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Functional Impairments after Neck Dissection and Adjuvant Treatment: Patterns of Care

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Abstract

Objective: Shoulder pain or weakness, lymphedema, and xerostomia are known treatment-related impairments of head and neck cancer, often leading to significant disability. The purpose of this study is to determine the referral patterns to rehabilitation for these impairments in patients who underwent primary surgery that included neck dissection and to identify potential predictors of need for rehabilitation.

Design: Retrospective chart review.

Setting: Tertiary hospital.

Patients: Patients who had ten or more lymph nodes removed via neck dissection.

Methods and Outcome Measurements: Demographics, cancer history, symptoms and referrals to rehabilitation for shoulder pain or weakness, lymphedema, and xerostomia were recorded.

Results: 155 patients with a mean age of 61.4 were identified. 29 patients (20.1%) had shoulder pain or weakness, 39 patients (27.9%) had lymphedema, and 72 subjects (50.7%) had xerostomia. No rehabilitation referrals were made for 24.1% of patients with shoulder pain or weakness, 51.3% with lymphedema, and 61.1% with xerostomia. Adjuvant radiation was associated with shoulder pain or weakness ($p=0.0004$), lymphedema ($p=0.001$), and xerostomia ($p<0.001$). Greater number of lymph nodes removed ($p=0.009$) and having a drain in place for >4 days post-operatively ($p=0.002$) were associated with lymphedema.

Conclusion: The majority of patients with shoulder pain or weakness were referred to rehabilitation, but less than half of patients with lymphedema or xerostomia were referred for appropriate rehabilitation treatment. In addition to radiation, which is a known association for these common impairments after HNC treatment, greater number of lymph nodes removed and prolonged drain placement may identify patients at risk of lymphedema.

Keywords: Chemotherapy; Radiation therapy; Xerostomia; Lymphedema

Introduction

There were an estimated 55,070 new cases of head and neck cancer (HNC) diagnosed in 2014 [1]. Patients with HNC are often treated with multimodality therapy for local disease control, including neck dissection (ND), radiation therapy (XRT) and/or chemotherapy. Due to improving outcomes, more patients are surviving to experience side effects of treatment such as shoulder pain or weakness, lymphedema and xerostomia [1-14]. However, recognition and treatment of these fairly common post-treatment conditions is highly variable, potentially leading to unnecessarily poor quality of life.

Rehabilitation interventions have been shown to improve function, pain and quality of life for these impairments. Rehabilitation with physical and occupational therapy may improve shoulder range of motion, increase independence with activities of daily living and improve quality of life after ND [15,16]. Additionally, for patients with continued pain despite therapy interventions, corticosteroid injections often provided by Physical Medicine and Rehabilitation (PM&R) physicians have demonstrated efficacy, especially in the short-term, for the treatment of common musculoskeletal conditions in the shoulder [17-20]. Rehabilitation for lymphedema is referred to as Complete Decongestive Therapy (CDT), typically performed by a physical or occupational therapist, and is highly effective [21]. In addition to pharmacologic interventions, acupuncture may be of potential benefit for radiation-induced xerostomia, which is becoming a specialty for an increasing number of PM&R physicians [22,23].

Despite identification of these common impairments after HNC, no standard of care exists regarding when patients should ideally be referred for further rehabilitation treatment. However, identifying predictors of impairments may allow for earlier rehabilitation referrals.

Adjuvant XRT is has been associated with poor quality of life and reduced shoulder ROM in HNC survivors after ND [24-26]. Resection of CNXI is part of a radical ND and typically associated with poor shoulder pain and range of motion, even in 5-year HNC survivors [27,28]. Newer surgical techniques do not resect CNXI, but it is unknown if a modified radical or selective ND near CNXI (level 2 ND) affects shoulder symptoms [12-14,29-31].

Lymphedema in HNC patients develops as a result of direct damage to lymphatic structures or soft tissue fibrosis, which can occur with removal of lymph nodes during ND, inflammation from post-surgical infections or seroma, physical disruption of tissue with prolonged surgical drains, or other insults such as radiation [32,22]. Lymphedema is more likely to occur in breast cancer survivors when more lymph nodes are removed, such as in an axillary node dissection compared to a sentinel lymph node biopsy [33,34]. Risk factors for lymphedema after HNC are less clear, but likely include XRT and include a greater number of lymph nodes removed during ND, as well as lesser known conditions such as post-surgical infection or prolonged surgical drain.

Xerostomia, or reduced salivary production, is a common toxicity related to XRT for the treatment of HNC [35]. Previous studies have reported a dose-volume relationship between the total Gray (Gy) received and the risk for xerostomia, however no previous studies have examined the involvement of level of ND near the salivary glands (level 1 ND) as a possible contributing factor [35-38].

The primary purpose of this study was to describe current referral and treatment patterns for shoulder pain or weakness, lymphedema, and xerostomia in HNC patients who underwent ND. The secondary purpose of this study was to identify associations between certain surgical and radiation treatments and these common impairments, in order to predict who may benefit most from rehabilitation referrals. We hypothesized that XRT, radical ND, and a level 2 ND would be associated with shoulder pain or weakness; XRT, greater number of lymph nodes removed, post-operative infection and prolonged surgical drain would be associated with lymphedema; and, finally, XRT and level 1 ND would be associated with xerostomia.

Methods

Permission to conduct the study was obtained from the institution's Institutional Review Board. Eligible patients were identified from a tertiary hospital cancer registry for retrospective review. This registry consisted of all HNC cases between January 2008 and December 2012 based on date of first contact.

Inclusion criteria were having ≥ 10 lymph nodes removed via ND in patients with a new diagnosis of HNC and primary surgery as treatment. Exclusion criteria included patients with primary radiation as treatment, previous treatment for a HNC, recurrent tumors, and/or patients undergoing revision or salvage ND.

Subject age, sex, ethnicity, date of diagnosis, and primary cancer site were recorded. Primary cancer sites were categorized as cancer of the larynx, oral cavity, oropharynx, hypopharynx, or salivery glands. Procedure variables that were recorded included the level and number of lymph nodes removed from each side of the neck, and whether there was resection of cranial nerve XI. Post-operative variables included infection occurring within the first 2 weeks of surgery and the continued need of a drain for >4 days after surgery. Treatment with XRT was documented with start and end date and total radiation delivered in Gy. Laterality of XRT was unavailable due to limited records.

The study outcomes included three HNC treatment-related impairments: shoulder pain or weakness, lymphedema, and xerostomia. Symptoms were documented with the date they first appeared in the patient's chart, which physician/team noted the symptom and whether or not a referral for treatment was made. The following parameters were assessed for each specific outcome.

Shoulder pain or weakness

Shoulder symptoms were reported as either pain or weakness based on the documentation in any post-operative clinic note. Referrals to PM&R, PT, OT or other providers for shoulder complaints were documented. Other treatment options considered were injections and referral for surgical evaluation.

Lymphedema

If a diagnosis of lymphedema was made, the location of the lymphedema was described as face (above mandible), neck (submandibular or submental), upper limb, or other. We documented if a referral for CDT was made, if a compression garment was prescribed, and if a PM&R referral for lymphedema was made.

Xerostomia

If the patient was diagnosed with xerostomia, specific treatment variables included whether or not artificial saliva, Biotene® (GlaxoSmithKline) or pilocarpine was prescribed. Referrals for acupuncture management for the treatment of xerostomia were also recorded.

Statistical analysis

The association between the HNC treatment-related impairments of shoulder pain or weakness, lymphedema, and xerostomia with potential risk factors was tested using logistic regression. Categorical variables were analyzed with the chi-square test, and continuous variables were analyzed with the t-test. If the predictive measures were significant at the alpha level of 0.05 in the univariate analysis, the association was then tested in a multivariate logistic regression model using Akaike Information Criterion to determine the best predictive model. One hundred forty-four patients were included in the shoulder pain or weakness statistical analysis; 11 patients were excluded because of missing data regarding shoulder symptoms. One hundred forty patients were included in the lymphedema analysis; 15 patients were excluded because of missing data regarding lymphedema symptoms. One hundred forty-two patients were included in the xerostomia analysis; 13 patients were excluded because of missing data regarding xerostomia symptoms.

Results

One hundred fifty-five subjects with a mean age of 61.4 were identified in this patient cohort. Of these, 67.7% (n=105) were male and 32.3% (n=50) were female. One hundred thirty-seven (88.4%) were Caucasian. There were no significant age, sex, or ethnicity differences in the patients who developed shoulder pain or weakness, lymphedema, or xerostomia compared with those who did not. Cancer of the oral cavity was most common (64.5%). Twenty-three subjects (14.8%) had pre-existing diabetes mellitus and 9 (5.8%) had documented pre-morbid rotator cuff pathology.

Four subjects had bilateral neck dissection; the remainder had unilateral neck dissection. Average number of lymph nodes removed during ND was 21.9 (range 2-61). Four patients (2.6%) had CN XI resected. The number of patients receiving adjuvant chemotherapy and radiation therapy is summarized in Table 1.

Demographic Variable	Results % (N)
Ethnicity	
Caucasian	88.4 (137)
African American	5.2 (8)
Hispanic	3.9 (6)
Asian American	1.9 (3)
Native American	0.6 (1)
Sex	
Male	67.7 (105)
Female	32.3 (50)
Cancer Site	
Oral Cavity	64.5 (100)
Parotid or Submandibular Gland	11.6 (18)
Larynx	11.6 (18)
Oropharynx	7.1 (11)
Hypopharynx	4.5 (7)
Adjuvant Treatments	
Radiation Therapy	59.4 (92)
Chemotherapy	27.1 (42)
Chemoradiation	26.5 (41)

Table 1: Demographic and Cancer Treatment in Patients Undergoing Neck Dissection for Head and Neck Cancer.

Rehabilitation referrals

Twenty-two patients (75.9%) of those with shoulder symptoms had a referral to PT or OT, referred most often by Otolaryngology (63.6%). Five patients (17.2%) were referred to PM&R and 2 patients (6.9%) were referred to Orthopedic Surgery. Two patients (6.9%) with shoulder symptoms were treated with shoulder injections and none had shoulder surgery. Seven patients (24.1%) with documented shoulder pain or weakness received no treatment. Nineteen patients (48.7%) who had documented lymphedema were referred for CDT, 15 patients (38.5%) received a prescription for a compression garment, and 4 patients (10.3%) were referred on to PM&R. Twenty patients (51.3%) with documented lymphedema did not receive treatment. Four patients (5.6%) with xerostomia were treated with artificial saliva, 5 patients (6.9%) received a prescription for Pilocarpine, 16 patients (22.2%) were treated with Biotene® (GlaxoSmithKline), and 6 patients (8.3%) were referred for acupuncture. Forty-four patients (61.1%) with documented xerostomia received no treatment (Figure 1).

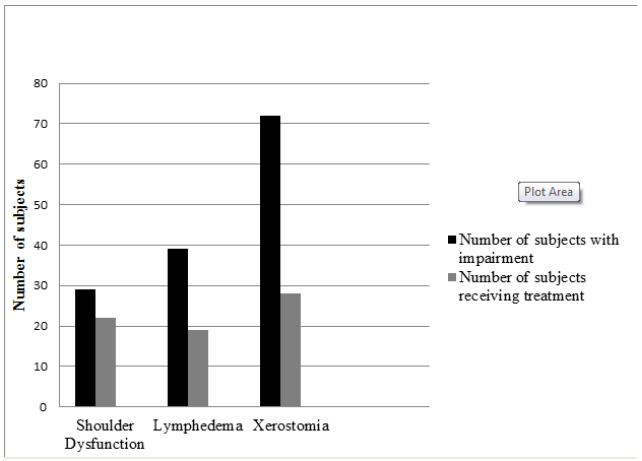

Figure 1: Number of Subjects with Impairment after Neck Dissection Who Received Rehabilitation Treatment.

Shoulder pain or weakness

Twenty-nine patients (20.1%) had documented shoulder symptoms after treatment completion, diagnosed most often by Otolaryngology (82.8%). All of the patients who underwent CN XI resection (n=4) developed shoulder pain or weakness ($p \leq 0.001$). There was no significant increase in shoulder pain or weakness in patients who underwent a level 2 ND (p=0.633)

Variable		Shoulder	Symptoms	
	Total	No	Yes	P Value
	N=144 (%)	N=115 (%)	N=29 (%)	
CN XI Resected				<0.001[C]
No	139 (97.2)	115 (100.0)	24 (85.7)	
Yes	4 (2.8)	0 (0.0)	4 (14.3)	
Level 2 ND				0.633[C]
No	1 (0.7)	1 (0.9)	0 (0.0)	
Yes	140 (99.3)	114 (99.1)	26 (100.0)	
XRT				0.053[C]
No	52 (36.1)	46 (40.0)	6 (20.7)	
Yes	92 (63.9)	69 (60.0)	23 (79.3)	
Total Gy*				0.021[T]
Mean ± SD	61.0 ± 9.7	59.6 ± 10.6	65.1 ± 4.4	
Chemo and XRT				
No	102 (70.8)	83 (72.2)	19 (65.5)	0.481[C]
Yes	42 (29.2)	32 (27.8)	10 (34.5)	

C=Chi-square test; T=t-test; SD=standard deviation; CN=cranial nerve; ND=neck dissection; XRT=radiation therapy; Gy=Gray, Chemo=chemotherapy
*Total Gy for those patients who received XRT

Table 2: Co-Morbid and Treatment-Related Risk Factors for Shoulder Symptoms in Patients Undergoing Neck Dissection for Head and Neck Cancer.

Lymphedema

Thirty-nine of the patients (27.9%) had documented lymphedema, diagnosed most often by Otolaryngology (56.4%). Lymphedema involving the neck, either submandibular or submental, was the most common (64.1%, n=25). Patients who developed lymphedema were more likely to have undergone post-operative XRT (37.1% *vs.* 11.8%; p=0.001). However, the total dose of Gy received was not a significant predictor (62.5 ± 3.7 Gy *vs.* 60.1 ± 12.3 Gy; p=0.279). Patients with lymphedema had a greater number of total lymph nodes removed (24.7) compared to those without lymphedema (24.7 *vs.* 32.4; p=0.009). Patients who developed lymphedema were not significantly more likely to have developed an infection in the early post-operative period (60% *vs.* 26.7%; p=0.103). However, they were more likely to have had a prolonged drain placement of greater than 4 days post-operatively (48.5% *vs.* 21.3%; p=0.002) (Table 3).

Variable		Lymphedema	Diagnosis	
	Total	No	Yes	P Value
	N=140 (%)	N=101 (%)	N=39 (%)	
Total LN removed				0.009[T]
Mean ± SD	26.9 ± 15.6	24.7 ± 14.0	32.4 ± 18.1	
XRT				0.001[C]

No	51 (36.4)	45 (44.6)	6 (15.4)	
Yes	89 (63.6)	56 (55.4)	33 (84.6)	
Infection				0.103[C]
No	135 (96.4)	99 (98.0)	36 (92.3)	
Yes	5 (3.6)	2 (2.0)	3 (7.7)	
Seroma				0.376[C]
No	138 (98.6)	99 (98.0)	39 (100.0)	
Yes	2 (1.4)	2 (2.0)	0 (0.0)	
Drain >4 days				0.002[C]
No	107 (76.4)	84 (83.2)	23 (59.0)	
Yes	33 (23.6)	17 (16.8)	16 (41.0)	
Total Gy*				0.279[T]
Mean ± SD	61.1 ± 9.9	60.1 ± 12.3	62.5 ± 3.7	
Chemo and XRT				0.082[C]
No	101 (72.1)	77 (76.2)	24 (61.5)	
Yes	39 (27.9)	24 (23.8)	15 (38.5)	

C=Chi-square test; T=t-test; SD=standard deviation; LN=lymph nodes; ND=neck dissection; Gy=Gray; XRT=radiation therapy; Chemo=chemotherapy

*Total Gy for those patients who received XRT

Table 3: Post-Operative Complication and Treatment-Related Risk Factors for Lymphedema in Patients Undergoing Neck Dissection for Head and Neck Cancer.

Xerostomia

Seventy-two subjects (50.7%) had documented xerostomia, diagnosed most often by Radiation Oncology (87%). Patients who underwent post-operative XRT were significantly more likely to develop xerostomia (77.2% *vs.* 2%; $p \leq 0.001$). However, the total dose of Gy administered was not significantly different in those who developed xerostomia compared to those who did not (61.2 ± 8.8 *vs.* 60.4 ± 13.1; p=0.760). Undergoing a level 1 ND did not produce a significant increase in xerostomia (44.4% *vs.* 62.5%; p=0.054) nor was the number of lymph nodes resected from level 1 a significant predictor (p=0.143) (Table 4).

Variables		**Xerostomia**	**Diagnosis**	
	Total	No	Yes	P Value
	N=142(%)	N=70(%)	N=72(%)	
XRT				<0.001C
No	50 (35.2)	49 (70.0)	1 (1.4)	
Yes	92 (64.8)	21 (30.0)	71 (98.6)	
Level 1 ND				0.054C
No	40 (28.8)	15 (21.4)	25 (36.2)	
Yes	99 (71.2)	55 (78.6)	44 (63.8)	
Level 1 LN Removed				0.143T
Mean ± SD	3.3 ± 3.8	3.8 ± 3.9	2.9 ± 3.6	

Total Gy*				0.760T
Mean ± SD	61.1 ± 9.7	60.4 ± 13.1	61.2 ± 8.8	
Chemo and XRT				<0.001C
No	101 (71.1)	61 (87.1)	40 (55.6)	
Yes	41 (28.9)	9 (12.9)	32 (44.4)	
C=Chi-square test; T=t-test; SD=standard deviation; LN=lymph nodes; XRT=radiation therapy; ND=neck dissection; Gy=Gray; Chemo=chemotherapy *Total Gy for those patients who received XRT				

Table 4: Treatment-Related Risk Factors for Xerostomia in Patients Undergoing Neck Dissection for Head and Neck Cancer.

Multivariate analysis

Multivariate analysis showed that receiving less than 60 Gy of adjuvant XRT was associated with less shoulder pain or weakness (p=0.0004). The primary risk factors for developing lymphedema were having received adjuvant XRT at any total dose (p=0.005) and/or having a drain in place for a prolonged period of time post-operatively (p=0.0103). The primary risk factor for the development of xerostomia was having received adjuvant XRT at any total dose ($p \leq 0.0001$) (Table 5).

Treatment Outcome	Variable	Estimate	Pr>ChiSq
Shoulder Symptoms	XRT<60 Gy	-1.5404	0.0004
Xerostomia	XRT (any dose)	5.11	<0.0001
Lymphedema	XRT (any dose)	1.3929	0.005
Lymphedema	Drain>4 days	1.1185	0.0103
XRT=radiation therapy; Gy=Gray			

Table 5: Multivariate Analysis Results- Radiation therapy and prolonged drain placement were significant risk factors for treatment-related impairments in patients undergoing neck dissection for head and neck cancer.

Discussion

The results of this study reiterate that shoulder pain or weakness, lymphedema, and xerostomia are common in this patient population. The majority of patients with shoulder dysfunction were referred for PT or OT; however, the majority of patients with lymphedema and xerostomia did not receive rehabilitation treatment for these diagnoses. It is important to better understand the treatment-related associations of these impairments, so that appropriate patients may be referred for rehabilitation sooner. Early recognition and appropriate referrals could potentially increase the quality of care delivered to this patient population. As expected, radiation therapy was a significant risk factor for developing lymphedema and xerostomia and was also associated with shoulder symptoms in patients who underwent multimodality treatment. Prolonged post-surgical drain placement and possibly greater number of lymph nodes removed during ND may also be significant associations with developing lymphedema.

Ewing and Martin first reported on a "shoulder syndrome" characterized by shoulder pain, decreased shoulder range of motion, shoulder droop, scapular winging and abnormal electromyographical findings after radical neck dissection (ND) [28]. Currently selective ND has superior outcomes for pain, quality of life, and function compared to radical or modified ND [12-14,29-31]. Shoulder dysfunction can result from resection of or damage to, the spinal accessory nerve (CN XI) during ND, which leads to denervation of the trapezius muscle [29]. CN XI is near level 2 during a ND. Shoulder complaints have been reported in 47-100% of patients after radical ND, 18-61% after modified ND, and 29-52% after selective ND [12-14]. Previous studies have shown improved pain-related quality of life scores 30 as well as better electromyographic results, less severe pain scores, improved strength, and more independence with activities of daily living (ADLs) in patients who underwent selective ND compared to those who underwent either radical or modified ND [31]. A recent study showed poor quality of life scores reported in 5-year survivors of HNC related to poor shoulder function after CNXI removal [27]. Our study reiterates that CNXI resection is related to development of shoulder symptoms, but did not find any association with modified or selective ND near level 2, which is anatomically near CNXI. This finding suggests that despite the physical proximity to CNXI during modified and selective ND, and the potential traction and inflammation in the perioperative period, preserving the nerve is associated with less shoulder morbidity.

The total dose of Gy received was also found to have a significant association with the presence of shoulder dysfunction in this study, with patients who received <60 Gy being less likely to have shoulder dysfunction. These findings are in contrast to a 2008 study performed in the Netherlands by Stuiver et al. which reported that XRT was not associated with shoulder disability in HNC patients who underwent ND [39]. Of note, 15% of patients in Stuiver's study underwent radical ND compared to only 2.6% of patients in this study. Given that a much

lower percentage of the patients in this study underwent radical ND, this may explain why XRT had a more significant association with shoulder dysfunction in this study. Other studies have shown self-reported QOL impairment and/or reduction in shoulder ROM after adjuvant XRT [24-26]. The difference in results across studies may also be due in part to the way shoulder morbidity was measured. Previous studies have shown significant improvement in shoulder pain and disability, upper extremity strength, and upper extremity endurance in HNC patients with shoulder dysfunction who underwent progressive resistance exercise training after ND compared to those who received standardized PT [40]. It is thought that with improved strength of the scapular stabilizers, pain may be subsequently reduced because of better shoulder mechanics. Early rehabilitation in HNC patients may reduce disability, improve QOL, and decrease the overall cost of healthcare [16].

Approximately 300 of the body's total estimated 800 lymph nodes are located in the head and neck region [41]. Lymphedema in HNC patients develops as a result of direct damage to lymphatic structures or soft tissue fibrosis, with onset typically between two to six months after cancer treatment completion [32,33]. Lymphedema can result in increased risk of infection, dysphagia, decreased neck range of motion, body image issues and in severe cases, airway obstruction [42-45]. Regarding lymphedema and XRT, the findings of this study are in accordance with the results of the 2012 study by Deng et al. which found that the total dosage and the number of days of XRT were both significant factors in the development of lymphedema [33]. It should be noted that the sample size of 81 patients was too small for multivariate analysis in Deng's study. Our study's sample size did allow for multivariate analysis to be performed, and reproduced these findings.

Similar to findings in breast cancer survivors, a greater number of lymph nodes removed were associated with more lymphedema in HNC survivors in our study. An interesting finding in our study was that a post-surgical drain >4 days was also associated with lymphedema. We hypothesize that prolonged surgical drains physically disrupted the lymphatic system near the surgical site, leading to increased incidence of lymphedema. While prolonged drain placement is medically necessary in some patients in the early post-operative period, it may be beneficial to follow these patients more closely with more frequent outpatient follow-up during the months after surgery. We did not see an increase in lymphedema after post-surgical infection, but perhaps larger, prospective studies would capture this association. Previous studies have reported a wide range of secondary lymphedema prevalence rates from 12-75% [3-6,32]. Our study found that 27.9% of patients had documented lymphedema. Early diagnosis and referral for CDT, the treatment gold standard [46], may improve outcomes in these patients. Future prospective studies could include serial physical examinations or other techniques of diagnosing lymphedema, such as bioelectrical impedence [46].

Xerostomia, or reduced salivary production, is a common toxicity related to XRT for the treatment of HNC, regardless of tumor stage or site and regardless of surgical intervention [35,47]. Xerostomia can lead to dental issues, insomnia, increased risk for oral infections, oral pain, difficulty chewing, dysphagia and as a result decreased QOL.35 Studies have reported a wide range of incidence rates (37-70%) of xerostomia [7-11]. Our study had a similar incidence of 50.7%. Previous studies have reported a dose-volume relationship between the total Gray (Gy) received and the risk for xerostomia [35-38], which we did not find in our study. This could be due to the limited documentation on XRT available due to retrospective nature of our study. No previous studies have examined the involvement of level of ND as a possible contributing factor to xerostomia. We hypothesized that a level 1 ND near the submandibular and submental salivary glands would be associated with xerostomia, however our study did not support this. It could be due to the over-arching effects of XRT or a result of our small sample size. In addition to standard pharmacologic interventions, acupuncture may be of potential benefit for radiation-induced xerostomia [22,23]. However, insufficient evidence is available to determine whether acupuncture is both safe and effective for the treatment of radiation-induced xerostomia [23]. More research is still needed on this topic.

This study has several limitations, primarily due to the retrospective study design. We were unable to accurately assess whether the patients who did receive treatment for their shoulder pain or weakness, lymphedema, and/or xerostomia had improved functional outcomes compared to those who were not treated because objective data regarding functional improvement was not available for all patients in our chart review. For lymphedema, improvement in volume/circumferential measurements of the affected site was documented in 12 patients (63.2%) who underwent CDT. However, no data was available regarding improvement for 7 of the patients. For xerostomia, 4 patients (66.7%) who received acupuncture had documented improvement in their symptoms. Future prospective studies assessing the rehabilitation treatment of these impairments would be beneficial because it would allow one to obtain data on improvement for all patients treated.

Another limitation of the study was that specific details of radiation delivery were not available, as many patients receiving their ND at our institution received their post-operative XRT at an outside facility. Only total Gy and dates of treatment were often summarized in our records, while specific radiation fields and laterality of XRT was most often missing and therefore not included in this preliminary study. In addition, only 4 subjects had bilateral neck dissection, which did not allow for comparison with unilateral ND for shoulder symptoms or lymphedema. Bilateral ND and XRT would likely be associated with more comorbidities. Level 1 ND was not a significant predictor for lymphedema or xerostomia in this study despite the proximity of the lymphatic structures and salivary glands to this level, respectively. We suspect this may be a result of the relatively small sample size and due to the overreaching effects of XRT. A prospective study with uniform inclusion criteria, specific cancer treatments and details of rehabilitation interventions would help clarify these concerns.

Conclusion

The majority of patients with shoulder pain or weakness were referred to rehabilitation, but less than half of patients with lymphedema or xerostomia were referred for appropriate rehabilitation treatment. Radiation therapy was found to be a significant risk factor for developing shoulder pain or weakness, lymphedema and xerostomia in HNC patients after ND. Additional associations for lymphedema were greater number of lymph nodes removed and prolonged drain placement greater than 4 days. These predictors may alert providers to refer for further rehabilitation treatment after ND. Consistent symptom recognition and therapy referral of these common treatment-related side effects is of utmost importance for the delivery of early rehabilitation interventions.

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