THE NOCTURNAL INTRAGASTRIC pH IN EEG SLEEP STAGES IN PEPTIC ULCER PATIENTS

Kose SEGAWA, M.D., Chiyuki MABUCHI, M.D., Zenji SHIOZAWA, M.D. and Saburo NAKAZAWA, M.D.
Department of Internal Medicine, Nagoya University School of Medicine, 65, Tsuruma-cho, Showa-ku, Nagoya 466, Japan

Summary

In 10 peptic ulcer patients, 5 duodenal ulcer and 5 gastric ulcer patients, the relation of nocturnal intragastric pH to EEG sleep stages was examined. The nocturnal intragastric pH was monitored by pH-measuring telemeter and sleep stages were recorded simultaneously by electroencephalography throughout the night. The EEG sleep stages were classified after the criteria of Dement and Kleitman.

The average of intragastric pH level at each sleep stage was higher in gastric ulcer than the duodenal ulcer. The intragastric pH level became low as the patients' sleep advanced to deep stage. This tendency was more likely in duodenal ulcer patients than the gastric ulcer patients, which indicated that the cephalic phase might play an important role in the pathogenesis of hyperacidity in duodenal ulcer.

Key Words: gastric ulcer, sleep stage, duodenal ulcer, intragastric pH, cephalic phase of gastric secretion.

Introduction

The etiology of peptic ulcer has been discussed following the classified theory of the defensive factor and aggressive one. In the latter factor the pepsin and acid in the gastric juice play an important role. So the mechanism of controlling the gastric secretion has been reported from the various laboratories. Three types of control, cephalic phase, gastric phase and intestinal phase are known regarding the mechanisms. The elucidation of gastric phase has markedly advanced through the study of gastrin. As for intestinal phase the development is proceeding rapidly through the study of various gastrointestinal hormones extracted from the small intestine such as secretin, CCK-PZ, enterogastrone and enteroglucagon. On the other hand, regarding the cephalic phase there are many clinical evidences of intimate relationship between the peptic ulcer and the brain such as the association of peptic ulcer with stress, head injury or cerebral bleeding. Experimentally the stimulation of hypothalamus increases gastric secretion and induces gastric lesion. However further development is retarded compared with the remarkable progress of gastric or intestinal phase mainly due to the deficiency of the method.

The peptic ulcer especially the duodenal ulcer is characterized by the hypersecretion of gastric juice and nocturnal epigastric pain is one of the most prominent symptoms of duodenal ulcer. These facts may suggest that nocturnal gastric secretion plays an important role in the formation of peptic ulcer.

Since the discovery of REM sleep in EEG by Aserinsky and Kleitman the phenomena accompanying the sleep have been actively studied. The association of various autonomic
functions such as respiration, blood pressure and temperature with sleep were disclosed through these investigators\cite{4,5,6}. In addition certain diseases such as angina pectoris\cite{7} and bronchial asthma\cite{8} have become known to be associated with the sleep stages. Consequently the association of gastrointestinal function with the sleep stages is supposed and the etiology of peptic ulcer may be clarified through the investigation. The authors attempted the simultaneous record of intragastric pH and the sleep stages.

**Subjects and Methods**

Subjects were 10 hospitalized patients which included 4 gastric ulcer patients, 3 males and one female. The mean value±SEM of their ages was 42.6±4.35 years in duodenal ulcers and 51.25±1.25 in gastric ulcers. There was no statistically significant difference between the two groups. Each subject was studied in sound-proofed experimental room and was monitored during normal night time sleep with continuous recording of the EEG, eye movement, EMG and intragastric pH. EEG patterns were recorded from the frontal, parietal, occipital and temporal region of the scalp with bipolar leads placed on the orbital ridge just lateral to the outer canthus of each eye. The electrodes were held in place throughout the night with bentoin paste and collodion-imregnated absorbent cotton. The recording paper was run at the speed of 3 cm per second throughout the night.

The simultaneous change of intragastric acidity was measured continuously by the pH-telemetering radiocapsule (3.0 gr.; 25×7×7 mm-) (NEC, Tokyo Japan).

The radiosignal from the capsule was received by the belt antenna worn over the subject’s abdomen, and then recorded by the pen-recorder. In the preliminary study in vitro this telemeter measured the pH 6.9 and 1.7 without shift for 24 hours\cite{9}. Prior to the study the capsule was calibrated in standard buffer solution at pH 1.7, 4.0 and 6.9. Then the capsule was swallowed to the stomach by the patient and was fixed at the face with the silk cord. The recording paper was run at the speed of 2 cm per minute. The subject’s supper on the day of the study was 200 ml of egg soup and 200 ml of rice gruel.

This method of gastric secretory study gave less discomfort to the subject than the nasogastric tube and scarcely disturbed the normal sleep so the authors were able to know the change of intragastric pH in the physiological condition for a long time. The intragastric pH at every 10 minutes was extracted from the record and the EEG sleep stage at the same time was checked up.

The sleep stages were classified after the Dement and Kleitman’s criteria\cite{10} into awake stage (0), 1st stage, 2nd stage, 3rd stage, 4th stage and REM stage. The EEG sleep stages and intragastric pH thus obtained were compared and examined. To analyze the data present, each of pH value was converted to molal concentration by the conversion table, which had been made for the daily gastric secretory study on small volume of the juice in our laboratory, and student’s t-test was applied.

**Result**

Fig. 1 illustrated the comparison of sleep stages and intragastric pH in a case of duodenal ulcer (A.I., 42 y., female). The initial pH of 2 when awake lowered as the patient slept deeply and during the following light sleep stages and awake stage the intragastric pH remained at 3, then in advance to deep stage it fluctuated between pH 4 and 5. During the following light sleep stage the pH level rose and toward morning it became low. The same examination was undergone