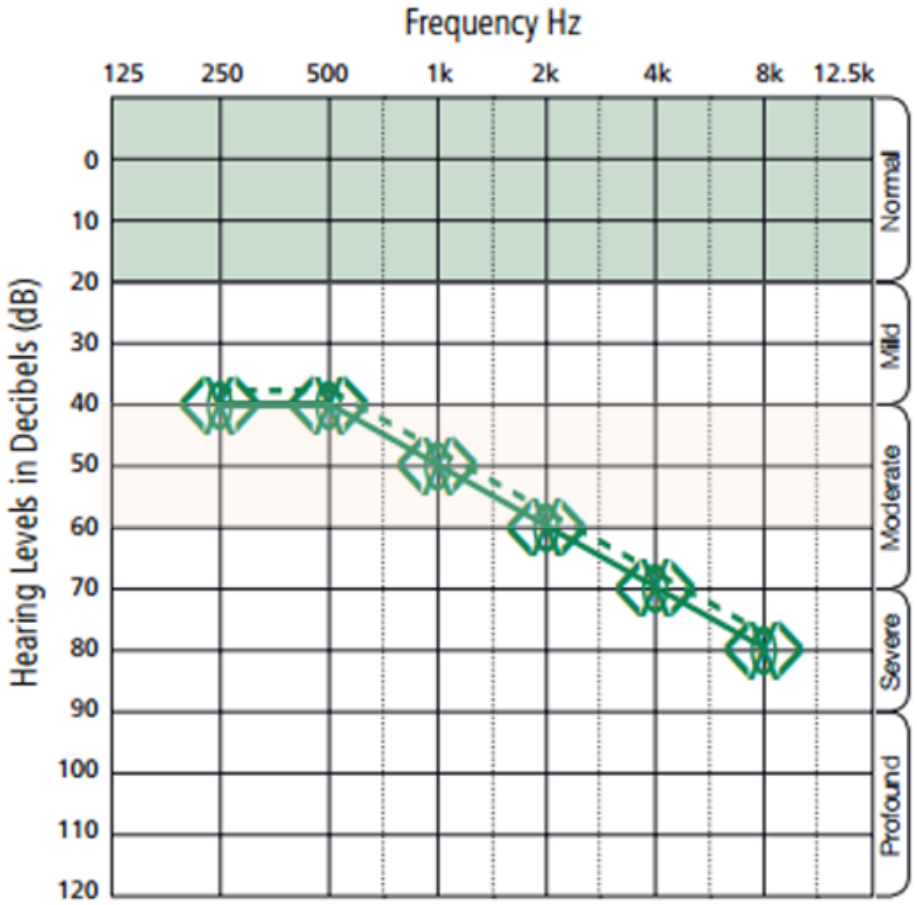
Hyperbaric oxygen therapy committee(1976)

- Reimbursement standards
  - Research review, clinical data
  - Recommendation rendering of safety and efficacy
  - 28 indications in 1976, 1979 reports→ 14 indications
- New indications development
  - Evidence based
  - Academic society
  - HIRA

Idiopathic sudden sensorineural hearing loss(ISSHL)

- Hearing loss of at least 30 dB < 3days at least 3 contiguous frequencies
- Sudden, unilateral hearing loss, tinnitus, aural fullness, vertigo
- 20 cases / 100,000

Hearing >20dB, whole Fr.

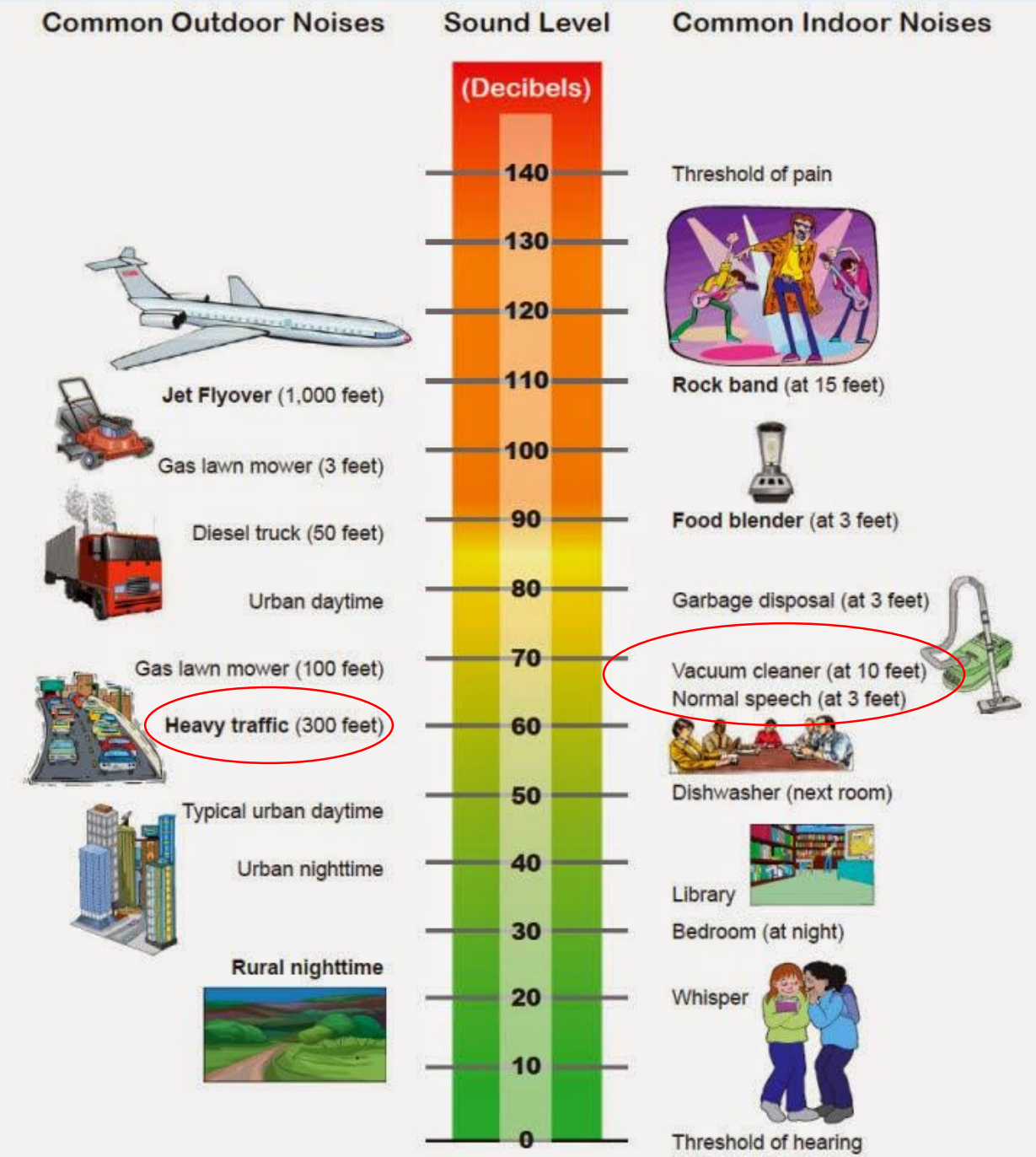


Sensorineural

- Due to problems with cochlear (hearing organ in inner ear) and/or hearing nerve.
- No significant 'air-bone gap' is evident.

소리, 데시벨

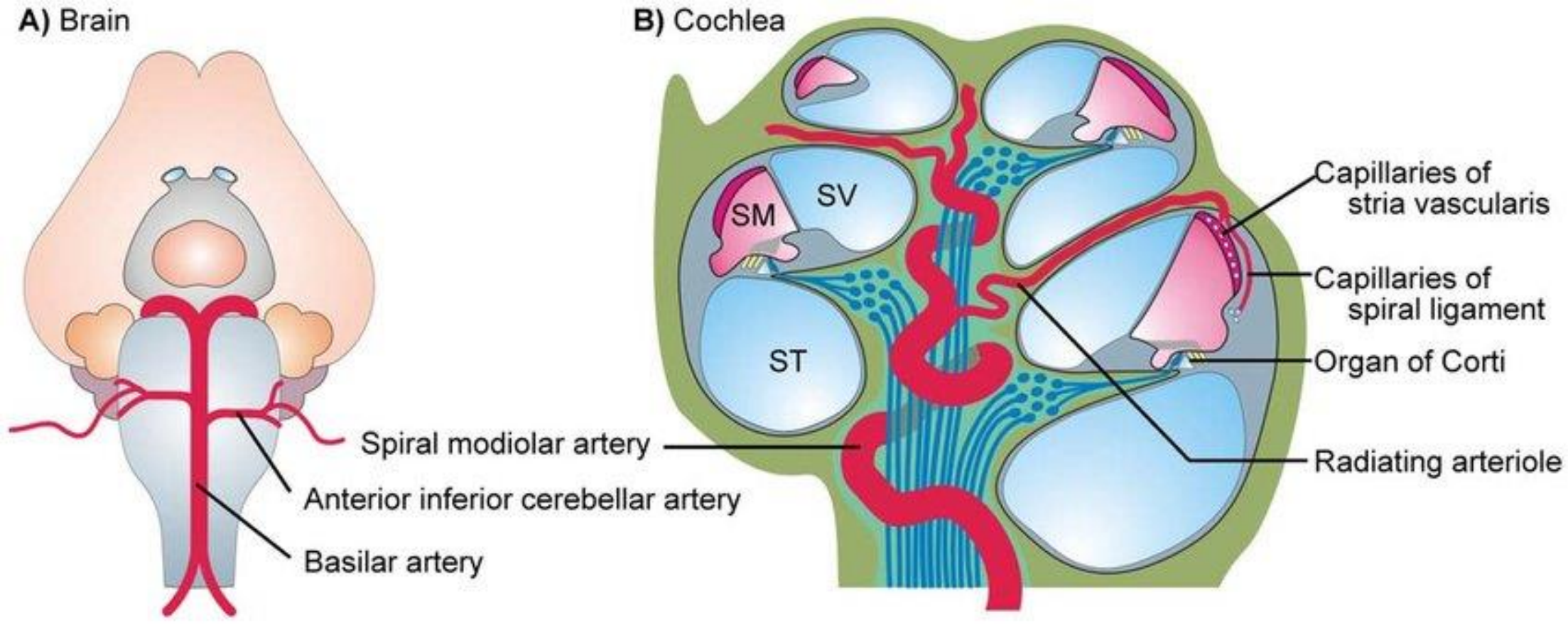
- 80 dB = 진공청소기 소리



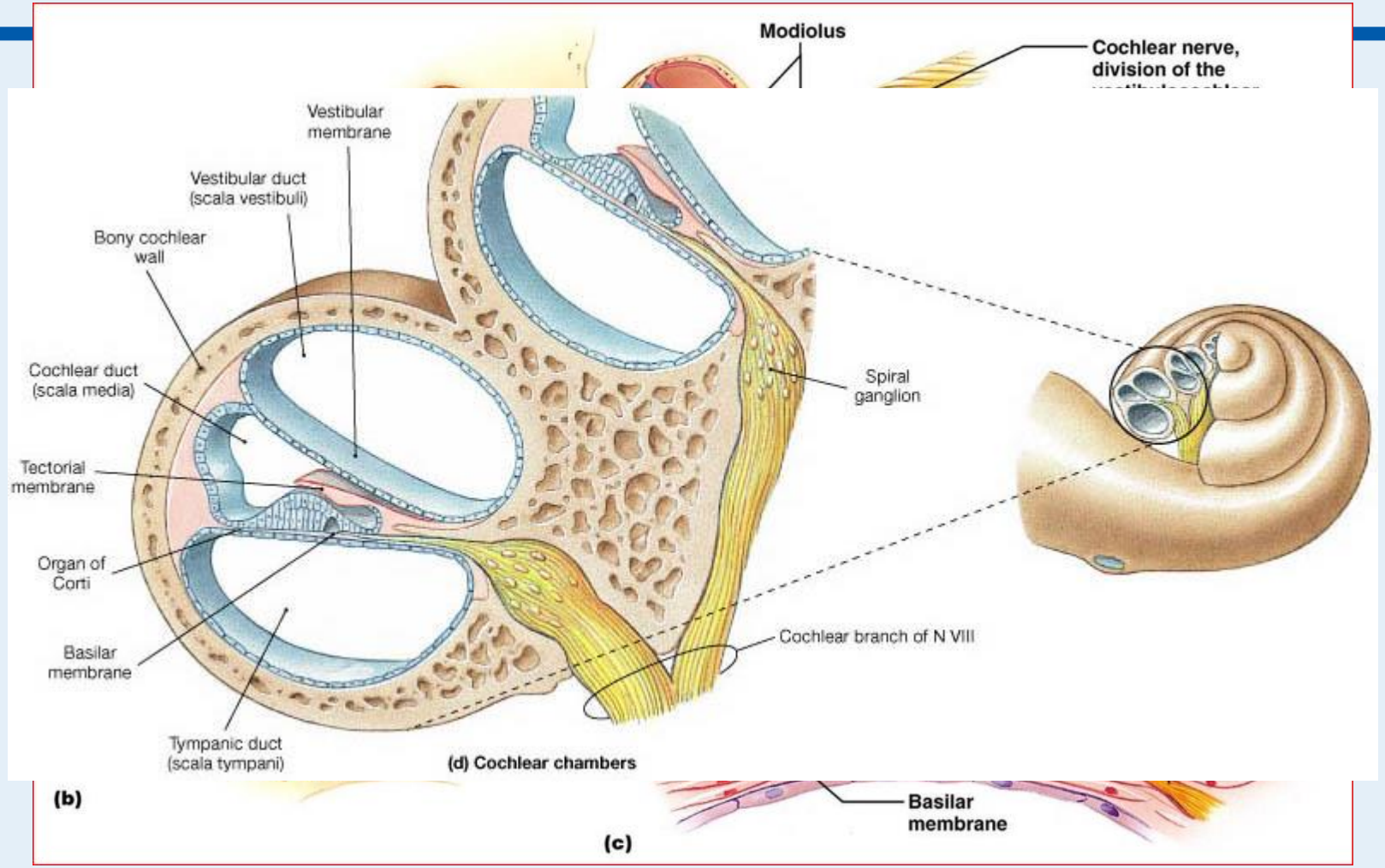
Rationale to treatment

- Vascular occlusion, ischemia
- Viral infection
- Labyrinthine memb. Break
- Immune associated
- Abnormal cochlear stress response
- Trauma
- Abnormal tissue growth
- Toxins, drugs
- Cochlear memb. damage

Blood supply: AICA→ modiolar a.



Stria vascularis in Corti organ



Changes in Corti organ

- Perilymph PO2: 3.4-fold normobaric vs. 9.4 fold hyperbaric
- Only HBO2 high perilymph O2 concentration differences→ increase diffusion

Table 1. Retrospective and Prospective Case-Controlled Studies of ISSHL and HBO_2

Study	Patient groups	HBO_2	Concomitant therapies	Hearing gains
Alimoglu[9] 2011	n = 219 HBO_2 (n = 57) POS (n = 58) POS + HBO_2 (n = 61) ITS (n = 43)	2.5 ATA/ 253.32 kPa 120 minutes 20 sessions	oral and intratympanic corticosteroids as controls and combined treatment with HBO_2	86.9% POS/HBO_2 63.8% POS 46.5% IT 43.9% HBO_2 Complete recovery 42.6% POS/HBO_2 19.0% POS 17.5% HBO_2 11.6% ITS Highest mean Hearing gain POS + HBO_2*
Liu[31] 2011	n = 465 HBO_2 (n = 112) Corticosteroids (n = 77) Corticosteroids + Dextran + HBO_2 (n = 277)	2.5 ATA/ 253 kPa 60 minutes 10–20 sessions	IV and PO corticosteroids, Dextran-40	HBO_2 is beneficial with profound initial hearing loss
Liu[37] 2010	n = 120 treated < 14 d MT + HBO_2 (n = 60) MT Only (n = 60)	unavailable	MT as control type(s) unknown	Overall effectiveness 83.3% HBO_2* 60% MT
Ohno[21] 2010	n = 94 HBO_2 (n = 48) MT only (n = 44)	unavailable HBO_2 given 4 weeks after MT failure	MT as control type(s) unknown	mean hearing gains not different between groups hearing gains for those with profound loss significantly higher than other groups*

2011	HBO_2 (n = 112) Corticosteroids (n = 77) Corticosteroids + Dextran + HBO_2 (n = 277)	253 kPa 60 minutes 10–20 sessions	corticosteroids, Dextran-40	profound initial hearing loss
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Suzuki[34] 2008	n = 196 loss > 40 dB for < 30 d unaffected ears served as controls POS + HBO_2 (n = 101) PEG1 & HBO_2 (n = 95)	2.5 ATA/ 253.32 kPa 60 minutes 10 sessions	PO corticosteroids, PGE1	No difference PGE1 as an alternative for corticosteroid intolerant
Dundar[19] 2007	n = 80 hearing loss > 40 dB for < 30 days HBO_2 (n = 55) controls (n = 25)	unavailable	none unaffected ears served as controls	HBO_2 gains across all frequencies*
Fujimura[50] 2007	n = 130 hearing loss > 40 dB for < 30 days POS + HBO_2 (n = 67) POS only (n = 63)	unavailable	PO corticosteroids unaffected ears served as controls	Severe loss (> 80 db) Hearing rate improvement 51.1% HBO_2* 27.1% controls Rate of recovery 59.7% HBO_2* 39.7% controls

Central Retinal Artery occlusion

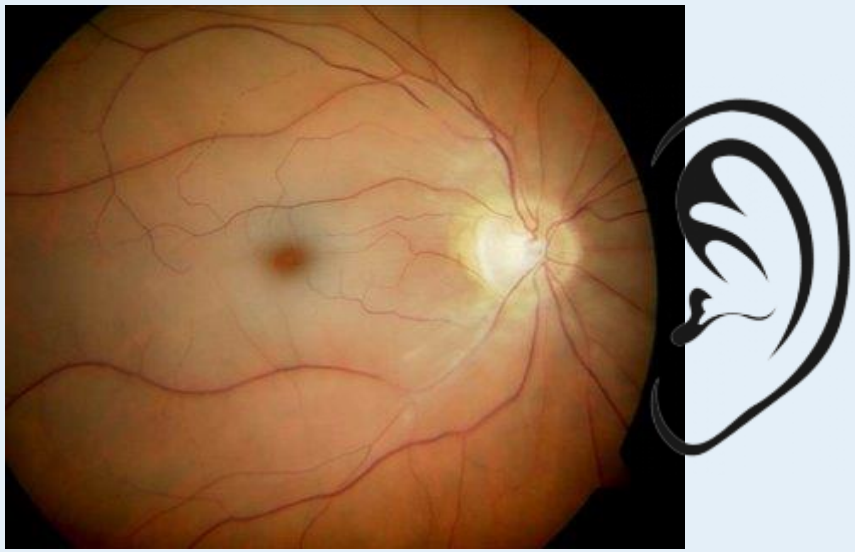
Introduction (1)

- 눈에 발생한 최악의 질환, 비교적 흔함(1/100,000)
- 갑자기, 한쪽만, 무통으로 발생
- 적절히 치료하더라도 시력의 심각한 장애를 남김
- 예후 ∝망막 생존 ∝ 측부 순환, 허혈 시간

Hayreh SS, et al. *Am J Ophthalmol* 2005;140:376. 1-18.

CRAO

- 1~2 / 10,000 peoples
- Pale yellow ~white appearing retina
- Painless!



Introduction (2)

- 기존치료
- 안압을 낮추고, 혈관 확장: 핏떡을 말초로 이동
  - ocular massage
  - anterior chamber paracentesis
  - intraocular pressure-lowering medications
  - vasodilators and oral diuretics

- No treatment effective for CRAO currently

Neubauer A, et al. *Klin Monbl Augenheilkd* 2000;217:30-6.

Introduction (3)

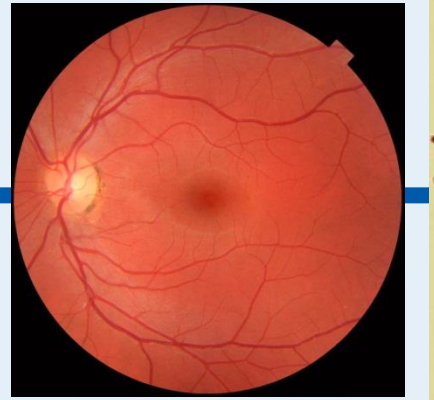
- Another treatment for CRAO is hyperbaric oxygen therapy (HBOT).
  - This involves the inhalation of 100% oxygen at pressures exceeding 1 ATA.
  - During HBOT, the volume of oxygen dissolved in the plasma increases up to 20–30 times.

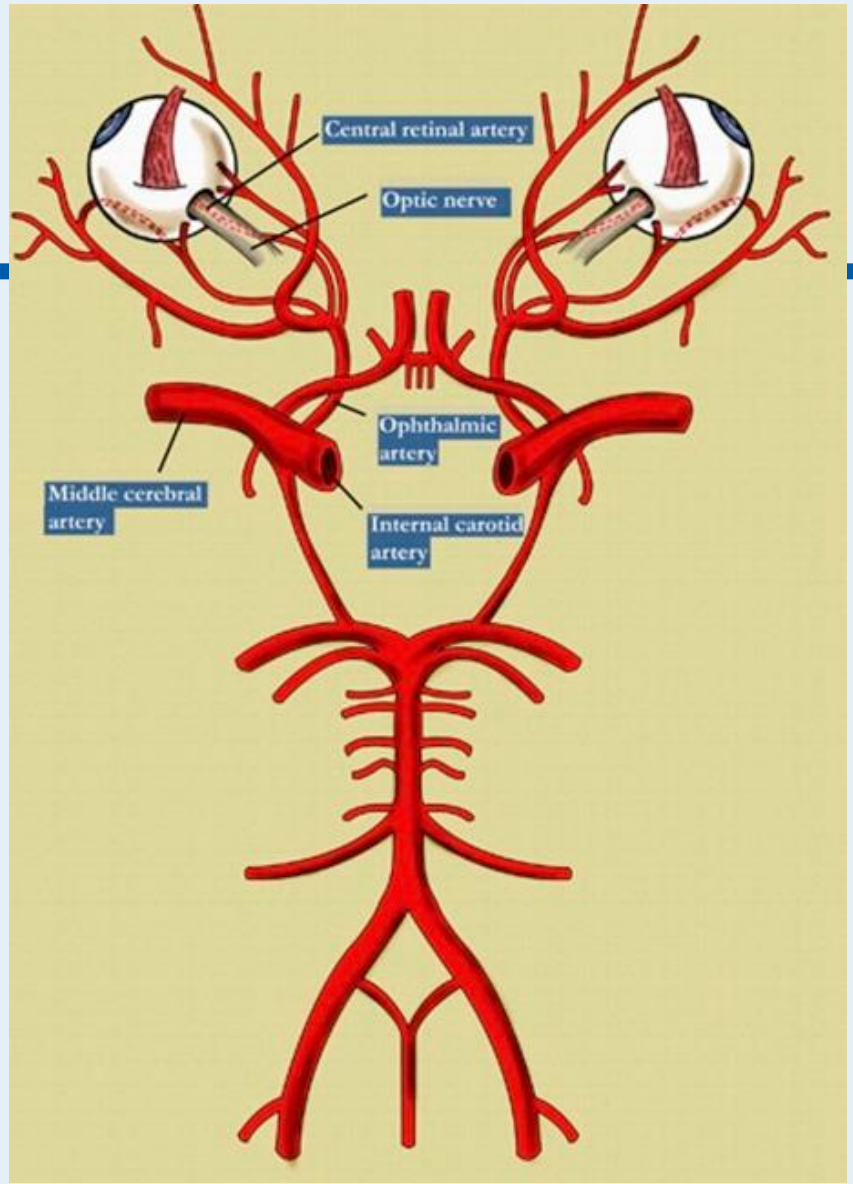
Fosen KM, et al. *Antioxid Redox Signal* 2014;21:1634-47.

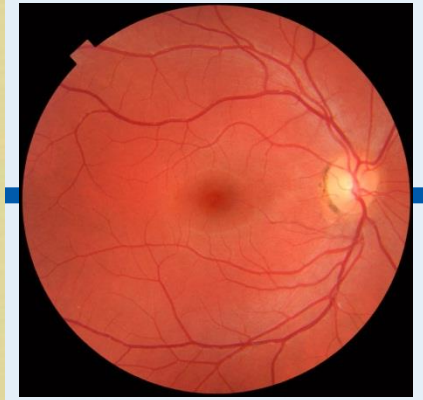
Backgrounds (1)

- Arterial blood supply
  - Internal carotid artery ⇒ Ophthalmic artery ⇒ Orbital structures +Tissues of the globes (central artery of the retina, short and long posterior ciliaries, anterior ciliaries).
  - The central retinal artery enters the globe within the substance of the optic nerve and serves the inner layers of the retina through its many branches.
  - **The long posterior ciliary arteries(PCA) provide blood to the choroid and the outer layers of the retina.**

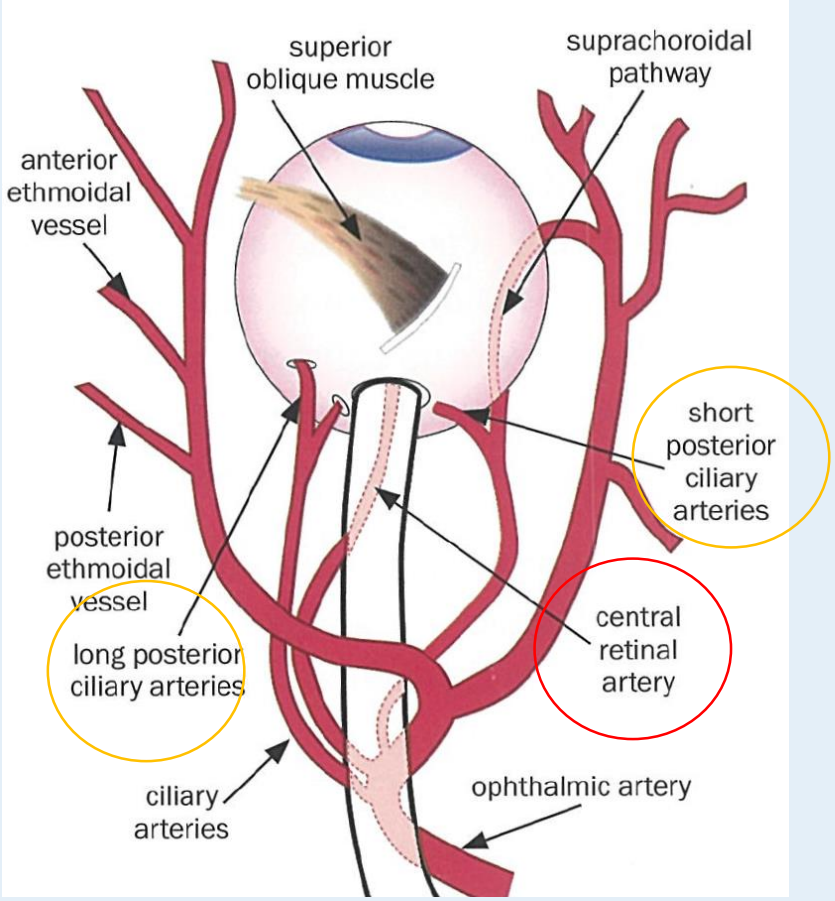
- **CRA→ inner retina, PCA→ outer retina**

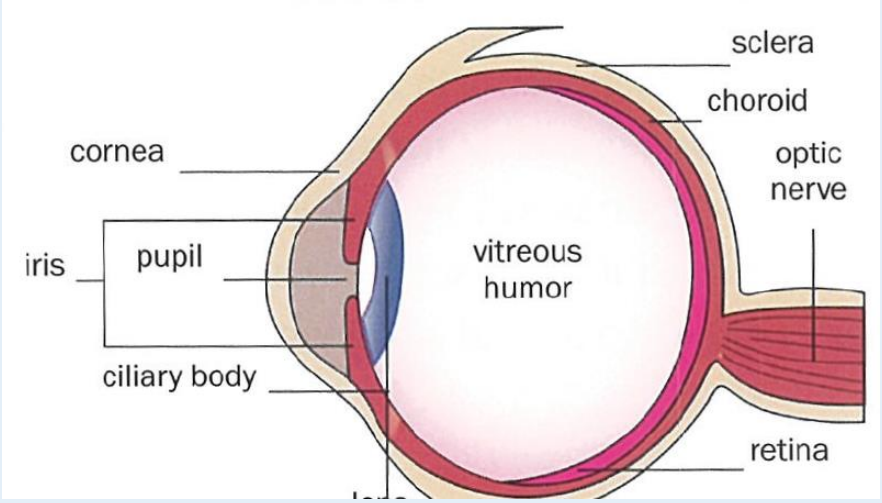



Central retinal artery
Optic nerve
Ophthalmic artery
Middle cerebral artery
Internal carotid artery



Central retinal artery occlusion



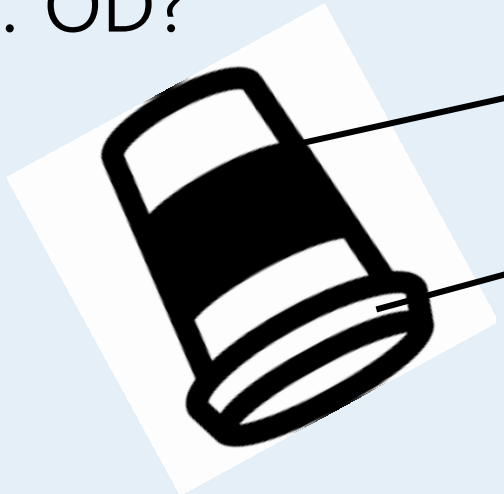


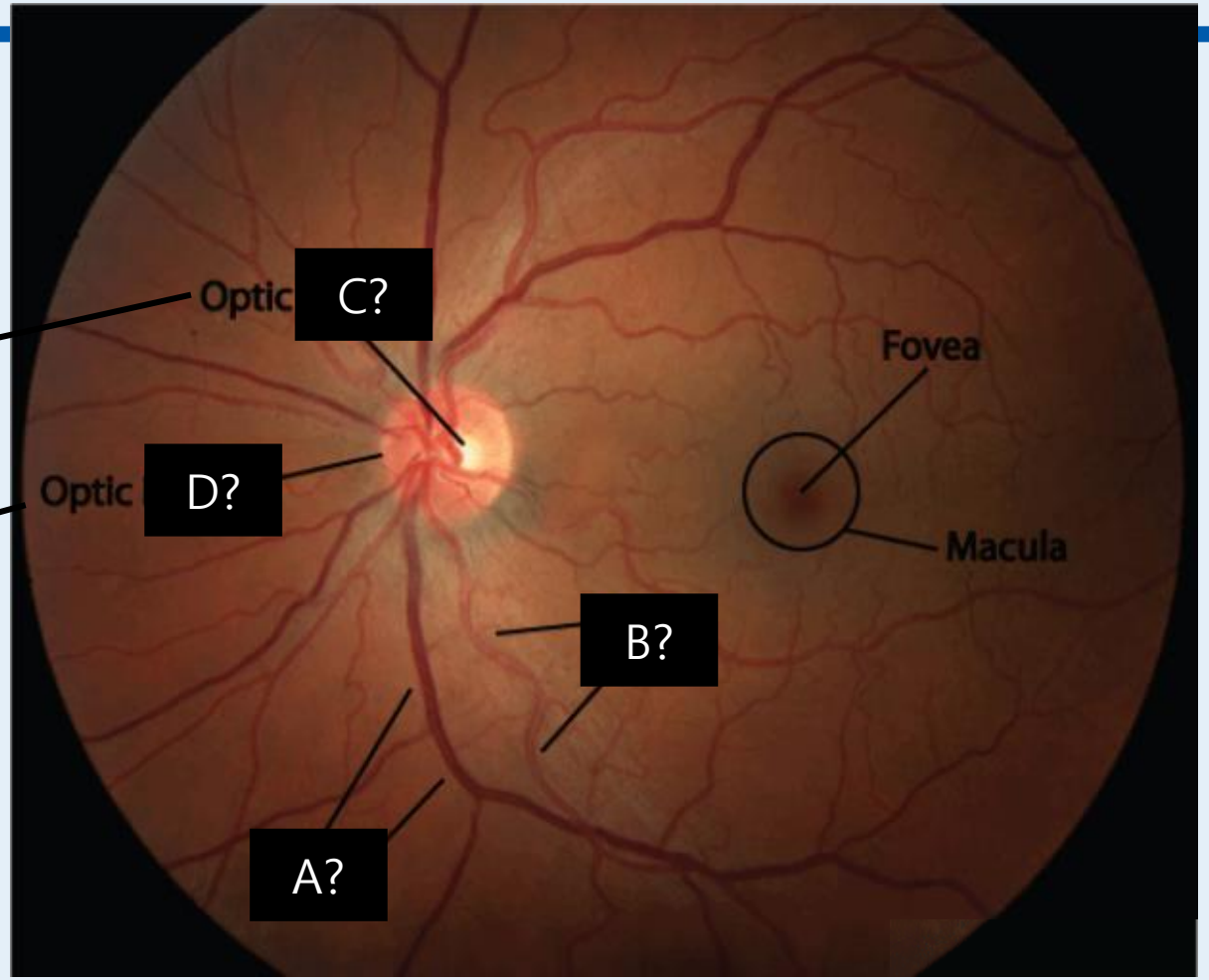
Rationale (2)

- In considering the effect of treating CRAO with supplemental oxygen
  - HBOT initiated ***before the retinal tissue damage is irreversible***.
  - Degree of occlusion of the blocked vessel matter.
    - If level of occlusion is at ophthalmic artery, there is no collateral circulation to provide oxygenation of the inner layer of the retina.
  - **Necessary oxygenation must be maintained to keep the retina viable** until natural recanalization, which usually occurs **within 72 hours.**

Back to EYE class

- Rt vs. Lt?
- OS vs. OD?





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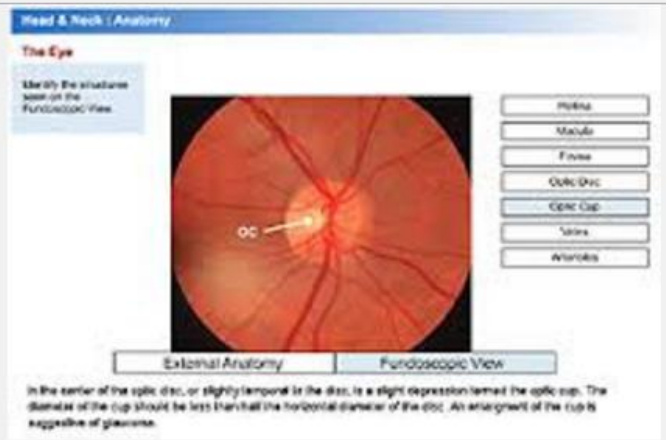

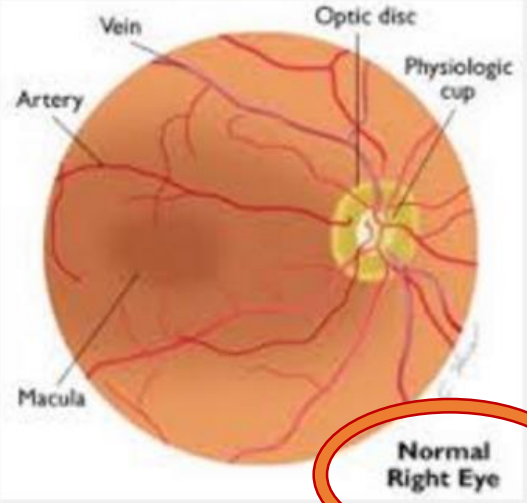

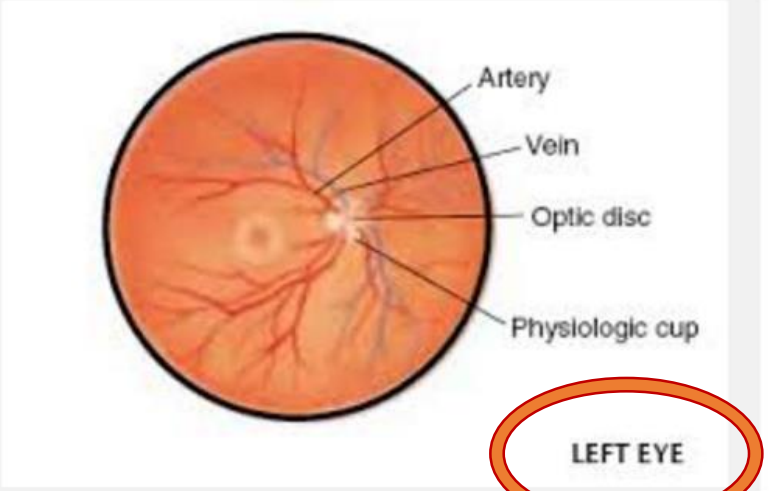

treatment

- Embolus down stream move and vasodilation
  - Ocular massage
  - Ant. Chamber paracentesis
  - IOP lowering medication
  - Vasodilator
  - Oral diuretics
- Thrombolytic agents and surgical removal

HBO for CRAO

- AHA classification of evidence: **IIb**
  - Fair to good evidence to support its use with retrospective controlled case series but no prospective RCT
  - But, no harm to patient
  - Potentially helpful treatment tools

Patient selection criteria

- Patients presenting within **24 hours** of symptom onset should be considered for HBOT
  - Few case reports of patients presenting after this time interval having positive results.

Ophthalmologic Tx

+

HBOT

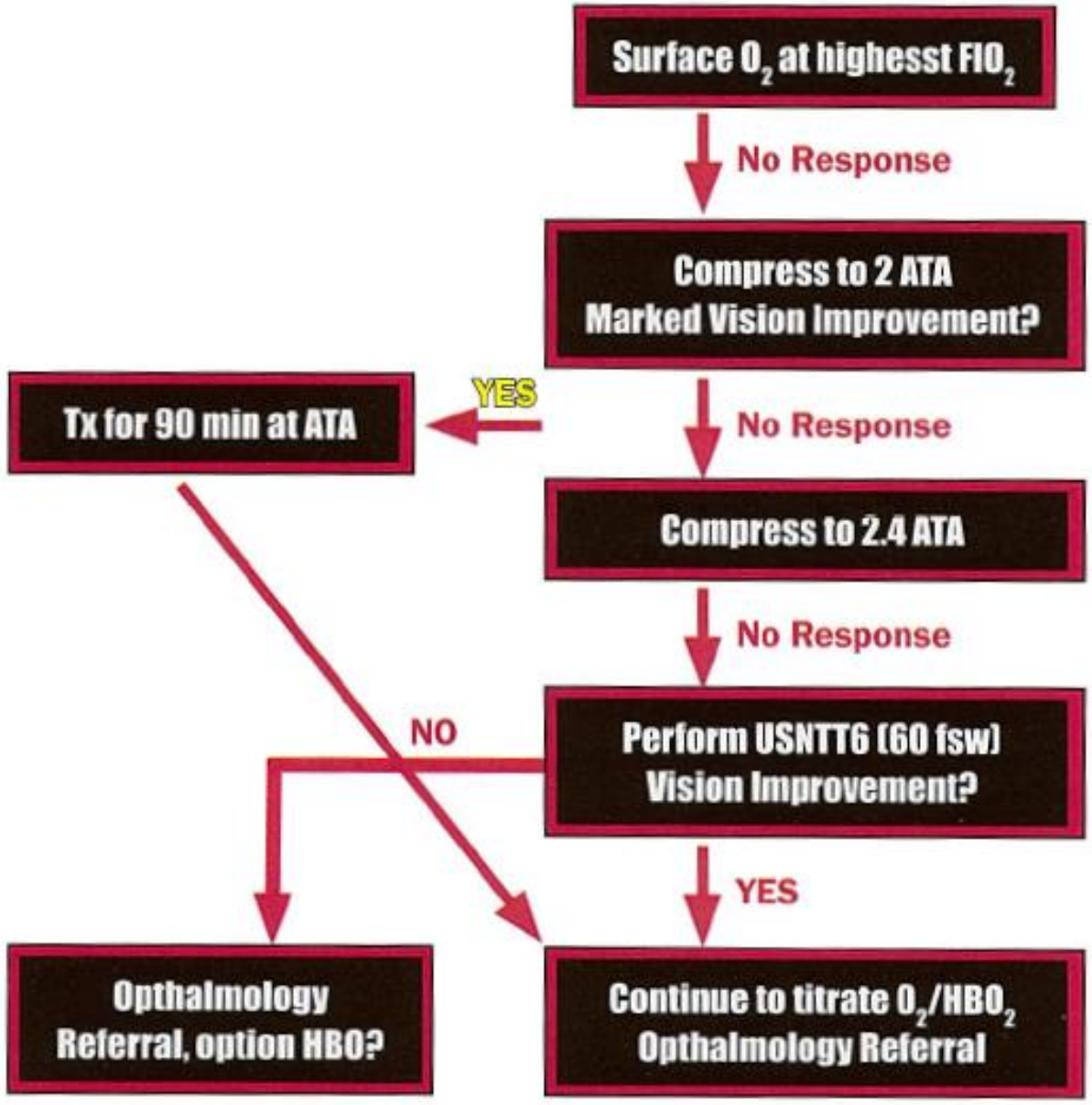

Figure 2. CRAO Treatment Algorithm (Murphy-Lavoie 2012).

Evidence-Based Review

Animal models of retinal injury have shown a reduction in apoptosis from 58% cell loss to 30% in animals treated with HBOT after experimental CRAO.

There are many case reports.

Based on the American Heart Association classification of evidence, treatment of CRAO with HBOT is class IIb.

There is fair to good evidence to support its use with retrospective controlled case series but no prospective randomized controlled trials.

Thank you