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GASTRECTOMY PERFORMED WITH NON-INVASIVE POSITIVE PRESSURE
VENTILATION FOR A PATIENT WITH SEVERE CHRONIC OBSTRUCTIVE
PULMONARY DISEASE: REPORT OF A CASE

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ABSTRACT

We report the case of a patient with severe chronic obstructive pulmonary disease (COPD) for whom gastrectomy was successfully performed with the use of non-invasive positive pressure ventilation (NPPV). A 63-year-old man who had been suffering from chronic pulmonary emphysema for 12 years and receiving home oxygen therapy (HOT) for 9 years was diagnosed with gastric carcinoma. The patient required supplemental oxygen *via* nasal cannulae even at rest, and had labored breathing through pursed lips after a short conversation. The forced expiratory volume in 1 second was 400 ml. The patient underwent conventional gastrectomy under general anesthesia, and was extubated 90 minutes after surgery and given NPPV support. He was successfully weaned from NPPV on postoperative day (POD) 10 and discharged from our hospital on POD 28. NPPV is useful for the perioperative management of patients with severe COPD and for extending the possibilities of surgery for patients on HOT.

Key words: chronic obstructive pulmonary disease, gastric cancer, gastrectomy, home oxygen therapy, non-invasive positive pressure ventilation

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a life-threatening illness that is characterized by a slow but steady progression. The patients finally reach the condition where they cannot sustain their lives without continuous oxygen administration. As home oxygen therapy (HOT) is well developed and widely used, it is becoming more frequent for physicians to encounter severe COPD patients who need surgery because they suffer from other incidental diseases such as gastrointestinal malignancies. However, COPD patients are at a high risk for postoperative respiratory complications [1] that lead to operative mortality or irreversible dependence on mechanical ventilation. Thus, the patients are frequently judged to be intolerant to surgery. Moreover, the poor prognosis of patients receiving HOT has led to hesitation among clinicians regarding the choice of surgical treatment even if it is the only way to cure the malignancy.

Non-invasive positive pressure ventilation (NPPV) is a supportive mechanical ventilation system in which intratracheal intubation is not needed and positive pressure is loaded synchronously with the patient's respiration *via* a facial mask [2]. The advantages of NPPV include obviation of complications induced by intratracheal intubation and reduced mental and physical burden on the patient.

We present herein a successful case of gastrectomy for a severe COPD patient with gastric cancer. We also discuss the contribution of NPPV to the safe perioperative management of severe COPD patients.

CASE REPORT

A 63-year-old man was admitted to a local hospital because of exacerbation of COPD. The patient had been diagnosed with chronic pulmonary emphysema 12 years before and introduced to HOT nine years before. His respiratory distress was relieved after hospitalization. He underwent gastrofiberscopic examination for a peptic ulcer that was previously diagnosed. Endoscopic examination revealed that the gastric ulcer was healed; however, incidentally, a gastric carcinoma was found at the antrum. The lowly elevated sessile tumor that exhibited a coarse nodular appearance on the surface was endoscopically diagnosed as IIA + IIC type early gastric carcinoma (Classification of the Japanese Cancer Association [3]) and estimated to be 3.5 cm in diameter and to reach the submucosa in terms of depth of invasion (Fig. 1). Histological examination on biopsy revealed that the tumor was moderately differentiated tubular adenocarcinoma. The patient was transferred to Niigata University Medical Hospital because he was considered to be at such a high risk not to receive standard treatment for gastric cancer.

The patient constantly required supplemental oxygen (1.5 L/min) via nasal cannulae. He complained of dyspnea even at rest and showed labored breathing through pursed lips after a short conversation (class V in the Hugh-Jones' classification). The patient was in bed except when he had to use the bathroom. The daily activities of the patient were highly restrained by his deteriorated respiratory function (ECOG performance status 3). Functional analysis provided objective data revealing that the pulmonary disorder of the patient was severe (Table 1). Data obtained from arterial blood gas analysis conducted under the condition of oxygen insufflation (1.5 L/min via nasal cannulae) were as follows: PaO₂, 78.2 mmHg; PaCO₂, 41.9 mmHg; pH 7.44; and base excess, 4.0.

Although the prognosis of severe COPD patients is poor *per se*, previously reported survival analyses of COPD patients [4] had predicted that the patients could survive for more than three years. We anticipated that the patient's survival would not exceed this period if the cancer was left untreated. The patient consented to undergoing surgery after repetitive consultations. Because the tumor was large and located at the prepyloric region, local resection was regarded to be inappropriate for accomplishing complete excision. Therefore, we selected conventional gastrectomy under general anesthesia. Lymph node dissection was omitted because no lymph node metastasis was detected by preoperative examination and operative observation. The gastric remnant was anastomosed to the duodenum (Billroth I- gastroduodenostomy). Feeding jejunostomy was also performed. Operative time was 1 hour and 50 minutes. The tumor was 4.2 x 3.8 cm in size. Pathological examination confirmed submucosal invasion of the tumor (Fig. 2). No metastasis was found in the excised perigastric lymph nodes.

The patient was extubated one and a half hours after surgery and in turn supported by NPPV via a facial mask (BiPAP Harmony S/T, Fuji Respironics, Tokyo; Fig. 3). The support pressure was set at 8 cmH₂O and positive end-expiratory pressure was set at 4 cmH₂O. Full-time NPPV support was required for the first six days, followed by only nighttime support for the next four days. Sedation was not needed for those 10 days. On the tenth postoperative day, the patient was successfully weaned from NPPV. No respiratory complication or anastomotic leakage occurred. The patient was returned to the local hospital for rehabilitation on the 28th postoperative day.

DISCUSSION

We reported a successful case of a severe COPD patient who underwent gastrectomy for stomach cancer in the present study. To decide the indication of surgery for COPD patients, particularly for severe COPD patients receiving HOT, two clinical questions should be answered: whether the surgery actually contributes to prolonging patient's life, and whether the surgery can be conducted safely or not. Because COPD itself is a life-threatening disease, it is necessary to compare the prognoses of COPD and the disease requiring surgical treatment. Several prognostic indicators are known for COPD, including sex, the underlying disease, and the forced expiratory volume in one second (FEV_{1.0}) [4]. Our patient showed an FEV_{1.0} of approximately 40%. The survival curve stratified by FEV_{1.0} indicated that the estimated three-year survival rate of the patient was approximately 80% [5, 6]. In addition, the COPD in the present case originated from chronic pulmonary emphysema, which is better than tuberculosis- or cancer-based COPD. As regards gastric carcinoma, it is difficult to estimate exactly the patient's life span without treatment. Nishizawa et al. [7] have retrospectively analyzed the results of X-ray mass screening for stomach cancer and concluded that while mucosal carcinomas remain as mucosal diseases for years, carcinomas that were diagnosed as being invasive to the submucosa progressed to advanced diseases in a year or earlier. Their findings suggest that the tumor in the present case could become symptomatic and life-threatening approximately one year later. Collectively, we judged that the life expectancy provided by the best supportive care for gastric cancer could not surpass the life span expected in the current case of COPD.

COPD is a high risk factor for postoperative morbidity and mortality. Although many studies have been conducted to evaluate the risks, no

absolutely reliable method has been established so far. Miller et al.'s classification [8], which stratifies the risk into four groups based on vital capacity and FEV_{1.0}, is commonly used even at present because it is simple and clinically useful. The risk evaluated from the patient's data was marginal between the poor group and the prohibited group. As the classification is somewhat classical, we finally selected gastrectomy after repeated consultations with the patient.

Ventilator-associated pneumonia (VAP) is a type of pneumonia that occurs during mechanical ventilation support. It is well known that COPD is one of the risk factors for VAP [9,10]. The lower airway is physiologically separated from the upper airway by the epiglottis. However, tracheal intubation creates channels through which pathogens are inhaled directly, thereby facilitating the development of pulmonary infection. Moreover, the positive pressure produced by mechanical ventilation injures the bronchiolar cells that play an important role in the clearance of the airway. COPD lungs are anatomically fragile and impaired functionally. This is one reason why COPD patients are susceptible to VAP. Once VAP occurs in COPD patients, the disease becomes serious and refractory. The mortality is reported to be 54% [11]. Therefore, early extubation is recommended for the prevention of VAP. On the other hand, COPD patients frequently need postoperative ventilation support to ensure sufficient oxygenation. Under such circumstances, the perioperative management of COPD patients requires resolution of the two conflicting issues. NPPV is a supportive ventilation system that enables sufficient oxygenation without tracheal intubation. The machine is primarily developed to manage severe COPD patients or patients suffering from nocturnal apnea syndrome. Recently, it has been applied also to the management of critically ill patients in the intensive care unit (ICU).

Guerin et al. [12] analyzed 320 ICU patients and found that the occurrence of VAP was significantly lower in patients supported by NPPV than in those supported by ventilation with tracheal intubation. Their study is notable because it showed the possibility that NPPV reduces the risk for VAP in patients requiring mechanical ventilation support.

Indeed, NPPV is a less invasive ventilatory support that requires no restraint of patients and permits them to talk. However, NPPV is rather stressful because it requires tight contact between the face and the mask to ensure a closed circuit. Air insufflated by positive pressure support occasionally disrupts the patient's breathing and causes hypoxia. The patient in our case started preliminary use of NPPV nine days before the surgery. The conditions were set preoperatively to ensure suitability for the patient's respiration. The preparation seemed to have led to the smooth introduction of NPPV and the uneventful postoperative course in the present case.

There was a concern that positive pressure exerted by NPPV could induce aerophagia and increase the risk for aspiration [13] and anastomotic dehiscence. Even a risk for barotraumas has been reported among patients undergoing long-term management [14]. In the current case, however, NPPV was applied for 10 days without the use of narcotics, and no untoward consequences were encountered.

In summary, we presented a successful case of gastrectomy in a severe COPD patient receiving HOT. NPPV was useful for perioperative management and seemed to contribute to the prevention of postoperative respiratory complications. NPPV is a new ventilatory support for extending the possibility of surgery to severe COPD patients.

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FIGURE LEGENDS

Figure 1. Gastrofiberscopic examination revealed that the patient had gastric carcinoma at the antrum. The carcinoma was a lowly elevated sessile tumor that showed a coarse nodular appearance and was partially amorphous on the surface. It was endoscopically diagnosed as a IIa + IIC type early gastric carcinoma that was invasive to the submucosa. Histological examination on biopsy revealed that the tumor was moderately differentiated tubular adenocarcinoma.

Figure 2. Gross appearance and microscopic appearance of the tumor. Arrowheads indicate the tumor and arrows indicate linear scar of healed peptic ulcer (top). Histological examination confirmed submucosal invasion of moderately differentiated tubular adenocarcinoma (bottom). Desmoplastic reaction surrounding cancer nests was found. Scale bar indicates 250 μm (H & E).

Figure 3. The patient equipped with NPPV.

The patient was extubated one and a half hours after surgery and in turn supported by NPPV (BiPAP Harmony S/T, Fuji Respironics, Tokyo). The support pressure was set at 8 cmH_2O and the positive end-expiratory pressure was set at 4 cmH_2O .

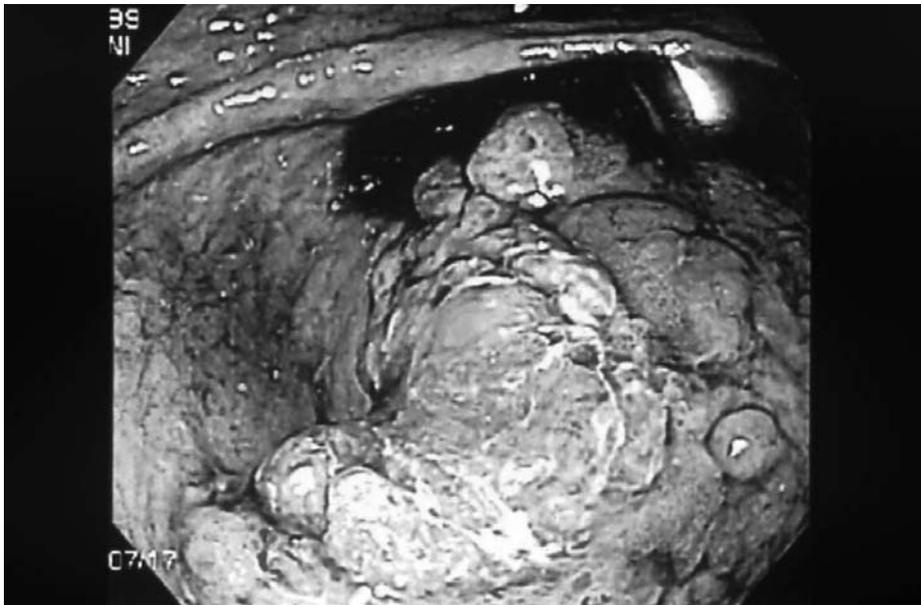


Fig.1 Watanabe M et al.

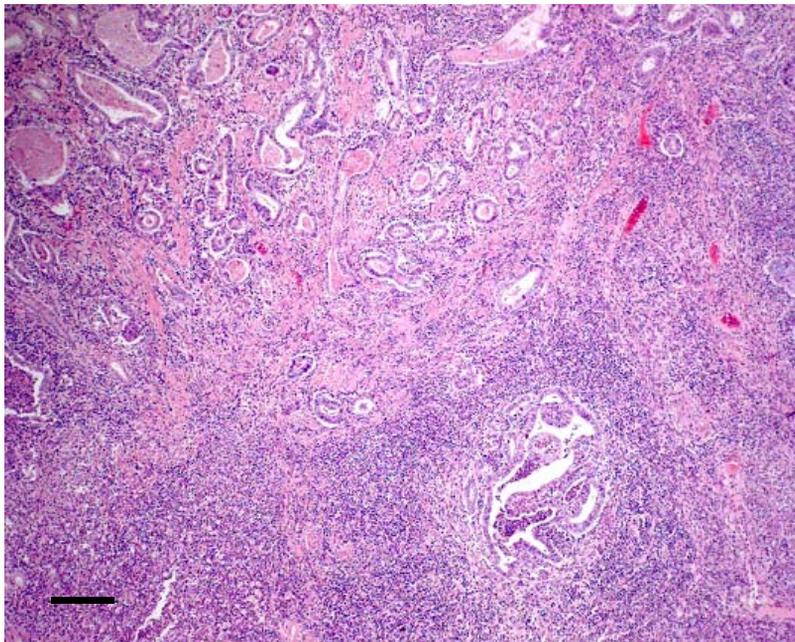
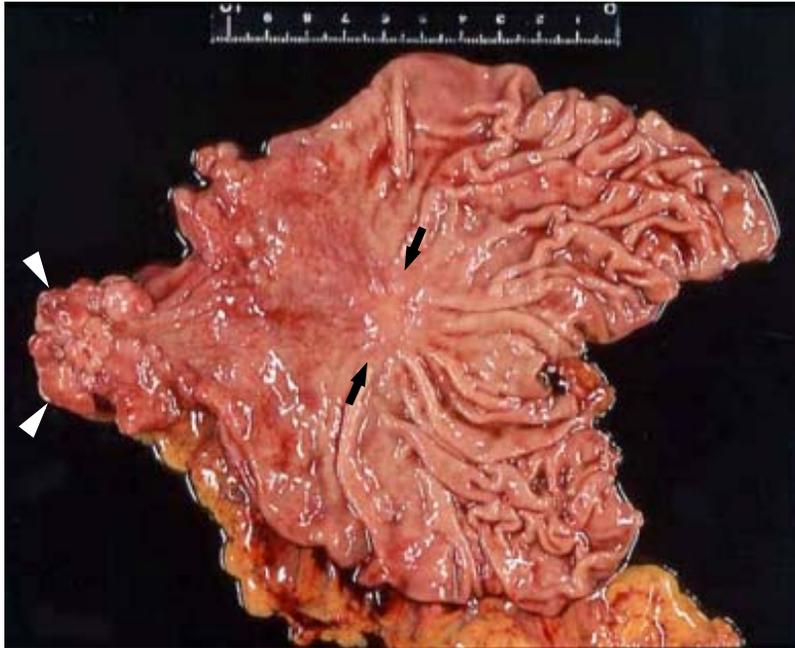


Fig.2 Watanabe M et al.



Fig.3 Watanabe M et al.