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Short Communication

Impact of chemotherapy on expiratory muscle strength in stage 1 head and neck cancer patients

Yashshree J. Shindikar*, Abhijit D. Diwate, Arijit K. Das

Department of Cardiovascular and Respiratory Physiotherapy, DVVPF's College of Physiotherapy, Ahmednagar, Maharashtra, India

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***Correspondence:**
Dr. Yashshree J. Shindikar,
E-mail: mugdhashindikar@gmail.com

ABSTRACT

Head and neck cancer (HNC), in current days, is one of the fatal diseases. Chemotherapy is one of the main treatments for cancer. Chemotherapy has an adverse impact on the respiratory parameters of patients. In these patients, expiratory force-generating capacity is impaired, which usually helps the patients cough effectively for airway clearance. Thus, as an impact of chemotherapy, airway clearance is affected in HNC patients. This study aimed to evaluate the impact of chemotherapy expiratory muscle strength in stage 1 head and neck cancer patients. We conducted an observational study including 15 patients with stage 1 HNC in the department of oncology in a tertiary care teaching hospital. The outcome measure included assessment of the expiratory muscle strength by measuring maximum expiratory pressure. In our study, we found a result showing a significant decline of 53.43% in maximum expiratory pressure values after 3-6 months of required chemotherapy sessions. The results of the current study suggest that chemotherapy has a deleterious impact on the expiratory muscle strength in stage 1 HNC patients after long-term exposure.

Keywords: Head and neck cancer, Stage 1 cancer, Chemotherapy, Maximum expiratory pressure

INTRODUCTION

According to the National Cancer Institute (NCI), cancer is a genetic disease caused by changes to genes that control how our cells function, especially how they grow and divide. These cells may form lumps of tissue called tumors, which can be cancerous (malignant) or non-cancerous (benign).[1]

Head and neck cancers (HNCs) are carcinomas that begin in squamous cells that line the mucosal surfaces of the head and neck, which are present inside the mouth, throat, and larynx.[2] According to this estimation of GLOBOCAN 2020, there are 19.3 million new cancer cases and almost 10.0 million cancer deaths reported worldwide in the year 2020.[3] In India, HNCs account for approximately 30–40% of all cancer sites. According to the ICMR Cancer Atlas project (2020), the incidence in Assam, Manipur, Mizoram, Tripura, and Nagaland states has been higher (54%) than in the other states.[4]

TNM classification is the primary oncology tool used worldwide for determining the clinical, pathological, and recurrent staging of cancer.[5] According to the American Cancer Society, TNM classification includes: T: size of the tumor and spread of the tumor into nearby tissues, N: spread of cancer to nearby lymph nodes, and M: metastasis (spread of cancer to other body parts).[6]

Chemotherapy is a well-known and effective treatment approach for managing various cancers. Chemotherapy includes administering multiple drugs in the body, triggering the secretion of inflammatory mediators that either suppress the tumor growth or powerfully eradicate the cancer cells.[7]

HNC patients are at increased risk of respiratory infection after chemotherapy. Expiratory functions that clear aspiration from the airway are compromised in HNC patients, primarily patients with dysphagia. Expiratory force-generating capacity is impaired in them, usually producing ineffective cough force for airway clearance.[8]

Side effects after the treatment may lead to long-term disabilities, including generalized peripheral muscle weakness, muscle mass loss, poor quality of life (QOL), decreased functional physical activity, and respiratory complications.[9]

In the respiratory system, cancer has an adverse impact on pulmonary function, respiratory muscle strength, and functional capacity of patients. Many previous studies have observed the immediate and long term effects of chemotherapy on parameters like pulmonary function, respiratory muscle strength, and functional capacity in almost all types of cancers.

Also, several studies have observed the short term effect of above parameters after chemotherapy in HNC patients. But, to our knowledge, this is one of the first studies to evaluate expiratory muscle strength components in stage 1 HNC patients, thus observing their long-term effect on maximum expiratory pressures after recommended chemotherapy treatment.

Aim

This study aimed to evaluate the impact of chemotherapy expiratory muscle strength in stage 1 HNC patients. We hypothesized that chemotherapy might have deleterious effects on expiratory muscle strength in stage 1 head and neck cancer patients.

METHODS

We conducted an observational study in the department of oncology in a tertiary care teaching hospital. The duration of study was from January 2023 to June 2023. Ethical clearance was obtained from the institutional ethics committee. Written informed consent was obtained from the patients. Our study included a convenient sample of 15 stage 1 HNC patients who had completed the required number of chemotherapy sessions. Newly diagnosed stage 1 HNC patients between 30-50 years of age and have completed 3-6 months after chemotherapy sessions were included in this study. Patients with any other cancer and HNC of stage 2, 3, or 4, metastatic cancer, patients who underwent any surgical management in the head and neck region, and patients unable to perform maximum expiratory pressure test were excluded from the study. The outcome measure included assessing the expiratory muscle strength by measuring maximum expiratory pressure with the help of a handheld ABP pressure gauge device. The procedure for measurement of maximum expiratory pressure was performed according to the standard guidelines of the American Thoracic Society.[10s]

Statistical analysis

Data Analysis was done using Microsoft excel sheet and GraphPad InStat version 3.06. Descriptive statistics (mean and SD) were calculated for all data. For statistical analysis, the parameter was set at the significance level, i.e., p value=0.05 and MEP were recorded.

RESULTS

The total calculated sample size was 15 at a 95% confidence level. The values are expressed in mean±SD. Baseline data, anthropometric data, site of tumor, and duration post-treatment (in months) are shown in Table 1.

Table 1: Baseline demographic data.

Characteristic/ demographic details	Mean±SD
Age (years)	47.13±3.20
Gender	
Male	8 (53.33)
Female	7 (46.66)
Anthropometric data	
Height (cm)	162.4±8.79
Weight (kg)	54.93±6.13
BMI (kg/m^2)	20.84±1.56
Site of tumor (n=15)	
Ca Buccal mucosa	03 (20)
Ca Esophagus	07 (46.66)
Ca Tongue	02 (13.33)
Ca Maxilla	01 (6.66)
Ca Soft palate	01 (6.66)
Ca Thyroid	01 (6.66)
Duration post-chemotherapy (in months) (n=15)	
3	05 (33.33)
4	05 (33.33)
5	03 (20)
6	02 (13.33)

Interpretation

Table 2 represents predicted and performed values for maximum expiratory pressure (MEP), compared using an unpaired t-test. The results showed statistically significant values.

Table 2: Within the group comparison of maximum expiratory pressure (MEP).

Variables	Predicted mean±SD	Performed mean±SD	t	P value	Significance
MEP (cm H_2O)	117.37±30.08	54.66±21.99	6.51	<0.0001	Extremely significant

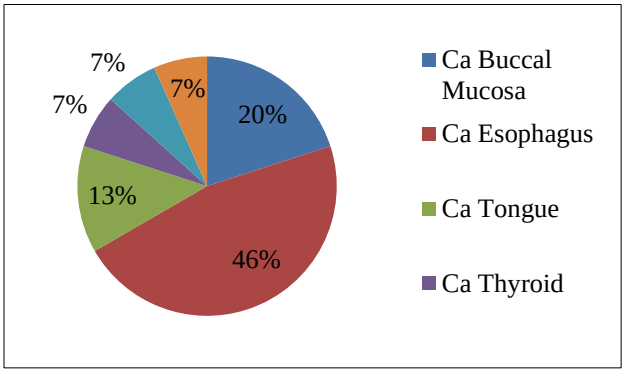

Figure 1: Graphical representation pie chart of site of tumor.

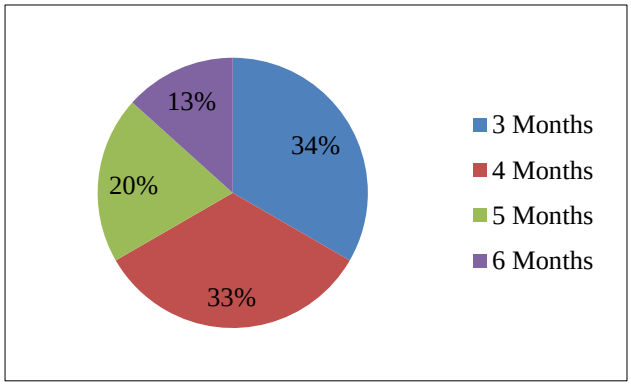

Figure 2: Graphical representation pie chart of duration post-chemotherapy.

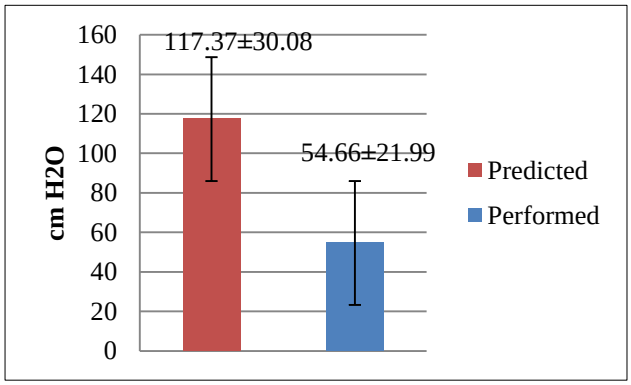

Figure 3: Graphical representation of predicted and performed difference of MEP.

DISCUSSION

Currently, the incidence of HNC in India is increasing day by day. As this cancer involves an area near the thoracic region, respiratory complications adversely impact these patients' respiratory muscle strength and expiratory functions. These adverse effects may occur during, immediately after the treatment, or after some days, months, or even years. Many researchers have studied the immediate adverse effects in HNC patients. But still, there is a lack of evidence about the effects that occurred lately after the required treatment. Thus, the current study helps us evaluate these late effects of chemotherapy on the respiratory system, including respiratory muscle strength in head and neck cancer patients after 3-6 months of the required treatment.

In our study, we found a result showing statistically significant changes in MEP values after 3-6 months of required chemotherapy sessions. After the assessment, we found a decline of 53.43% in MEP, as described in Table 2 and Figure 3.

The decline in expiratory muscle strength may be seen due to difficulty in generating effective expiratory force because of expiratory muscle weakness. It may lead to ineffective cough force and, ultimately poor airway clearance.

This is supported in a cross-sectional study on expiratory muscle force by Hutcheson et al.[8] According to their findings, expiratory functions were depressed in post-radiated HNC aspirators relative to non-aspirators ≥3 months post radiotherapy, suggesting that airway protection impairments may extend beyond disrupted laryngopharyngeal mechanisms. Therefore, after receiving head and neck chemotherapy, workouts to increase subglottic expiratory force-generating capacity may provide an additional therapeutic target to enhance airway protection in chronic aspirators.

Similar results are found in a longitudinal study conducted by D'souza et al.[11] They assessed MIP and MEP at three different timelines: at baseline, 3 weeks, and 7 weeks of chemoradiation. The data reported a significant decline in expiratory pressures by the end of 7 weeks.

Although the data reported a significant decline in expiratory pressures of stage 1 HNC patients, our study has several limitations. It includes less sample size, including only stage 1 HNC patients and only expiratory muscle strength evaluation.

As per the evidences by Santos et al, due to long duration exposure to chemoradiation therapy causes damage to the respiratory system.[12] This damage can alter the elastic recoil of the lung and chest wall leading to a decrease in the respiratory pressures, which may lead to further increase in the respiratory muscle effort. Based on the generalized loss of muscle mass in cancer patients we can conclude that; abdominal muscle weakness could have led to the decrease in the expiratory muscle strength which may have contributed to the decrease in the MEP values.

Another reason for the decrease in expiratory muscle strength in these patients could be because of sarcopenia which has been shown to be one of the major side effects of chemotherapy in head and neck cancer. A study conducted by Chauhan et al in 2019 proved that sarcopenia and its poor effects are majorly seen in peripheral muscles in HNC patients.[13] The sarcopenia found in this study is

similar to the loss in muscle function that we observed in the diaphragm muscle in our current study. This study could indicate that sarcopenia is not limited to peripheral muscles but can also be observed in the muscle of inspiration and expiration.

CONCLUSION

The results of the current study suggest that chemotherapy has a deleterious impact on the expiratory muscle strength in stage 1 head and neck cancer patients after long term exposure. Further studies can be carried out to design a standard exercise protocol for the improvement of expiratory muscle strength and for better prognosis of HNC patients. Also, some studies can be carried out to evaluate chemotherapy's impact on other respiratory parameters like inspiratory muscle strength, pulmonary function, and functional capacity. As the current study included patients undergoing chemotherapy only, future studies can be carried out for HNC patients undergoing radiation therapy or concomitant chemo-radiation therapy.

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