

## **Clinical Evaluation on Acoustic Respiration Rate (RRa™) in PACU Compared With the Conventional Monitoring System**

Tomoko Fukada, M.D., Yuko Uenaka, R.N., Yuri Tsuchiya, M.D., Hiroko Iwakiri, M.D., Minoru Nomura, M.D., Makoto Ozaki, M.D. Tokyo Women's Medical University, School of Medicine, Tokyo, Japan. *Proceeding of the Society for Technology in Anesthesia Annual Meeting*, 2013: A1180.

### **Introduction**

Residual effects of anesthetics and neuromuscular blockade contribute to adverse respiratory events. Patient-controlled analgesia, an effective method for postoperative pain management, is associated with opioid-induced respiratory depression. Thus, the respiration rate should be accurately monitored in the post-anesthesia care unit (PACU) to detect respiratory depression immediately. This study aimed to determine the most accurate and noninvasive method to measure the spontaneous respiration rate of postoperative patients using acoustic respiration rate (RRa™; Masimo Corp.), capnometry with Cap-One mainstream capnometer system (CAP; Nihon Kohden Corp.), and thoracic impedance pneumography (IMP; Nihon Kohden Corp.) and compare them with visual 1-min chest movement inspection.

### **Methods**

After the institutional review board approval, and written informed consent, 110 patients  $\geq 20$  years old were enrolled in this study. Patients with surgery involving the neck, face, or entire chest were excluded because the sensor could not be placed.

Immediately after admission to PACU, patients' respiration rate was measured every 3 or 5 min by RRa™, CAP, IMP, and visual 1-min chest movement inspection during 3-5 L/min oxygen administration through a face mask. Results were presented as mean (SD).

### **Results**

Data were obtained from 103 patients (M/F 48/55) whose mean age was 62 (15) years, and body mass index was 23 (4) kg/m<sup>2</sup>, and who did not experience apnea or arterial desaturation. There was a small difference and almost perfect correlation between results of RRa and visual chest movement inspection, even in obese patients. Moreover, there was a substantial correlation between these in patients with respiration rates  $\leq 10$  per minute (Table).

### **Discussion and Conclusion**

To detect respiratory depression (i.e., apnea, bradypnea, or airway obstruction) during the postoperative period, both respiration rate and pulse oximetry should be measured. However, supplemental oxygen administered to most patients during this period may mask hypoventilation, and pulse oximetry detects respiratory depression very late.

In this study, 3 methods of respiration rate monitoring were compared with visual chest movement inspection in PACU. Continuous respiration rate assessments with RRa™ correlated well with visual inspection, even for obese patients and patients with respiration rate  $\leq 10$  per minute.

CAP measurements also showed good correlation with visual chest movement inspection, but the equipment was often removed by some patients because of displeasure or an inserted gastric tube. IMP measurements were inaccurate because of electrode positioning and patient movement and shivering. Therefore, RRa™ was the most accurate and noninvasive method to monitor respiration rate for detecting apnea, bradypnea, and airway obstruction.

**Table. Comparison of respiration rate monitoring systems**

Patient data (n=1269)	RRa	CAP	IMP
mean difference	- 0.2	- 1.8	0.9
95 % limits of agreement	- 0.3 ~ - 0.1	- 2.0 ~ - 1.6	0.7 ~ 1.1
correlation coefficient	0.89	0.8	0.74
Obese patient data (n=319)	RRa	CAP	IMP
mean difference	0.2	-1.4	1
95 % limits of agreement	0 ~ 0.5	- 1.7 ~ - 1.1	0.7 ~ 1.3
correlation coefficient	0.92	0.87	0.83
Patient with respiration rate ≤10 per minute (n=195)	RRa	CAP	IMP
mean difference	0.2	- 1.2	1.8
95 % limits of agreement	0 ~ 0.4	- 1.6 ~ - 0.8	1.3 ~ 2.2
correlation coefficient	0.64	0.38	0.19

Figure 1