

Can chemo-radiotherapy for non-laryngeal cancer affect acoustics of voice – a preliminary study?

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ABSTRACT

Background: Treatment for cancer using chemo-radiotherapy and radiotherapy are age old treatment procedures which are found to be efficient in eradicating cancerous cells thereby improving overall quality of life of the individual. Though they seem to improve the disease condition, they adversely affect different bodily systems and functions. One such effect is noted in literatures on regard of voice acoustics. Knowledge in voice acoustics in these participants would adequately provide management options before and after treatment. In our study we aim to estimate extend of voice changes in participants undergoing radiation therapy for non-laryngeal head and neck cancer. **Methods:** Multidimensional voice profile (MDVP) was used to assess voice parameters on three time basis such as pre-treatment, immediate post treatment and one month after post treatment. **Results:** Significant difference was seen between all the three time points namely; pre-treatment, post treatment and one month after post treatment were observed. **Conclusion:** The study revealed that, radiation therapy significantly affects the voice parameters in the same way as it affects other parts of the body. Though these effects seem to be of higher significance, during and immediate treatment; the recovery on late post treatment is satisfactory.

Keywords: Chemoradiotherapy, Jitter; Shimmer; Noise to harmonic ratio, Soft phonation index.

INTRODUCTION

Cancer is the second most common disease in India responsible for maximum mortality rate, among which head and neck cancer contribute to 30% of all cancers. Cancer is defined as the abnormal growth of cells due to changes in gene expression resulting in imbalance in the process of cell multiplication and cell death which ultimately progresses into a population of cells which invade healthy normal tissues.^[1] They further metastasize to distant sites, causing morbidity. The treatment options for these cancerous cells are radiation therapy in the initial stages and concurrent chemoradiotherapy (cCRT) on the subsequent stages of cancer. Though concurrent chemoradiotherapy is the present standard treatment protocol for locally advanced head and neck cancer with a confirmed survival benefit rates, they often are associated with acute and late toxicities which affects the patient's quality of life. These toxicities were on higher rates with concurrent chemoradiotherapy than with radiotherapy alone.^[2] These effects range from minor to severe ailments in most of the bodily systems and functions of central nervous system, cardiac system, myelosuppression, nephrotoxicity, dermatitis with various associated short and long term effects including changes in acoustics of voice.

A study demonstrated increased jitter, shimmer in participants undergoing radiotherapy for laryngeal cancer.^[3] Another study stated atrophy of muscle, laryngeal mucosa dryness, fibrosis, hyperaemia, and erythema in these participants.^[4,5] The related voice changes include reduced vocal intensity, pitch, respiratory support, vocal hoarseness, roughness, breathiness, and vocal fatigue.^[6] Some authors has also reported similar findings in non-laryngeal cancers of head and neck.^[7] Though literature provides enough assuring and satisfactory evidence for effect of radiation on laryngeal and non-laryngeal cancers, there are only limited studies dealing with chemoradiotherapy and its effects on voice in non-laryngeal cancers participants. An insight into their voice measures is necessary for understanding the voice and plans the management strategies. Therefore, adequate knowledge on voice acoustics in these participants would provide sufficient information for accurate diagnosis and efficient management. The aim of this study was to investigate the effect of chemoradiotherapy on acoustic parameters of voice such as jitter, shimmer, noise to harmonic ratio, and soft phonation index.

MATERIALS AND METHODS

15 subjects undergoing chemoradiotherapy for head and neck cancer, sparing laryngeal cancer were recruited for the study. These subjects had no history of voice and related disorders prior to commencement of chemoradiotherapy. Voice evaluations were carried out using Multidimensional Voice Profile Software

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(Computerized Speech Lab Model 4150: Kay Elemetricscorp.) on three time basis viz. prior to the commencement of the treatment regime, immediately after the treatment and lastly, one month after the treatment, for the sustained phonation of vowel /a/. Recording was carried out using a condenser microphone placed at a distance of 10cm away from the subject's mouth. The measured acoustic parameters were compared within the three time frames using ANOVA repeated measures and paired t-test with p value less than 0.025 as significant.

RESULTS

To obtain statistical conclusion, two tests; Post hoc tests using the Bonferroni correction and paired t-test were employed. In the current study, statistically significant main differences were

observed between all the three time points that is: pre-treatment, post treatment and one month after post treatment for jitter ($F(2,14)=12.863, p=.001$), shimmer [$F(2,14)= 3.988, p=.043$], NHR [$F(2,14)= 10.482, p=.002$] and SPI [$F(2,14)=8.202, p=.004$]. Post hoc tests using the Bonferroni correction revealed statistically significant difference between pre-treatment vs. post treatment values for jitter ($p=.012$), NHR ($p=.008$) and SPI ($p=.021$). On paired t-test, for pre-treatment vs. post treatment measures, statistical significant difference was seen on all acoustic parameters. On post treatment vs. one month after post treatment measures, significant difference was seen for jitter, shimmer, and SPI. On contrary, no significant difference was seen for any of the acoustic parameters on comparison of pre-treatment vs one month post treatment values. The findings of paired t-test are as described in Table 1.

Table 1: Acoustic parameters in Chemoradiotherapy participants

Parameter		Pre vs Post treatment		Post vs One month post treatment		Pre vs One month post treatment	
		p value	t value	P Value	t value	p value	t value
Jitter %	Pre Treatment	.000*	-6.266	.003*	4.537	.062	-2.219
	Post Treatment						
	One Month Post Treatment						
Shimmer %	Pre Treatment	.008*	-3.103	.025*	2.838	.147	-1.633
	Post Treatment						
	One Month Post Treatment						
NHR	Pre Treatment	.001*	-3.965	.048	2.386	.064	-2.199
	Post Treatment						
	One Month Post Treatment						
SPI	Pre Treatment	.000*	-5.162	.019*	3.029	.396	-.903
	Post Treatment						
	One Month Post Treatment						

* Significant difference ($p<0.025$)

DISCUSSION

The differences in jitter values are assumed to be due to the laryngeal mucosa dryness, atrophy of laryngeal muscles, erythema, fibrosis, reduced lubrication of vocal folds as a result of chemoradiotherapy.^[8] Literature has reported similar findings as in present study that jitter values were higher immediately following treatment in non-laryngeal concurrent chemoradiotherapy patients and has also found that, these changes reversed in direction at the late post treatment.^[7] Increased shimmer values are attributed to diminished laryngeal control and degenerative changes in the larynx.^[7] This study depicts similar findings as that, voice outcome declined during chemoradiotherapy, but gained improvement after one to two months post treatment.^[9] The result of the current study is also in accordance with the findings of authors who reported that NHR values deteriorated at early post treatment when compared to pre-treatment values which subsequently

improved at late post treatment.^[7] On regard to SPI findings, inadequate vocal fold adduction has been reported by few researchers which is in line with the current observation.^[10] voice effects seem to be higher at 10-week post-treatment but often stabilises at 1-year post treatment.^[11] Also its reported that voice measures do not show normal values before or after treatment.^[9] The above findings were supported by researches stating that these individuals have increased jitter, shimmer, noise to harmonic ratio and fundamental frequency, along with swallowing related changes in these individuals.^[8] The author also stated that quality of life was found to be reduced even on long run as they did not presume to the normal level. Recovery seen in the present study at one month after post treatment can be related to health related quality of life which declines after treatment but recovers to baseline levels by about 12 months duration.^[12]

CONCLUSION

Jitter, shimmer, noise to harmonic ratio, and soft phonation index revealed significant difference on pre-treatment vs. post treatment evaluations. On post treatment vs. one month post treatment evaluation, significance was seen for jitter, shimmer, and SPI whereas no significant difference was seen for any of the voice parameters on pre-treatment vs. one month post treatment values, indicating a recovery in voice quality in them. Therefore, this study points that chemoradiotherapy significantly affects acoustics of voice even when laryngeal area is spared. Also recovery towards baseline voice is seen on late post treatment. As stated by Lefor (1999), the toxic effects are linked to the type of drug used in treatment, its total dosage and also the schedule of drug prescribed. Therefore future studies can be aimed at these directions along with specific site of cancer, age range and gender.

Acknowledgement

Authors would like to thank Manipal University for the grant provided to carry out this research work. We also extend gratitude to Ms Rashmi Ananth Pai for her support and guidance.

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How to cite this article: Sabu F, Bhat JS. Can chemo-radiotherapy for non-laryngeal cancer affect acoustics of voice – a preliminary study? *Ann. Int. Med. Den. Res.* 2015;1(3):175-77.

Source of Support: Nil, **Conflict of Interest:** None declared