The Ophthalmology Development of Hyperbaric Medicine for Treating Central Retinal Artery Occlusion in Hong Kong

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Editorial

Hong Kong first established the Hyperbaric Oxygen Therapy (HBOT) for treatment of Central Retinal Artery Occlusion (CRAO) since November 2018 [1]. Before the era of hospital-based HBOT in 2018, similar service was provided by the Fire Services Department of the government on a remote island situated Recompression Treatment Center, which was designed to train and treat divers [2]. CRAO was not on the treatment indication list during that divers-oriented era. From September 2018 onwards, HBOT public hospital service was provided under the Accident and Emergency department in Pamela Youde Nethersole Eastern Hospital, the only territory public hospital with HBOT chambers currently [3]. CRAO was then included as one of the treatment indications supported by the Undersea and Hyperbaric Medical Society (UHMS) and United States Food and Drug Administration approval [4].

Keywords

Central Retinal Artery Occlusion; Hyperbaric Oxygen Therapy; Ophthalmology; Hong Kong; HORA Study

Background

Few life threatening or organ saving diseases are covered by the public HBOT service in Hong Kong. Other than severe decompression sickness, cerebral arterial gas embolism, carbon monoxide poisoning and necrotizing soft tissue infection, CRAO is the only ophthalmology entity covered by the current public HBOT service [1,2,5,7]. This HBOT referral service is opened to both public and private medical practitioners 24 hours every day [1]. Our service was uninterrupted despite the few waves of novel coronavirus disease 2019 outbreak locally [8-10]. Being the first regional HBOT center for CRAO treatment, our public territory-wide service was also conducted under research basis, the HORA (Hyperbaric Oxygen therapy for central Retinal Artery occlusion) study [1,9-11].

Patient Preparation

First, do no harm [12]. This is an important treatment principle for treating every patient with HBOT. Past medical history is taken to alert HBOT providers. Particularly, diabetes mellitus, epilepsy, chronic obstructive airway disease, asthma, psychiatric illness, pregnancy will be asked. Besides, pacemaker or implantable cardioverter defibrillator implantation history and pneumothorax history are also essential [13]. Visual Acuity (VA) will be documented before commencement of HBOT to monitor progress, and determine the length of treatment.

Contraindication of HBOT

A check list of absolute contraindications is established [14]. They include unresolved severe bronchospasm or pneumothorax, untreated tension pneumothorax, pneumocephalus, presence of intraocular gas, hollow orbital prosthesis (Medpor implant is not considered as hollow orbital prosthesis), and currently taking bleomycin or adriamycin. Chest X-ray (CXR) and Electrocardiogram (ECG) will be done before entrance of the HBOT multi-place chamber for screening purpose. Ophthalmological exclusion of cases include those filler injection related, giant cell arteritis and ophthalmic artery occlusion [15-17]. Because choroidal circulations are compromised in these etiologies, thus HBOT will not be effective.

Possible Complications of HBOT

These can be classified into ocular and systemic complications. For ocular complications, they include visual field narrowing, eyelid twitching, myopia progression and cataract formation [18]. The commonest systemic complication is barotrauma over the middle ear [19]. Other systemic complications are sinus pain, pulmonary oxygen toxicity presenting with squeezing

sensation in chest, retrosternal burning sensation, or reversible decline of pulmonary function. Occasionally, central nervous system oxygen toxicity can occur [20].

Treatment Protocol for CRAO

There are 2 available protocols for treating CRAO in our center, they are referenced to UHMS Hyperbaric Therapy Indications, and the United States Navy Diving Manual. Stepwise decompression takes slightly longer treatment time than the usual one (Fig. 1), but is less commonly used in our practice (Fig. 2).

Figure 1: The shorter duration, and less manipulator dependent protocol for treating CRAO.

Figure 2: The longer duration, and more complex protocol.

Practical Operation Manual

The HBOT center assessment outline (illustrated with a case example)

<HBOT treatment notes>

Diagnosis: Right CRAO

New Case

History of Present Illness (HPI):

- Date and Time of symptom onset: 20/11/2019 8 am
- Seen by Ophthalmology at ~10:40 am
- VA on presentation: hand movement

Referral Source: Hospital an ophthalmology

Treatment initiated by Eye: Timolol 0.5%

Background

Past Medical History (PMH): Hypertension; eczema; Non-smoker

Diabetes Mellitus: No

Past Eye History: nil

Mobility: Walk with stick

Planning Treatment

Any difficulty equalizing in the past: no

No Contraindications

Physical exam:

- Vitals stable
- Bilateral Tympanic Membrane (TM) normal
- Chest exam air entry good
- VA before HBOT: Right (R): Finger Counting (FC) at face and Left (L): 0.3 PH 0.4-1

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CXR: clear

ECG: SR, RBBB

Benefits and risks explained

Consent signed

Precautions: nil

Current Treatment

Treatment Session Number: #1

Date and time of treatment: 20/11/2019 16:12 pm

- For 1st Session: Duration from symptom onset to HBOT: 8 hours

Maximum pressure (in ATA): 2.8

Duration of Treatment (in minutes): 125

- HBOT started at 14:51. Failed equalization with bilateral ear blockage sensation and left ear pain, treatment aborted at 106kPa

- R TM mild erythema, L TM grade 1-2 barotrauma

- Bilateral myringotomy performed

- HBOT restarted at 16:12, uneventful after myringotomy

Post-treatment TM: bilateral erythema L>R

Post treatment VA: R eye FC at 1 feet

Dispatch

- Back to ophthalmology ward

- Next treatment 21/11/2019 09:30

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The Ophthalmology Clinic Assessment Outline (Illustrated with the same case example)

No Known Drug Allergy

PMH: Hypertension, eczema

Past Ophthalmic History: nil

R CRAO

HPI:

- Source of referral: Accidental & Emergency department of Hospital A
- Date and time of symptom onset: 20/11/2019 8 am
- Symptom to Door Time (Hr): 2.5 hr
- Presenting VA (at parent team): FC
- Treatment by parent team: nil
- Appointment at medical: in-patient consult pending

HBOT treatments (date, time, HBOT pressure, complication)

1. 20/11/19 pm

2. 21/11/19 am

Ophthalmology Assessment

Subjective improve with brighter feeling.

R diffuse retinal edema, cherry red spot, L macula and vessels normal.

Fundus Fluorescein Angiography: R mild delayed retinal perfusion to 1:03. L fully perfused by 0:49.

Optical Coherence Tomography: R macular edema sparing fovea/ retina swelling+, Central Macular Thickness (CMT) 383. L normal, CMT 242.

Pre- treatment VA (with/ without glasses, + Pinhole (PH)):

Day 1 (dd/mm/yy): am ----

pm FC without glasses

Day 2 (dd/mm/yy): am FC without glasses

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pm

Day 3 (dd/mm/yy): am

pm

Day 4 (dd/mm/yy): am

pm *

VA after 6th /7th HBOT treatment (with/ without glasses, + ph):

Day 5 (dd/mm/yy): am

pm

Plan:

Proceed to further HBOT: (Yes/No)

Next Eye Follow Up date:

Referral to Medical:

Referral to Parent Team:

Bloods (if any): erythrocyte sedimentation rate

Practical Tips and Future

Some vitreoretinal surgeons would arrange pars plana vitrectomy with intra-arterial tissue plasminogen activator injection within the same session with the recent advances of such [21]. Intravitreal gas fluid exchange for tamponade is not suggested, if these CRAO patients are subsequently planned for HBOT, as intraocular gas will expand and shrink across HBOT pressure variation. HORA study has now published its third reports [1,9,10]. With the promising VA outcome of HBOT for CRAO and to cope for an increasing demand, a future HBOT center will be available in the coming decades in Hong Kong [1]. We, ophthalmologists, are looking forward to further collaboration with other hyperbaric medicine practitioners to save vision for these ocular stroke patients [22,23].

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