Case Report

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Preoperative and Postoperative Respiratory Rehabilitation in A Patient with Spinal Cord Injury Undergoing Diaphragmatic Pacing

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ABSTRACT

Acute and chronic respiratory complications are the leading cause of mortality after spinal cord injury (SCI). Patients with SCI may be able to breathe spontaneously without the need for mechanical ventilatory support via the diaphragmatic pacing system. Respiratory rehabilitation during this period aims to provide more effective device function and speed up the familiarization of the patient with the device. The aim of our case report was to investigate the efficiency of preoperative and postoperative respiratory rehabilitation in a patient with cervical SCI undergoing diaphragmatic pacing.

Keywords: Diaphragmatic Pace, respiratory muscle, strength, respiratory, rehabilitation, spinal cord injury

Introduction

Spinal cord (SC) injury is an important health problem having personal and social dimensions and is accompanied by physical, psychosocial, and economic problems. Increases are observed in the number of hospital admissions, hospitalizations, and health expenses owing to respiratory complications that occur because of the loss or decrease in the function of the respiratory muscles depending on the stage of neurological lesion (1). In recent years, the use of a diaphragmatic pacing system (DPS) has become more widespread in tetraplegic patients because it reduces the treatment costs and the risk of phrenic nerve injury. DPS used in SC injuries helps the patient to actively breathe without the support of mechanical ventilation (2). The goal of respiratory rehabilitation, which is applied in this study, is to enable the device to function more efficiently and to accelerate patient compliance to DPS. It has been revealed in the literature review that the number of studies on respiratory rehabilitation in patients with SC injuries is inadequate.

Case Report

A 29-year-old male patient, with a weight of 65 kg and height of 1.69 m, who was injured in a traffic accident was diagnosed with tetraplegia at C3-4 level and underwent operation. The patient, had a C5 sensory level according to the ASIA scale (3), C4 motor level, dyspnea score of 4 in Modified Medical Research Council, and six pack-year history of smoking. The patient, who was hospitalized seven times during this period, stayed in the intensive care unit for 54 days, and in whom a permanent cardiac pacemaker was placed owing to frequent cardiac arrests, could spontaneously breathe through tracheostomy in room air. Because of complaints such as labored breathing, cough, phlegm, and fatigue, the patient underwent DPS 2.5 months after trauma. Because his clinical picture was severe, the patient was admitted to the Department of Cardiopulmonary Physiotherapy and Rehabilitation for evaluation. The patient's maximal inspiratory pressure (MIP), maximal expiratory pressure (MEP), sniff nasal inspiratory pressure (SNIP) values, and chest circumference were measured preoperatively, on the postoperative day 1, on the day of discharge, and after 1 month (Figure 1). The patient was evaluated for his depression level using the Beck Depression Inventory (4), independence level using the Functional Independence Measure (FIM) (5), and quality of life using the Short Form-36 (SF36) (6) preoperatively and in the first postoperative month.

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Figure 1. View of the patient during postoperative evaluation

In the preoperative period, the patient performed abdominal, intercostal breathing, and general mobilization exercises under the guidance of a physiotherapist for a minimum of 1 h, twice a day. The patient and his family were educated for performing the deep breathing exercises for five times every 2 h. While the same program was continued under the guidance of a physiotherapist for once a day in the postoperative period, it was aimed to synchronize the spontaneous respiration of the patient with the device impulses by performing breathing exercises when DPS was active. During hospitalization, DPS was left open for 30 min at 2-hour intervals to help the patient perform deep breathing exercises. Training protocol was planned considering the patient's clinical symptoms such as heart rate, oxygen saturation (SpO_2) level, shortness of breath, and fatigue during the procedure. A total of 10 preoperative sessions and five postoperative intense respiratory rehabilitation (diaphragmatic, segmental, and pursed lip breathing) and general mobilization exercises (passive range of motion in bed and positioning every 2 h) were implemented. The patient and his family were told to perform the same exercises at home. DPS was adjusted to be open for 1 h at 2-h intervals, and the patient was discharged from the hospital.

The first postoperative MIP, MEP, and SNIP values and chest circumference measurements of the patient were significantly higher compared to the preoperative values (Figure 2) (Table 1). A further increase in these values and a decrease in the depression level were observed in the first postoperative month

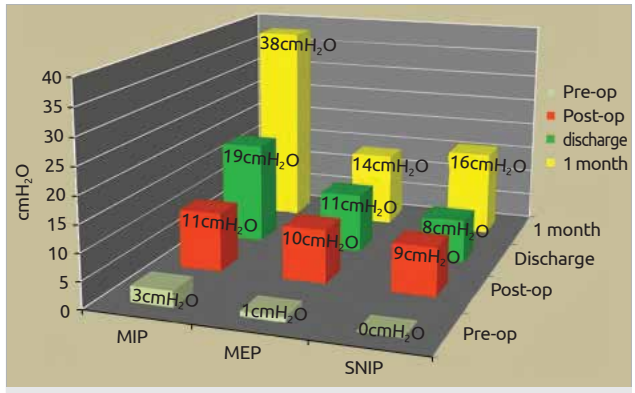

Figure 2. The first and following MIP, MEP, and SNIP values of the patient

Table 1. The first and following chest girth measurements of the patient

	Pre-op	Post-op	Discharge	1 month
Aksillar (cm)	0	2	2	2
Epigastrik (cm)	0	1	1,5	2
Subkostal (cm)	1	3	3	6,5

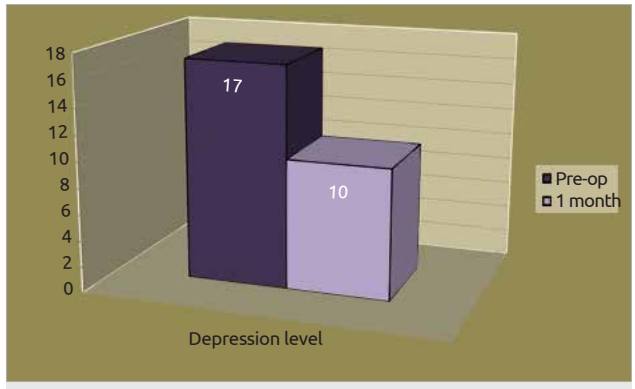

Figure 3. The first and following Beck Depression Scale values of the patient

(Figure 3). There was no change in the quality of life and FIM values. There was an increse in the depth of breathing and a decrease in rate of breathing and fatigue. It was observed that he could perform slight intercostal breathing, which he could not perform before respiratory rehabilitation; he could perform resistant abdominal breathing; and he was adapted DPS through respiratory rehabilitation in a short time.

Discussion

In SC injuries, inspiratory–expiratory volumes decline because of inadequate functioning of the diaphragm, intercostal, and abdominal muscles. The compliance and mobility of the rib cage decrease (7). As understood from the first evaluations, while the respiratory muscle strength and flexibility of the thorax decreased in our patient, the depression level increased. In our patient, low inspiratory, expiratory, and sniff values before

respiratory rehabilitation are consistent with those reported in the literature (1). An increase in these values measured before activating DPS might have resulted from the positive effects of respiratory rehabilitation and mobilization exercises. In a randomized study in which pre- and postoperative respiratory rehabilitation were performed, an increase in the SpO_2 level and exercising capacity, a decrease in the duration of hospitalization, and an improvement in the distribution of ventilation–perfusion were reported (8). However, the literature review revealed that no studies investigated the effects of pre- and postoperative respiratory physiotherapy rehabilitation approaches on patients having SC injuries and who underwent DPS. Demir and Haas (9, 10) reported an increased axillary chest expansion through respiratory exercises in patients with SC injuries. In our case, we found increases in all three chest circumference measurements from different points after respiratory rehabilitation. The occurrence of these increases in the first-month measurements after having begun to use DPS with respiratory rehabilitation in the postoperative period might have been because of the functional improvement in the diaphragm, intercostal, and accessory respiratory muscles. Moreover, the improvements in the depression level might have resulted from the elevated respiratory parameters and the absence of any respiratory problem in this 1-month period.

Conclusion

Pre- and postoperative respiratory physiotherapy and rehabilitation approaches implemented in the patient in whom DPS was placed owing to an SC injury at the cervical level positively affected the clinical course of the patient in the postoperative period. It is suggested that when these procedures are performed as in-hospital routine approaches in similar patients, it will be helpful in improving mouth pressures (MIP, MEP, and SNIP) and chest expansion.

Informed Consent: Written informed consent was obtained from patient who participated in this case.

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