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High Level of Intra-Gastric Pressure is Risk Factor for Patients with Percutaneous Endoscopic Gastrostomy (PEG)

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1. Introduction

In Japan, percutaneous endoscopic gastrostomy (PEG) has been used mainly in patients with stroke and dementia, who are unable to undertake oral ingestion voluntarily. The number of patients who rely on PEG feeding has recently increasing. The occurrence of aspiration pneumonia after PEG placement is difficult to predict. With a simple and new examination procedure which measures intra-gastric pressure (IGP) during the hungry period, we were able to determine the presence of aspiration pneumonia in PEG patients. Sixty patients living in a home-care type facility or nursing home were examined in our hospital from November, 2010 to January 2011. The patient lies down horizontally in the supine position. IGP is measured using a PEG tube. Using like this method, the intra-abdominal pressure (IAP) is measured in cases of the abdominal compartment syndrome, while central venous pressure (CVP) is measured in cases of heart disorder. The mean IGP in patients without complicated pneumonia was 2.1 ± 1.7 cmH_2O. In patients with complicated pneumonia ($p<0.0001$), it was 7.9 ± 2.7 cm H_2O. There is a relationship between IGP and the symptoms of aspiration pneumonia. Our simple and easy technique can estimate the level of complication and can assist in the prevention of pneumonia in patients living in nursing facilities.

2. Prognostic significance of intra-gastric pressure for the occurrence of aspiration pneumonia

Percutaneous endoscopic gastrosotomy (PEG) tubes have been used mainly in the patients with stroke and dementia who are unable to undertake oral ingestion voluntary. PEG feeding nutrition has been reported to be an effective and safe procedure with a low incidence of complications. Nevertheless, with increased use by many patients in serious condition and among very old patients, complications have been encountered more frequently in recent years in Japan. One of the most common complications is aspiration pneumonia and PEG tube problems such as obstruction accompanied with pollution inside

the tube. There have been several reports of cases of PEG patients having died as a result of aspiration pneumonia (1, 2).

Due to the benefits of enteral nutrition and with improvements in PEG patient management, the number of PEG patients has increased remarkably. However, the placement and management of PEG tubes are not without risks (3, 4). The overall complication rate has remained stable over the last 15-20 years, ranging from 4 % to 23.8 % of cases. Three to 4% of all cases are affected by major complications, i.e. those that are life threatening and/or require surgical intervention or hospitalization. More common minor complications occur in between 7.4% and 20.0% of cases (5).

In many cases, PEG patients live in home-care facilities or nursing homes which lack the more sophisticated instruments available in hospitals. It is necessary to distinguish patients for whom complications can easily arise from patients for whom complications are unlikely. Our new technique measures intra-gastric pressure (IGP) for the purpose of screening for high risk cases of aspiration pneumonia (6). This examination technique is a modification of that technique being used to measure intra-abdominal pressure (IAP) in the case of the abdominal compartment syndrome (7) and for measuring central venous pressure (CVP) to monitor cardiac function and so on (8). A rise of IGP causes the reflux to the esophagus from the stomach. And as a result of aspiration of gastric juice to the lung, symptoms of aspiration pneumonia occur. We can prevent aspiration pneumonia by monitoring IGP.

We have confirmed that a relationship between pneumonia and a high IGP level exists, and hope to introduce this safe, simple and effective bedside technique for evaluating patients living in home-care facilities, in the hope that we can decrease complications such as the pneumonia and the obstruction of the PEG tube.

2.1 Materials and methods

Sixty consecutive patients (23 men, aged 49-89 and 37 women, aged 43-90) who had received a medical examination with PEG catheter, were studied from November 2010 to January 2011. A PEG tube of from 20 to 24 Fr in diameter had been inserted as the primary means of long-term nutrition in patients with swallowing disorders. It had been 3 months since the PEG operation. In many cases, patients had been maintained in home-care type facilities or nursing homes lacking hospital-level medical instruments.

The patient lies down horizontally in the supine position. Intra-gastric pressure is measured directly using the PEG catheter over 6-8 respiratory cycles in the empty period. First, the air in the stomach is aspirated, and we put into 50 ml of warm water in the syringe into the PEG tube and the stomach. We measure the height from the top of the skin of the abdomen to the surface of the water in the PEG tube (Fig. 1). We wait several minutes and measure when the IGP value is high. The height of the surface of the water is unstable; however, the value can be measured at the center. We repeat the same technique three times and we average the results

Patients were classified into two groups. In the first group there was no suspicion of pneumonia while in the second group pneumonia was complicated. The first group contained of 19 men aged 44-89 and 30 women aged 46-89. The second group consisted of four men aged 48-86 and 7 women aged 43-90. For all cases, diatrizoate (Gastrografin) study was performed. Gastrografin 30 ml was given by using PEG tube, and confirmed that the PEG tube was in proper position in the stomach and the discharge from the stomach to the

duodenum was normal. Finally, the gastro-esophageal reflux and the movement and function of the stomach are confirmed carefully.

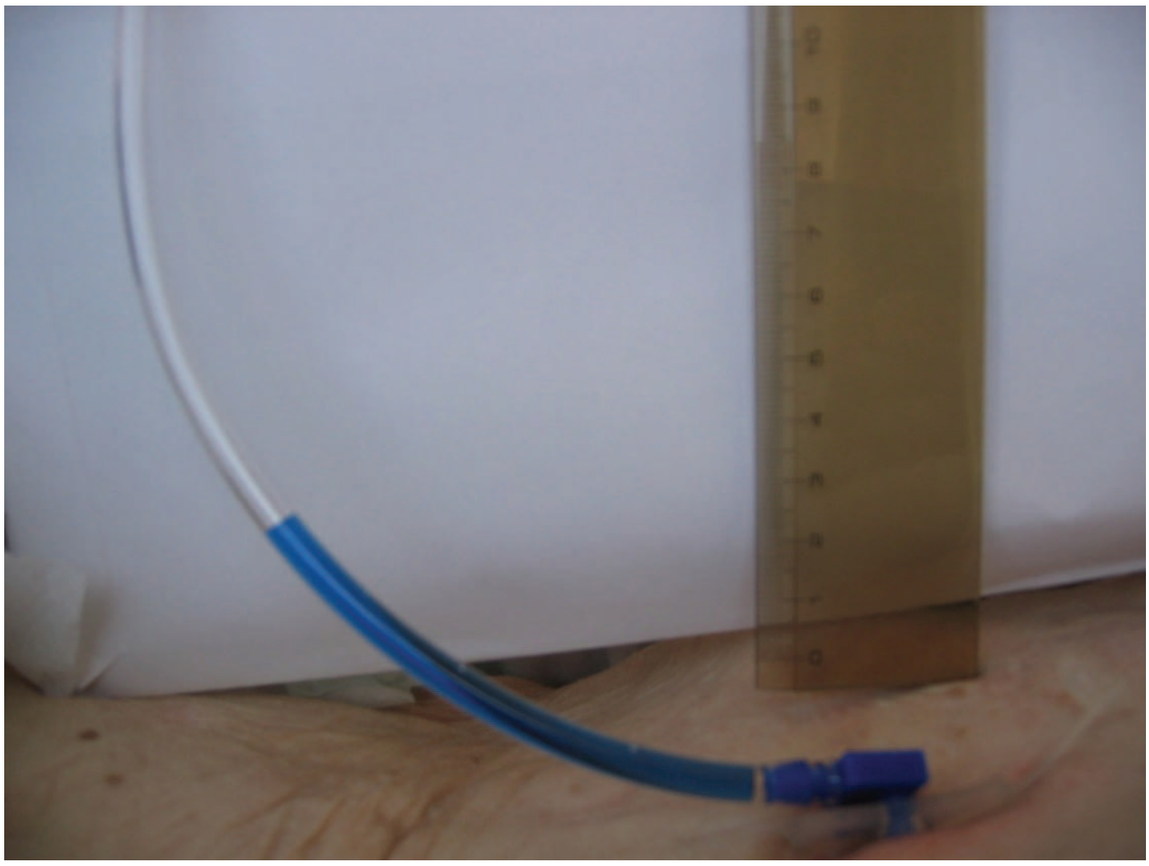

Fig. 1. The technique of measuring intra-gastric pressure using PEG tube. The patient lies down horizontally in the supine position. The water contains 0.1 mg/ml Indigocarmine. Intra-gastric pressures show 3 cmH_2O in this case

A chest x-ray, a body temperature over 37.5 degrees C, pulse rate is over 100 beats/min and listening to the lungs with a stethoscope (auscultation), were criteria used to diagnose pneumonia.

2.2 Statistical analysis

The data was stored on Microsoft Excel Office 2007 and processed using SPSS Scientific package SPSS 12.0 (SPSS Inc., Chicago, IL). Statistical significance of the changes in routines was evaluated by χ^2 and Fisher exact test. Results were considered to be statistically significant at an alpha of 0.05.

2.3 Results of intra-gastric pressure of PEG patient

The median IGP was 2.1 ± 1.7 cmH_2O for patients who were not suffering from complicated pneumonia (n=49) and 7.9 ± 2.7 cmH_2O for patients who were suffering from complicated pneumonia (n=11) ($p < 0.0001$)(Fig. 2). In cases where the pneumonia was not complicated, IGP was lower than 8 cm. The rate of IGP was equal to or greater than 7 cm was 0%. While

in cases involving complicated pneumonia and the rate of IGP was equal to or greater than 7 cm, it was 63.6%.

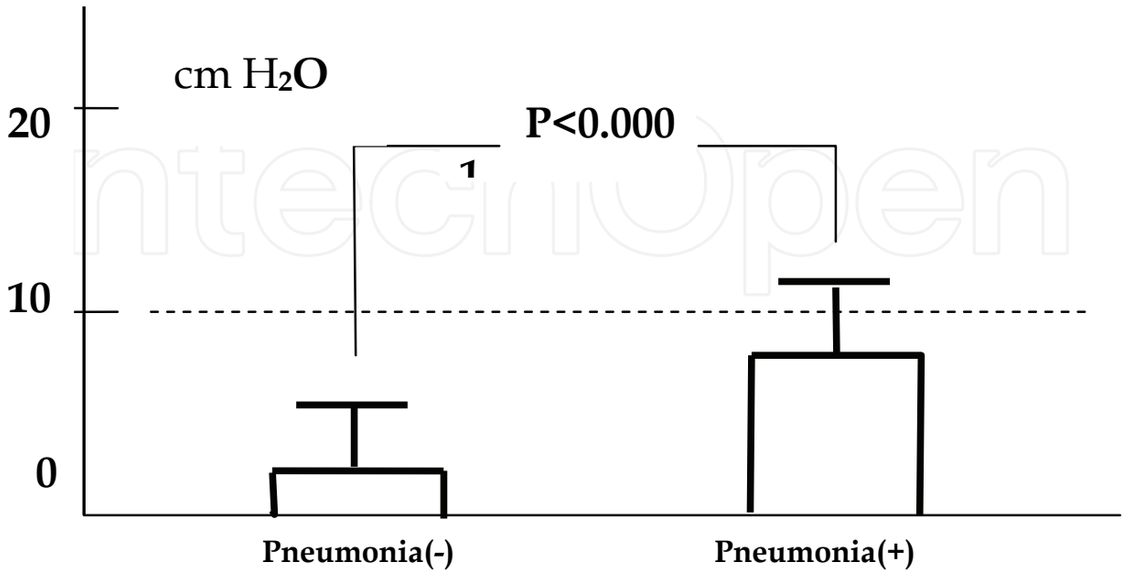

Fig. 2. Intra-gastric pressure (IGP) cm H_2O

Intra-gastric pressure of PEG patient. The median IGP were 2.1 ± 1.7 cmH_2O for the patient without complicated pneumonia and 7.9 ± 2.7 cmH_2O for the patient with complicated pneumonia ($p < 0.0001$).

2.4 Discussion

Percutaneous endoscopic gastrostomy (PEG) is generally used for long-term enteral nutrition in patients with prolonged swallowing difficulties and inabilities. Patients requiring PEG placement are often very sick, and suffer from postoperative complications. One such complication, aspiration pneumonia, can be especially fatal. Complications encountered in a large series of studies have demonstrated that procedure-related mortality occurred in less than 1%, of major complications and in 3% of minor complications in less than 14% of patients(9). During observation after PEG operation, the occurrence of aspiration pneumonia is well recognized. Over 70 % of causes of death after PEG operation at our hospital were aspiration pneumonia even if the gastrografin study is normal in the stable postoperative condition (6). Therefore, an examination aimed at prevention of pneumonia in PEG patients is needed.

Moreover, physicians who place PEG tubes endoscopically often do not have the opportunity to provide these patients with long-term follow up care (10). Thus, those nutrition support specialists who do treat PEG patients may be different than those members of the health care team who are in the most advantageous position for ongoing inspection and maintenance of the access devices. Dietitians, wound-care ostomy nurses, and other nutrition support specialists are encouraged to be more proactive with their participation in the care and management of the PEG site. However, because all the members are not experts in PEG, simple methods for identifying problems are necessary.

In preventing complications in PEG patients, inspection techniques are of primary importance.

When a patient develops a distended and taunt abdomen in the case of the abdominal injury, the measurement of abdominal compartment pressure can help with early recognition of organ dysfunction (7). Normal IGP is 0-5 mmHg (0-7 cmH_2O). At 10 mmHg, the cardiac output may begin to decrease. Hypotension and oliguria can occur at 15 to 20 mmHg (20-26 cmH_2O), and anuria will occur with pressure over 40 mmHg. The collective effects of the increased abdominal pressure are called Abdominal Compartment Syndrome. When pressure in the abdominal compartment overcomes the pressure inside the capillaries perfusing the organs of the abdomen, ischemia and infarction of the organ can occur.

The reason for measuring intra-abdominal pressure is due to the following structure (7). The bladder is an extraperitoneal, intra-abdominal structure with a very soft wall. Because of this, changes in intra-abdominal pressure are reflected in changes in bladder pressure. When the bladder is filled with 50 to 100 ml of fluid, there is virtually no pressure exerted on the bladder wall, allowing it to act as a passive pressure monitor. A foley catheter can be then used to monitor for abdominal compartment syndrome. Failure to recognize and treat intra-abdominal hypertension will results in increased risk of renal impairment, visceral and intestinal ischemia, respiratory failure and death.

From a similar point of view, CVP is clinically applied to monitor cardiac function. CVP is an indicator of cardiac preload and reflects right ventricular function (8). In most cases, left heart function correlates well with right heart function. Considering the above, measuring IGP by using the PEG tube was useful for determination of the patient's condition.

IGP has also been used for other purposes. For example, IGP is used to estimate abdominal wall hernia formation following surgery. The mean pressures of males and females do not differ. And, it has been reported that the mean IAP for sitting and standing is 16.7 and 20 mm Hg respectively. Coughing and jumping generate the highest IAP (107.6 and 171 mmHg, respectively) (11).

The endoscopist who places PEG tubes is not often concerned with long-term management and follow-up care in PEG patients. There needs to be a system for identifying complications more easily. It is important that the measurement of IGP in PEG patients can be determined easily without any special instrument.

According to our measurements, the median IGP of patients with complicated pneumonia were 7.9 ± 2.7 cmH_2O, and 2.1 ± 1.7 cmH_2O and for patients without complicated pneumonia ($p < 0.0001$). We reported the similar results in the previous manuscript in 2008(6) and confirmed that by the results of our measurement, the median IGP of the patient who complicated pneumonia were 10.4 ± 7.1 cmH_2O, and 4.7 ± 4.5 cmH_2O for the patient who did not have complicated pneumonia ($p < 0.0001$). The higher pressure reflects the status of the pneumonia. Based on our observations, patients who have symptoms of pneumonia appear to generate a significant elevation in IGP, and IGP reflects the prognosis of PEG patients by a similar method of IAP and CVP. In cases of complicated pneumonia, the rate of IGP over 7 cmH_2O was 63.6 %.On the other hand, in cases without complicated pneumonia, the rate of IGP over 7 cmH_2O was 0%. Cases in which IGP is equal to or greater than 7 cm H_2O, may possibly be complicated pneumonia.

The highest intra-abdominal pressure in healthy patients is generated during coughing. And, coughing is a symptom of pneumonia. Therefore, the IGP of patients with pneumonia increases. The measurement of IGP is also related to physiological conditions.

Among elderly people such as PEG patients, the lower esophageal sphincter (LES) pressure shows a greater decrease than in younger people (12, 13). Consequently, for elderly people, the risk of aspiration pneumonia is higher than it is in younger people. We confirmed gastro-esophageal reflux by the Gastrografin study. The result showed that the reflex is recognized in only thirteen of one hundred thirty –two cases (9.8%) (6). we need further examination to determinate the condition of PEG patients from these results (date not shown) (14).

Serious complications related PEG tubes which can not be predicted were reported several months after PEG placement. For example, a case of prolonged duodenal paralysis after PEG replacement in a patient with traumatic brain injury was reported in 2011 (15). This case report describes an uncommon complication of PEG placement in a vegetative state after traumatic brain injury: the development of prolonged duodenal paralysis. This patient was treated by placement of a transient jejunostomy until recovery of duodenal function activity, to permit adequate nutrition. This transient jejunostomy for duodenal paralysis has been previously unreported. In this case, persistent high level of IGP is expected, the aggravation of the symptom can be prevented.

Buried bumper syndrome is a serious complication related to PEG tubes and needs hospital treatment (16). It is difficult to diagnose from the appearance of the PEG tube and vital signs of the patient. Computed tomography examination of the abdomen is effective to reveal buried bumper syndrome. But in many cases, patients live in a nursing facilities or at home. In addition, buried bumper syndrome is not uncommon and can occur soon after insertion of a PEG tube. The buried tube can be safely removed by external traction and in most cases can then be replaced with a pull-type or balloon replacement tube by expert doctor (17). It is essential that the condition be easily recognized without any instrument at nursing facilities and in the patient's home. In cases of buried bumper syndrome, IGP is assumed to be approximately 0 cm H_2O. Although buried bumper syndrome is still relatively uncommon, it may be a complication that deserves increasing attention because PEG tube replacement is expected to be used more frequently in the future (18).

Incorrect insertion of the PEG tube that may occur in case of PEG tube replacement is a common complication. This changeover complication may seriously affect the patient's nutrition, so it is important to detect it early. The frequency of incorrect insertion of the balloon gastrostomy tube is lower than that of the bumper type PEG tube. Although the balloon gastrostomy tube may be used as alternative to PEG tubes in patients on long-term enterable feeding in the community, the higher cost of using balloon gastrostomy tube over PEG tubes should be considered when selecting feeding tubes for patients in community (19). In many cases of the patient utilize bumper type PEG tube feeding. Correct replacement of PEG tube can be confirmed by Gastrografin study or endoscopic examination at the hospital. It is possible to confirm this complication by comparing IGP before and after exchange PEG tube. If the staff at the nursing facilities or patient's family measure IGP, it is possible to suspect that some problem has occurred after PEG tube replacement.

PEG proved an effective method for enteral nutrition (20), and many people have been able to return to their home (21). The appropriate training of care professionals and familiar supporters in charge of the patients carrying a PEG tube ensures its continuous functioning and reduces the risk of complications (22). A system for identifying complication more easily is important, and the measurement of IGP in PEG patients can be determined easily without the need for any special instrument.

3. Conclusion

There is a relationship between IGP and the symptoms of aspiration pneumonia. Our simple and easy technique can estimate the level of complication and can assist in the prevention of pneumonia in patients living in nursing facilities and at home. We conclude that our technique is useful in monitoring PEG patients and in preventing aspiration pneumonia and other complications related to PEG feeding. Indeed, it is not possible to prevent aspiration pneumonia in all cases, but higher IGP is one of the causes of aspiration pneumonia. We believe that this technique will prove to be an effective technique for monitoring PEG patients under a network of integrated services.

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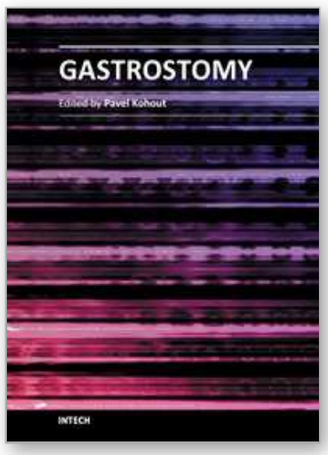

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The gastrostomy placement is a method of providing nutrition to the patients who are unable to eat. In this book you can find chapters focused on the use of gastrostomy in children, patients with neurological impairment and patients with head and neck tumours. Home enteral nutrition is suitable for all of these groups of patients and is far easier with gastrostomy. The new indications (especially in very young children) required new techniques such as: laparoscopic gastrostomy, laparoscopy assisted endoscopic gastrostomy with/without fundoplication, ultrasonography assisted gastronomy. All information about these techniques can be found in this book. This book does not serve as a basic textbook, but as an interesting reading material and as an aid for physicians who are already familiar with the indication for gastrostomy and want to know more.

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