EFFECTS OF EPIDURAL ANALGESIA FOR GASTRECTOMY ON BLOOD GAS IN THE GERIATRIC PATIENT

(epidural analgesia/blood gas/gastrectomy)

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The blood gas effect of epidural analgesia supplemented with a small dose of sedatives was studied in geriatric patients over 65 years old with gastrectomy. In group A, 20 patients (mean age 72.4±4.3) were given oxygen from 20 min after epidural puncture throughout the surgery, and in group B, 10 patients (71.5±4.1) were given no oxygen throughout the procedures. No significant change in blood gas was observed in either group either before or after the epidural analgesia. A small dose of sedatives, however, caused a slight fall in pH and a slight rise in $PaCO_2$. These changes are considered to be clinically of less importance, and in less than 20 min they were restored to the previous values. In connection with patient management from the aspect of respiratory care, we consider epidural analgesia to be one of the safe methods for the anesthesia of gastrectomy in elderly patients as long as a short period of inspection on the respiratory state of the patient is given after administrating a small dose of sedatives.

Since its introduction in 1885 by Corning, epidural analgesia has been extensively applied for various sorts of surgical anesthesia. As the toxicity of inhalational gas, such as nephrotoxity of methoxiflurane and hepatotoxity of halothane, has often been reported, efforts to reduce the intraoperative concentration of gases have always been made in order to avoid organ damage. Thus regional techniques have been preferred by most anesthesists. Epidural analgesia has been practically

applied for lower abdominal surgeries and limb surgeries as a main anesthetic method, especially in elderly patients. Anesthesia for gastrectomy is at present applied in the form of general anesthesia with endotracheal intubation. To add epidural analgesia to general anesthesia is of great benefit for postoperative pain relief and for prevention of pulmonary functional change. In geriatric patients reduction in visceral relaxes and muscular strength enables gastrectomy to be done with epidural analgesia without general anesthesia. On this occasion we examined blood gas changes during epidural analgesia in elderly patients beyond the age of 65 undergoing gastrectomy to ascertain the safety of epidural analgesia, while paying attention to respiration.

MATERIALS AND METHODS

Thirty patients above the age of 65 undergoing epidural analgesia for gastrectomy were studied. All patients were considered to be free from cardiovascular diseases. Informed consent was obtained from patients participating in this investigation. After an overnight fast, the patients were premedicated with hydroxyzine, 25 mg and atropine, 0.5 mg intramuscularly 60 min before the epidural analgesia. Before the epidural analgesia, a venous infusion line was obtained and the radial artery was inserted with a Teflon catheter for continuous blood pressure monitoring and blood sampling. After positioning the patient left-laterally, the T_8-T_{12} interspace was identified, and an 18 gauge Tuohy needle was inserted into the extradural space, which was identified by the hanging drop method. 6-8 ml of 2 % mepivacaine without adrenaline was injected directly through the needle. A 'Portex' catheter was then indwelt in a rostal direction to a distance of 5 cm from the tip of the needle. The needle was withdrawn and the catheter strapped in position. By this means, analgesia was induced to a level of T_2, extending to L_1, which was assessed by the pin-prick method. The patients were divided into two groups according to procedures and the time of blood sampling.

In group A, twenty patients above 65 years old (mean age 72.3 ± 4.3) were given oxygen 3 liters/min by Ohio face mask after 20 min of epidural analgesia. In group B, ten patients (71.5 ± 4.1) were given no oxygen throughout the study and were
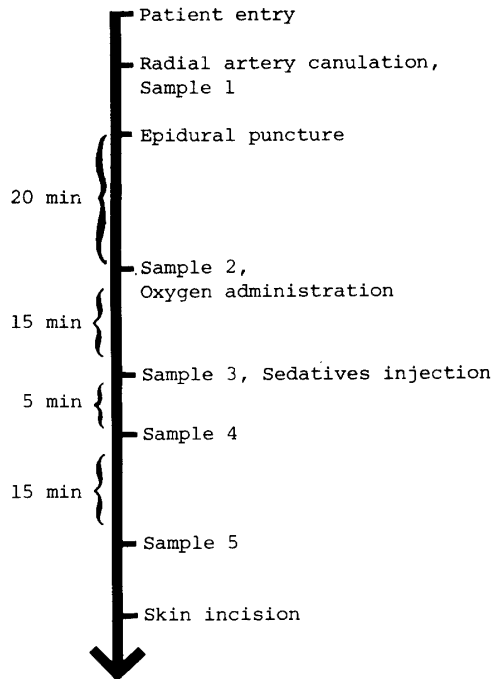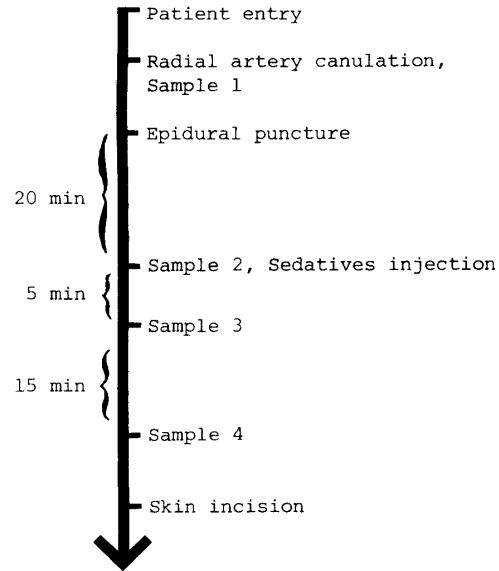
Fig.1. Procedures in group A

Fig.2. Procedures in group B

allowed to breathe in room air. In both groups, a small dose of diazepam 3-5 mg, and pentazocine, 15 mg, were administered intravenously for intraoperative sedation 35 min in group A and 20 min in group B after epidural analgesia was performed. Blood samples were obtained in group A in a sequence as follows: before the administration of epidural analgesia as a control, 20 min (just before the Oxygen administration), 35 min (before the sedatives injection), 40 min (5 min after the sedative injection), 60 min (20 min after skin incision) after the epidural analgesia. In group B, it was obtained before epidural analgesia, 20 min, 25 min, and 45 min after epidural analgesia. (Figs. 1 and 2)

Arterial blood samples were analyzed by ABL-II of the Radiometer company. A drop in blood pressure during the procedures was treated with an increase of infusion rate of Lactated Ringer solution and intravenous administration of a small dose of ephedrine (5-10 mg) so that systolic pressure would not fall under 100 mmHg.

Student t-test was used to test statistical significance. and P 0.05 was considered significant.

RESULTS

Gastrectomy in thirty elderly patients above the age of 65 was performed under epidural analgesia supplemented with a small dose of sedatives. Analgesic conditions were excellent and no patient was intraoperatively intubated and no patient needed the addition of general anesthesia. Surgical procedures were completed without any trouble.

Table I. CHANGE IN BLOOD GAS ANALYSIS IN 20 PATIENTS WHO WERE ADMINISTERED OXYGEN

	pH	$PaCO_2$(mmHg)	PaO_2(mmHg)	BE
Control	7.38 ± 0.04	38.7 ± 4.6	72.3 ± 5.5	-1.7 ± 2.6
20 min after epidural anal.	7.39 ± 0.04	38.4 ± 4.5	74.0 ± 6.0	-1.7 ± 2.1
15 min after Oxygen admini.	7.38 ± 0.03	39.7 ± 3.6	158.4 ± 40.4*	-2.0 ± 2.0
5 min after sedatives inject.	7.34 ± 0.04*	43.7 ± 6.2*	161.4 ± 46.0*	-2.5 ± 2.1*
20 min after sedatives inject.	7.36 ± 0.04	40.8 ± 3.9	147.7 ± 32.3*	-2.5 ± 2.3

Values represent means ± standard errors of means.   n=20 (mean age 72.3 ± 4)
*Significantly different from control (P<0.05).

The results of arterial blood gas analysis are shown in Tables I and II. In group A, 20 patients were administered oxygen by face mask from 20 min after the epidural analgesia throughout the procedures. The epidural analgesia minimally influenced the result of blood gas analysis. No significant change in pH, PaO_2, $PaCO_2$, and Base excess was observed. By Oxygen administration, PaO_2 rose from 74.0 to 158.4 mmHg in accordance with inspired concentration of oxygen. Pentazocine and diazepam, administered for intraoperative sedation, induced a slight change in arterial blood gas from the samples obtained 5 min after the intravenous injection. $PaCO_2$ rose from 39.7 ± 3.6 to 43.7 ± 6.2 mmHg, and pH fell from 7.39 ± 0.03 to 7.34 ± 0.04. These changes are statistically significant. PaO_2 and Base excess did not change. These changes, however, returned to the pre-administration level 20 min after the injection.

Table II. CHANGES IN BLOOD GAS ANALYSIS IN 10 PATIENTS WHO WERE NOT GIVEN OXYGEN

	pH	$PaCO_2$ (mmHg)	PaO_2 (mmHg)	BE
Control	7.38 ± 0.03	37.4 ± 4.3	75.2 ± 6.4	-2.4 ± 2.6
20 min after epidural anal.	7.39 ± 0.04	38.0 ± 4.8	77.0 ± 6.3	-2.2 ± 2.1
5 min after sedatives inject.	7.36 ± 0.04*	42.1 ± 5.8*	72.0 ± 8.1	-2.1 ± 2.1
20 min after sedatives inject.	7.37 ± 0.04	42.0 ± 4.1*	74.2 ± 5.4	-2.3 ± 2.4

Values represent means ± standard errors of means.   n=10 (mean age 71.5 ± 4)
*Significantly different from control ($P < 0.05$).

The same tendencies were observed in group B, in which no patient was administered oxygen throughout the surgeries. The effects of the epidural analgesia on the blood gas analysis were considered to be minimal. No significant change compared with the control values were seen in pH, PaO_2, $PaCO_2$ and Base excess. 5 min after the sedatives administration, pH and PaO_2 decreased and $PaCO_2$ increased. These changes tended to revert to the previous level in 20 min.

DISCUSSION

Clinical applications of regional block (nerve block, spinal analgesia, and epidural analgesia) to surgical anesthesia have been extended as a supplement of general anesthesia especially since the hepatotoxity of halothane came to be suspected. Some surgeries in the thoracic and abdominal area had been carried out only under general anesthesia, but these have been increasingly assisted or sometimes replaced by regional technique.

In upper abdominal surgeries, spinal block, which completely blocks the whole thoracic spine, may cause extreme lowering of blood pressure and paralyze intercostal muscles, and thereby respiratory impairment may ensue. Immobilization of intercostal muscles by motor blockade is compensated for by exaggerated flapping up and down of the diaphragma, which interferes with intraabdominal manipulations.

On the other hand, epidural analgesia even where the block reaches the first thoracic segment does not completely affect respiratory motor neural outputs and its respiratory depression is thought to be unexpectedly minimal at tranquil breathing (1). Besides, extradural blockade up to the first thoracic segment may attenuate the phrenic reflex (from stimulation on the central portion of the diaphragma), and expiratory responses to noxious stimulation are reduced (2). Therefore epidural analgesia has been growing popular in mastectomy and some upper abdominal surgeries, e.g. cholecystectomy.

Upper abdominal surgeries especially in elderly patients are reported to have an increased chance to invite pulmonary complications postoperatively, and a cautious postoperative respiratory care is specially important.

Aging itself gives rise to alterations in the respiratory system though these are not pathological (3). Structurally, elastic recoil of lung tissues is lost, an anteroposteior diameter of the thorax increases due to the degenerative changes of rids and thoracic vertebrae and total muscle strength including the ventilatory weakens. Based on these changes residual volume, compliance and closing capacity increase their values. As a result, arterial oxygen tension (PaO_2) declines progressively with age to such a degree that an average PaO_2 in the seventies is 75 mmHg.

General anesthesia with endotracheal intubation and controlled ventilation affects respiratory function intra- as well as postoperatively. Spontaneous ventilation which is always the case with epidural analgesia, on the other hand, is of greater benefit for gas exchange from intrapulmonary gas distribution than mechanical control (1,4).

We have used epidural analgesia since 1966 for various sorts of surgeries. In geriatric patients who present weakened muscle strength and reflexes (vagal relex) 1.5 to 2.0 % of local anesthetics can sufficiently induce relaxation of abdominal musclature, and we have realized that epidural analgesia alone, even without being assisted by general anesthesia, enables upper abdominal surgeries to be undergone. In addition, it is demonstrated that the incidence of postoperative mental deterioration in elderly patients operated under epidural analgesia is lower than in general anesthesia (5).

Epidural analgesia by cervical approach which is attempted

in order to differentiate between C_4 and T_{10} may influence
respiratory function to a considerable degree. According to
Takasaki PaO_2 decreases by 9 % and $PaCO_2$ increases by 3 % though
these changes are judged to be of less importance clinically (6).

In the case of thoracic epidural analgesia whose paralytic
levels range from T_2 to T_{12}/L_1 no significant alteration in PaO_2
and $A-aDO_2$ has been observed (7,8). Systemic effect of local
anesthetics absorbed from extradural space is reportedly minimal
in connection with the depression of the respiratory center(9).
Diazepam and pentazocine, which we usually use for the purpose of
intraoperative sedation, are another hazard relating to
respiratory depression. Diazepam reduces the minute volume by 20
to 30 % and thereby induces CO_2 retension and hypoxemia though it
persists transiently after intravenous administration (10-12).
Pentazocine is also a respiratory depressant half as potent as
morphine (13). Diazepam and pentazocine for intraoperative
sedation must be administered with great caution especially in
elderly patients.

The present study was an attempt to examine the safety of
epidural analgesia for gastrectomy in elderly patients from the
aspect of intraoperative changes in arterial blood gas. Epidural
analgesia alone did not influence the values of blood gas
analysis and therefore respiratory capability when patients are
breathing at rest. Blood pressure change should be controlled
minimally on this occassion by keeping the lower limbs free from
sympathetic blockade. Supplemented sedatives, however, did induce
respiratory depression which was scarcely prolonged beyond 15
minutes and returned to the pre-administration state. The
present study revealed that it is a safe method to take epidural
analgesia as surgical anesthesia for gastrectomy of elderly
patients and that no oxygen administration is necessary provided
cautious attention is paid to the respiratory state for a short
period after administration of sedatives.

General anesthesia with intubation and mechanical
ventilation, which is usually used for upper abdominal surgeries
in elderly patients, may predispose to postoperative pulmonary
complications (14). Endotracheal intubation may damage
respiratory mucosa and ciliary function and inhalational agents
may induce postoperative hypoventilation followed by airspace
collapse and absorption atelectasis. On the other hand, epidural
analgesia for upper abdominal surgeries can relieve postoperative

hypoxemia (15), even though for a short period, by easing the postoperative pain and thereby may contribute to lessening the incidence of postoperative pulmonary complications. However, overall incidence of postoperative pulmonary complications is not influenced by anesthetic technique, for many factors other than anesthesia are related to their occurrence.

Even with these advantages of epidural analgesia, not all gastrectomies of elderly patients can be performed under this technique. It may depend on the technical capabilities of surgeons who understand and co-operate with this method. Not only an excessive dose of sedatives but also an incautious supplementation of intravenous anesthetic such as barbiturates just to deprive the patient of consciousness would probably invite serious results. Regurgitation of gastric contents and ensued aspiration pneumonia is a potentional danger if the patient's consciousness is completely lost. Patients should rather be intubated without hesitation in cases where the loss of the patient's consciousness is judged to be really necessary. Even where intraoperative intubation is unavoidably performed, the advantages of epidural analgesia still remain when anesthesia is maintained with light general anesthesia.

Epidural analgesia supplemented with a small dose of sedatives is judged to be one of the safe methods for surgical anesthesia of gastrectomy in geriatric patients.

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