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Cover Page Footnote

None

The Kent-Collins Protocol for Symptom Management in Post-Radiotherapy Eustachian Tube Dysfunction: A Case Report

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ABSTRACT

INTRODUCTION: Eustachian tube dysfunction is a common side effect of radiotherapy for head and neck cancers or brain tumors, although few effective treatments exist. The Kent-Collins Protocol represents a novel therapeutic option for post-radiotherapy Eustachian tube dysfunction.

CASE DESCRIPTION: The Kent-Collins Protocol was employed in one patient with Eustachian tube dysfunction following fractionated stereotactic radiotherapy for cerebral metastases from HER-2 positive breast cancer. The Kent-Collins Protocol provided relief of symptoms (conductive hearing loss, aural fullness, and otalgia) for a range of 5 to 45 minutes. The protocol could be repeated when symptoms returned to provide additional relief. The patient also reported psychological benefit from this protocol, knowing the hearing loss was reversible and not likely to be permanent.

DISCUSSION: This case demonstrates the potential of The Kent-Collins Protocol for the treatment of post-radiotherapy Eustachian tube dysfunction. The protocol is effective, inexpensive, easy to teach, and safe, offering an alternative to invasive therapies currently in existence.

INTRODUCTION

The Eustachian tube (ET) regulates middle ear pressure, optimizing tympanic membrane and ossicle function. Additionally, it protects the middle ear from sudden loud noises and serves as a mucociliary transporter, clearing debris from the middle ear to the nasopharynx for disposal. It is typically in the closed position and opens to relieve positive or negative pressure build up in the middle ear. Opening of the ET exposes the middle ear to atmospheric pressure via the nasopharynx and thus equalizes pressure. The opening and closing of the tube is regulated by six muscles under the control of cranial nerves V and X: tensor tympani, salpingopharyngeus, tensor veli palatini, levator veli palatini and the lateral and medial pterygoids.¹ Radiotherapy (RT) induces mucosal edema within the ET, leading to increased gas exchange from edematous capillaries. This produces negative pressure in the middle ear which is further exacerbated by reduced ET patency. Occasionally, this causes fluid to leak from the capillaries, resulting in a middle ear effusion. Overall this process manifests as ET dysfunction, leading to conductive hearing loss, aural fullness, imbalance, autophony, tinnitus and otalgia.²

Although, spontaneous resolution is achieved in most cases, the condition is associated with significant morbidity.³ Non-invasive treatment options include the Valsalva and Politzer maneuvers, antihistamines, oral decongestants and intranasal corticosteroids; however, evidence for their use is inconclusive.⁴ Importantly, a 2022 meta-analysis suggests that the modest benefits seen from these treatments may be due to the inclusion of patients with infectious or allergic etiologies of ET dysfunction, limiting their generalizability to post-radiotherapy ET dysfunction.⁴ More invasive options include surgical placement of a ventilation tube which is associated with complications, including persistent otorrhea

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occurring in 20-30% of cases and tympanic membrane perforation occurring in 10% of cases.^{5,6} Balloon Eustachian Tube Dilation has recently been investigated as a possible treatment, but did not demonstrate benefit.⁵

The use of a novel stretching protocol, the Kent-Collins protocol, in the management of post-radiation ET dysfunction offers an inexpensive, effective, easily teachable, and non-invasive alternative to currently available treatments.

CASE DESCRIPTION

We present a case of a 60-year-old female with stage IV HER-2 positive breast cancer who developed ET dysfunction following fractionated stereotactic radiation for cerebral metastases. Prior to this treatment her cancer progressed following neurosurgical resection, cavity radiation, and several courses of systemic therapy. After further intracranial progression was noted, she received stereotactic radiation with volumetric modulated arc therapy (VMAT) to 10 targets using a total dose of 30 Gy in 5 fractions. At 2 weeks following RT, she began to report hearing loss and “a feeling of fullness” in the right ear. ET dysfunction was diagnosed clinically, and no treatment recommendations were made at the time given that spontaneous resolution of symptoms without chronic complications was expected within several weeks. At 4 weeks post RT, the hearing loss and “feeling of fullness” shifted to the left ear. Full resolution of symptoms was achieved at 6 months and initial tumor reduction was noted on a follow up MRI at 2 months.

Several weeks following RT, the patient reported transient resolution of symptoms following her usual exercise routine. The routine was optimized with assistance from PC and MK to achieve maximal relief. This modified version of the stretch was subsequently named the Kent-Collins protocol and is seen in Figure 1. Given that this stretch would be difficult for patients with limited mobility, we designed an alternate protocol completed from a seated position (Figure 2). Both versions of the protocol were held for 60 seconds in the final position and were always performed bilaterally. The length of time the stretch was held is consistent with the American College of Sports Medicine (ACSM) guidelines for static stretching.⁷ The mechanics of both versions of the protocol suggest stretching of the sternocleidomastoid (SCM), the scalenes (particularly the middle scalene), levator scapulae and trapezius. Scores on a modified version of the Eustachian Tube Dysfunction Patient Questionnaire (EDTQ-7) recorded 10

FIGURE 1. Step by Step Sequence of the Kent-Collins Protocol from the Half-Kneeling Position



1. Standing position with feet shoulder width apart.
2. Half-kneeling position with back knee on the ground and front foot slightly wider than shoulder width.
3. Hand is planted firmly on the ground (planted hand should be opposite side as affected ear)
4. Forearm is dropped to the ground; opposite arm is reached toward ceiling until shoulders are aligned; Head is rotated toward planted elbow until stretch is felt in the neck.
5. Hold stretch for 60s (affected ear should be towards the ceiling).

FIGURE 2. Step by Step Sequence of the Kent-Collins Protocol from the Seated Position



1. Seated position with feet shoulder width apart.
2. Head is rotated to 45 degrees away from affected ear.
3. Neck is laterally flexed until stretch is felt.
4. Head is dropped to about heart level (or as close as is tolerated).
5. Hold in stretch for 60s (affected ear should be towards the ceiling).

TABLE 1. Modified version of the Eustachian Tube Dysfunction Patient Questionnaire (EDTQ-7)

Symptom	Symptom Severity (0-7) Before Performing the Kent-Collins Protocol	Symptom Severity (0-7) After Performing the Kent-Collins Protocol
Pressure in the ears?	5	0
Pain in the ears?	1	0
A feeling that your ears are clogged or "under water"?	5	0
Crackling or popping sounds in the ears?	5	0
Ringing in the ears?	1	0
A feeling that your hearing is muffled?	5	0

With responses recorded 10 minutes before and 10 minutes after performing the Kent-Collins protocol. Symptoms are recorded on a scale of 0-7 with 0 indicating no symptoms and 7 indicating the most severe symptoms.

Table 2. Responses on the Eustachian Tube Dysfunction Patient Questionnaire (EDTQ-7)

Symptom	Symptom Severity (0-7) Before Performing the Kent-Collins Protocol	Symptom Severity (0-7) After Performing the Kent-Collins Protocol
Pressure in the ears?	6	5
Pain in the ears?	1	1
A feeling that your ears are clogged or "under water"?	6	5
Crackling or popping sounds in the ears?	6	5
Ringing in the ears?	1	1
A feeling that your hearing is muffled?	6	5
Ear symptoms when you have a cold or sinusitis?	1	1

Recorded at baseline and one month following consistent use of the Kent-Collins protocol. Symptoms are recorded on a scale of 0-7 with 0 indicating no symptoms and 7 indicating the most severe symptoms.

minutes before and after performing the protocol (*Table 1*) were reduced from 22/42 to 0/42.⁸ Initial scores were recorded 6 weeks post RT. The length of symptom relief ranged from 5 minutes to 45 minutes and did not differ between protocol versions. If symptoms returned, either version of the protocol was repeated, leading to a resolution of symptoms. Although the protocol was effective for immediate symptom relief, it did not appear to reduce overall

symptom burden as evidenced by a modest reduction in scores on the EDTQ-7 from 27/49 to 23/49 assessed after four weeks (10 weeks post RT) of consistent use of the protocol (*Table 2*). In addition to physical relief of symptoms, the patient described psychological relief knowing that the hearing loss was reversible and not likely to be permanent. Lastly, there were no adverse reactions reported following use of the Kent-Collins protocol.

DISCUSSION

The Kent-Collins protocol is similar to osteopathic manipulation treatments (OMTs) used to drain the ET in acute otitis media, including the Galbreath, Muncie and other generalized OMT techniques.^{9,10} The mechanisms leading to opening of the ET from these techniques is unknown, but it is thought to be related to increased range of motion and myofascial release within the cervical region. One study suggested benefit from OMT (targeted to the head and neck) in pediatric patients with recurrent acute otitis media.⁹ The authors proposed that impaired drainage of the ET may be due to physical pressure from surrounding musculature and thus myofascial release and increased range of motion may be the underlying mechanism of OMT. Likewise, the Kent-Collins protocol may improve drainage of the ET by increasing the angle between the middle ear and the nasopharynx. This is consistent with evidence suggesting that the 10-degree angle of a pediatric ET versus the 45 degree angle of an adult ET may be partly responsible for the increased prevalence of otitis media in the pediatric population.^{11,12}

In summary, the Kent-Collins protocol may provide immediate symptom relief in post-radiotherapy ET dysfunction, although it does not appear to reduce overall symptom burden when used consistently for one month. Thus, it may be most useful to employ when patients experience severe symptom flares. In comparison with current treatments, the protocol is less technically involved than OMTs, which require substantial anatomical knowledge. Furthermore, it does not require the assistance of a trained professional, following an initial demonstration and can be performed from the seated position, allowing patients with limited mobility to use the protocol safely and effectively (*Figure 2*). Although unlikely, potential complications cannot be ruled out including a theoretical risk of cervical fracture or vertebral artery dissection, particularly among patients with pathology of the cervical spine. Future research should explore the physiology resulting in the resolution of symptoms, the amount of patient education required to achieve proficiency, and the modification of the protocol to further optimize the underlying physiologic mechanisms. In particular, switching from static stretching to proprioceptive neuromuscular facilitation (PNF) may increase the effectiveness of this pose as recent research suggests that PNF improves flexibility to a greater degree.^{13,14} Lastly, these results should be interpreted with caution as these results were only obtained in one patient. Fur-

ther validation of our results should be explored in subsequent case reports and ultimately prospective clinical trials.

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