Effects of manual lymph drainage on lymphoedema and dysphagia in head and neck cancer

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Objective: This study examined whether manual lymph drainage (MLD) administered to head and neck cancer patients with external lymphoedema improved internal lymphoedema, symptoms such as dysphagia and swallowing function. **Methods:** In this case series, head and neck cancer patients with dysphagia and secondary external lymphoedema on physical examination completed a 4-week, eight-treatment MLD therapy programme. Severity of internal and external lymphoedema, dysphagia and swallowing function were assessed before and after participation in the programme. **Results:** Of the four participants, two had decreased external lymphoedema severity, three had reduced internal lymphoedema severity, three had a reduction in dysphagia symptoms and two had improvements in flexible endoscopic evaluation of swallowing. There were no changes in functional communication measure scores. **Conclusion:** Preliminary data suggest MLD has beneficial effects on the symptoms of internal and external lymphoedema. Results further support the association between improved lymphatic function, improved lymphoedema and improved dysphagia and swallowing function. Randomized trials are needed to replicate the findings of this study.

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One of the most disfiguring and debilitating late effects of head and neck cancer (HNC) is secondary lymphoedema and fibrosis (LOF) (Smith and Lewin, 2010; Deng et al, 2011). Lymphoedema occurs when lymphatic fluid load exceeds the transport capacity of the lymph system (Földi et al, 2006). LOF may be caused by cancer, surgery, radiation or chemotherapy-induced damage to the lymphatic system and its surrounding soft tissues (Földi et al, 2006; Lymphoedema Framework, 2006). HNC-associated LOF may be categorized as involving external structures (e.g. the neck, face and shoulders), internal structures (e.g. the larynx, pharynx and nasal passages) or both (combined lymphoedema) (Micke et al, 2003; Deng et al, 2011). The occurrence of this condition correlates with symptom burden (e.g. dysphagia), functional status (e.g. decreased neck range of motion) and overall quality of life (Smith and Lewin, 2010; Deng et al, 2013). Internal lymphoedema, as measured by the Patterson scale, correlates with swallowing function as measured by both self-report and objective measures of swallowing function (Jackson et al, 2016).

The standard therapy for external lymphoedema is complete decongestive therapy provided by a certified lymphoedema therapist. Such treatment includes (Zuther, 2009):

- Manual lymph drainage (MLD)
- Compression with garments or bandages
- Exercise
- Skin care
- Education regarding posture, self-care etc.

Although clinical experience indicates the efficacy of complete decongestive therapy, as manifested by decreased visible soft tissue swelling

Box 1. Description of MLD

MLD uses a combination of four basic techniques (stationary circle, rotary technique, pump technique and scoop technique) to treat lymphoedema located in specific areas of the body. Common features of these techniques include:

- A stretching phase, in which small circular stretching of the skin is used to promote lymph formation
- A pressure phase, which promotes fluid movement in the desired drainage direction
- A relaxation phase, which leads to refilling of the lymph vessels from the periphery.

These techniques are repeated at a rate of about one repetition per second with five to seven repetitions per area (Földi et al, 2006).

Stationary circle technique is used to increase lymph formation and promote lymphatic vascular transport of fluid in lymphoedema of the head and neck. It consists of an active (pressure) and a passive (relaxation) phase. During the active phase, the skin is maximally stretched in the direction of desired drainage. During the passive phase, the hand is removed with subsequent release of the pressure and the skin returns to the starting position. This technique is performed at a rate of 1 circle per second with five to seven repetitions per area (Földi et al, 2006).

Table 1. **Stages of lymphoedema (Földi et al, 2006)**

Stage	Pathology	Signs and symptoms	Diagnosis
0 Latency	Focal fibroscleterotic tissue alterations	None	Functional isotope lymphograpy
I Reversible	High protein oedema; focal fibrosclerotic tissue alterations	Pitting oedema; elevation reduces the swelling; possibly 'pain of congestion'	Basic diagnostic procedures
II Spontaneously irreversible	Extensive fibrosclerosis, proliferation of adipose tissue	Brawny, hard swelling that does not recede with elevation	Basic diagnostic procedures
III Elephantiasis	Extensive fibrosclerosis, proliferation of adipose tissue	Like Stage II; invalidism	Basic diagnostic procedures

in the face and neck, data supporting its use in HNC patients are lacking. Of note, anecdotal cases and clinical observations indicate that the treatment of external lymphoedema with MLD improves the signs and symptoms of both external and internal lymphoedema. These observations have led to the hypothesis that drainage of lymph in the larynx and pharynx may be facilitated by mobilising the lymphatic fluid trapped within the lymphatic tissues of the face and neck. If this is possible, MLD may be a potentially important treatment modality for patients with internal lymphoedema. Conceptually, reduced internal lymphoedema may improve symptoms of dysphagia in HNC patients (Jackson et al, 2016).

To date, no prospective reports have been published that examine the possible impact of MLD on external lymphoedema, internal lymphoedema, symptoms of dysphagia and swallowing status. Thus, the authors conducted a pilot study to examine whether the application of MLD in HNC patients with external lymphoedema will result in improvements in internal lymphoedema, symptoms such as dysphagia and swallowing function.

Methods

Study design

This study was approved by the Vanderbilt University Institutional Review Board (IRB) and Vanderbilt-Ingram Cancer Center's Scientific Review Committee. All of the participants signed a written informed consent form. The study targeted HNC patients with dysphagia and findings of secondary external lymphoedema on physical examination, for which they were referred for, and agreed to receive, twice weekly MLD therapy for 4 weeks *[Box 1]*. The study was closed prematurely when the principal investigator left the institution, therefore, data from the patients who participated are presented here as a case series.

Eligibility criteria

Inclusion criteria:

- ≥21 years of age
- Histologically-confirmed squamous cell carcinoma of the head and neck
- Have completed either primary radiation therapy with or without induction or concurrent chemotherapy or adjuvant radiation therapy with or without concurrent chemotherapy
- Evidence of external lymphoedema of the head and neck requiring lymphoedema therapy
- A dysphagia rating of at least 4 out of 10 on the Vanderbilt Head and Neck Symptom Survey version 2.0 (VHNSS) indicator question 'Swallowing takes great effort' (Murphy et al, 2010).

Exclusion criteria:

- Unable to understand English
- Unable to provide informed consent
- Medical contraindication to MLD, such as congestive heart failure or kidney failure
- Recurrent or metastatic cancer
- Any other active cancer
- Impending airway obstruction due to lymphoedema
- Currently undergoing physical therapy or lymphoedema therapy
- Concurrent initiation of steroid therapy.

Study measures

External lymphoedema

External lymphoedema was assessed using the Földi stages of lymphoedema (Földi et al, 2006). This scale consists of four stages ranging from stage 0 to stage III, where 0 is subclinical and III is elephantiasis *[Table 1]*. External lymphoedema was considered to be present if participants had at least stage I lymphoedema.

Internal lymphoedema

Internal lymphoedema was assessed during flexible endoscopic evaluation of swallowing

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Table 2. **Participant demographics and disease characteristics**

Participant number	Age, years	Gender	Race	Primary tumour site	HPV status	Tumour stage at diagnosis	Complete treatment received	Lymphoedema duration (months)
1	55	M	White	Oral cavity	Unknown	IV	Surgery and CCR	23
2	80	M	White	Oropharynx	Positive	IV	CCR	12
3	54	M	White	Oropharynx	Positive	IV	Surgery and CCR	2
4	61	M	White	Oropharynx	Positive	IV	CCR	3

CCR = concurrent chemoradiation.

(FEES) examination and graded using the Patterson scale by one study speech-language pathologist to eliminate inter-rater differences. The Patterson scale was developed to measure the amount of oedema in the larynx and pharynx. It includes 11 laryngopharyngeal structures and two spaces sensitive to the development of post-radiation oedema (Patterson et al, 2006). Four grades are used to describe degrees of oedema from normal (no oedema) to severe oedema. The Patterson scale has been validated and has good intra-rater reliability and moderate inter-rater reliability (Patterson et al, 2006).

Swallowing function

Swallowing function was graded by the study speech-language pathologist using the Functional Communication Measure (FCM) based on the FEES findings. FCM values range from 1 to 7 (National Outcomes Measures System, 1998). Lower numbers indicate more severe swallowing dysfunction. The FEES allows for visual inspection of the mucosal surfaces, as well as objective evaluation of the motor function required for appropriate swallowing mechanics.

Self-reported symptoms

Symptoms were assessed using the VHNSS version 2.0, a validated 27-item measure of physical symptom burden related to HNC and its treatment (Murphy et al, 2010). It includes 10 subscales:

- Swallowing solids
- Swallowing liquids
- Dry mouth
- Mouth pain
- Mucus
- Voice
- Pain
- Taste/smell
- Nutrition
- Teeth.

Studies have reported that the VHNSS has good internal consistency for the 10 subscales (Cronbach's alpha: 0.62–0.86) and adequate convergent and divergent validity (Barroso, 2015). Mean scores on each VHNSS subscale can range from 0 (none) to 10 (severe). Higher scores reflect a greater symptom burden.

Data collection

After signing the study consent form, the participant was asked to complete the study questionnaires. After this, the trained staff member performed an external lymphoedema assessment. Participants then underwent FEES examination to evaluate internal lymphoedema and swallowing function. This examination was performed by the study's speech-language pathologist.

Once baseline (pre-MLD) measures were completed, MLD was initiated and performed twice per week for 4 consecutive weeks. In order to eliminate inter-rater differences in technique, MLD was performed by one certified lymphoedema therapist. After completing lymphoedema therapy, all of the study measures were repeated.

Data analysis

Descriptive statistics, such as mean, minimum and maximum, were used to describe the sample and to summarize the distributions of the study variables, including demographic information, HNC disease/treatment information, lymphoedema status and the measures of symptoms and swallowing function.

Results

During the study period, a total of six patients who were eligible were enrolled. Four of these patients completed all of the study procedures. Two patients withdrew from the study: one due to a recurrence of cancer; and one due to family responsibilities. Participants' demographics and disease characteristics are given in *[Table 2]*. The mean age of the participants was 63 years. All four patients had squamous cell carcinoma HNCs and stage IV tumours. The mean dysphagia score at

Table 3. **Changes in lymphoedema, dysphagia and swallowing function**

Participant number	Severity of external lymphoedema (Földi's scale)		Severity of internal lymphoedema (Patterson's scale)		Mean VHNSS score		FCM score		Observational changes by flexible endoscopic evaluation of swallowing (FEES) examination following manual lymphatic drainage
	Pre-MLD	Post-MLD	Pre-MLD (sites with oedema)	Post-MLD (sites with oedema reduction)	Pre-MLD	Post-MLD	Pre-MLD	Post-MLD	
1	II	I	13	0/13	6	1	3	3	Less vallecular residue after swallowing compared with the FEES completed 4 weeks ago, possibly indicating improved base-of-tongue retraction and/or epiglottic inversion
2	II	II	13	8/13	5	6	4	4	Less asymmetry in oedema when compared with the FEES completed 4 weeks ago
3	I	I	7	1/7	6	5	5	5	No observational changes
4	II	I	8	4/8	4	3	6	6	No observational changes

Highlighting indicates changes in lymphatic drainage following manual lymphatic drainage. FCM = functional communication measure; MLD = manual lymph drainage; VHNSS = Vanderbilt Head and Neck Symptom

baseline, based on VHNSS dysphagia rating, was 5.25 (range: 5–6). All of the patients had external and internal lymphoedema and completed the 4-week MLD therapy.

The scores and observations made before and after the participants received MLD are given in *[Table 3]*. Two of the participants' external lymphoedema had decreased in severity from II to I on the Földi scale. When measured using Patterson's scale, the severity of internal lymphoedema after 4 weeks of MLD was lower at a number of sites in three-quarters of participants. There were improvements in VHNSS scores in three out of four participants, indicating a decrease in the severity of symptoms associated with dysphagia. There were no changes in the FCM scores, however, suggesting that MLD did not have an impact on swallowing function. Finally, positive observational changes were found during FEES in half of the participants.

Discussion

This study was designed to explore the possible role of MLD in reducing the symptoms of and associated with lymphoedema in the HNC population. Detailed assessments of changes in external lymphoedema, internal lymphoedema, associated symptoms and swallowing function among study participants prior to and after 4 weeks of therapy enabled us to evaluate the impact of MLD in a detailed and prospective manner. The results support the hypothesis that treatment of external lymphoedema may result in improved internal lymphoedema and its associated symptoms in some patients.

In general, the findings were encouraging because a two out of four participants had a decrease in external lymphoedema and three-quarters had noteworthy improvements in internal lymphoedema. It is important to note that half of the participants had chronic lymphoedema (duration: 12 and 23 months), and findings from studies of chronic lymphoedema at other anatomical sites indicate that this condition tends to be refractory to treatment, responding poorly to MLD (McNeely et al, 2004). The sole participant with no visible improvement in internal lymphoedema had a long history of lymphoedema (23 months), which was both severe and extensive, involving all 13 internal anatomical sites. Overall, our results indicate that MLD of the external face, neck and shoulder regions may mobilize lymph fluid, which may potentially facilitate drainage of the internal structures, reducing swelling in the region of the upper airway and digestive tract.

Our findings also indicate a substantial improvement in symptom burden. MLD resulted in an improvement in swallowing, with reductions in VHNSS scores post-treatment in three out of four participants. Although the FCM score did not improve after treatment, improved function was noted by the speech-language pathologist in two patients. This indicates that FCM score may not be sensitive to change over time and/or that while the patient had improved swallowing, he/she may not have advanced his/her diet.

There are a number of possible explanations for the impact of MLD on subjective and objective swallowing function. First, oedema of the soft tissues involving the pharynx and larynx may decrease tissue compliance and associated function. Decreasing pharyngeal and laryngeal swelling may therefore result in

improved swallowing function. The observations made in this study are consistent with findings from a recent report that correlates internal lymphoedema documented via endoscopy with self-reported dysphagia and swallowing function as measured by the FCM (Jackson et al, 2016). Laryngeal adductor reflex (LAR), an involuntary reflex evoked at stimulus intensities similar to those previously described by perceptual responses, could also be used as an objective method of assessing laryngopharyngeal sensory capacity (Aviv et al, 1999). This is because, in theory, internal lymphoedema could blunt the LAR, leading to incomplete closure of the larynx and subsequent aspiration through the pharyngeal phase of swallowing (Murphy and Gilbert, 2009). Thus, interventions that decrease internal lymphoedema — such as MLD — may support the LAR, leading to effective closure of the larynx and reduced aspiration.

A growing number of clinical trials indicate that swallowing exercises implemented in a prospective manner prior to and during radiation-based therapy result in improved swallowing outcomes (Wall et al, 2014; Starmer et al, 2017). This may be due in part to reduced degrees of disuse atrophy. An alternative explanation is that swallowing exercises improve lymph flow within the soft tissues of the pharynx and larynx, resulting in decreased lymph stasis, decreased internal lymphoedema and decreased loss of function. The relationship between preventive swallowing exercise regimens and internal lymphoedema needs to be explored.

Strengths and limitations

This is the first report that the authors are aware of that examines the impact of MLD on external and internal lymphoedema, dysphagia and swallowing function in the HNC population. Measures were detailed and methodical, exploring the phenomena from multiple perspectives. This gave us the opportunity to garner a comprehensive picture of the effects of MLD on individual patients, providing insights that will help guide future studies.

This study has a number of limitations. This report only included four cases and therefore the findings need to be confirmed in larger clinical trials. In addition to this, a case series design was used, which limits the explanation of causal relationships.

Conclusion

This pilot study provides preliminary data supporting the use of MLD in HNC patients to reduce internal and external lymphoedema. These results support the association between reduced lymphoedema and improved swallowing function. Larger randomized prospective trials are needed to confirm the findings from this small trial. WINT

References

Aviv JE, Martin JH, Kim T et al (1999) Laryngopharyngeal sensory discrimination testing and the laryngeal adductor reflex. *Ann Otol Rhinol Laryngol* 108(8): 725–30

Barroso EM, Carvalho AL, Paiva CE et al (2015) The Vanderbilt Head and Neck Symptom Survey Brazilian Portuguese version 2.0 (VHNSS 2.0): psychometric properties for patients with head and neck cancer who have undergone radiotherapy. *BMC Res Notes* 8: 522

Deng J, Ridner SA, Murphy BA (2011) Lymphedema in patients with head and neck cancer. *Oncol Nurs Forum* 38 (1): E1–10

Deng J, Murphy BA, Dietrich MS et al (2013) Impact of secondary lymphedema after HNC treatment on symptoms, functional status, and quality of life. *Head Neck* 35(7): 1026–35

Földi M, Földi E, Strössenreuther RHK, Kubik S, eds (2006) *Földi's Textbook of Lymphology: For Physicians and Lymphedema Therapists* (2nd edn.) Munich, Germany: Mosby

Jackson LK, Ridner SH, Deng J et al (2016) Internal lymphedema correlates with subjective and objective measures of dysphagia in head and neck cancer patients. *J Palliat Med* 19(9): 949–56

Lymphoedema Framework (2006) *Best Practice of the Management of Lymphoedema. International Consensus.* London: MEP Ltd

McNeely ML, Magee DJ, Lees AW et al (2004) The addition of manual lymph drainage to compression therapy for breast cancer related lymphedema: a randomized controlled trial. *Breast Cancer Res Treat* 86(2): 95–106

Micke O, Bruns F, Mucke R et al (2003) Selenium in the treatment of radiation-associated secondary lymphedema. *Int J Radiat Oncol Biol Phys* 56(1): 40–9

Murphy BA, Gilbert J (2009) Dysphagia in head and neck cancer patients treated with radiation: assessment, sequelae, and rehabilitation. *Semin Radiat Oncol* 19(1): 35–42

Murphy BA, Dietrich MS, Wells N et al (2010) Reliability and validity of the Vanderbilt Head and Neck Symptom Survey: a tool to assess symptom burden in patients treated with chemoradiation. *Head Neck* 32(1): 26–37

National Outcomes Measures System (1998) *National Outcomes Measures System (NOMS): Adult Speech-Language Pathology Training Manual.* Rockville, MD: ASHA

Patterson JM, Hildreth A, Wilson JA (2006) Measuring edema in irradiated head and neck cancer patients. *Ann Otol Rhinol Laryngol* 116(8): 559–64

Smith BG, Lewin JS (2010) Lymphedema management in head and neck cancer. *Curr Opin Otolaryngol Head Neck Surg* 18(3): 153–8

Starmer HM, Abrams R, Webster K et al (2018) Feasibility of a mobile application to enhance swallowing therapy for patients undergoing radiation-based treatment for head and neck cancer. *Dysphagia* 33(2): 227–33

Wall LR, Ward EC, Cartmill B et al (2017) Adherence to a prophylactic swallowing therapy program during (chemo) radiotherapy: impact of service-delivery model and patient factors. *Dysphagia* 32(2): 279–92

Zuther J (2009) *Lymphedema Management: The Comprehensive Guide for Practitioners* (2nd edn.) New York, NY: Thieme