A marked decrease in heart rate variability associated with junctional rhythm during anesthesia with sevoflurane and fentanyl

Y. FUIWARA, Y. ASAKURA, Y. SHIBATA, K. NISHIYAMA, and T. KOMATSU
Departments of Anesthesiology, Aichi Medical University, Nagakute Aichi and Nagoya University, Graduate School of Medicine, Nagoya, Japan

Heart rate variability (HRV) was investigated using a new technique for time series analysis combining the maximum entropy method and non-linear least squares method—the ‘MemCalc method’—in patients undergoing general anesthesia with sevoflurane and fentanyl for elective surgery. As the occurrence of junctional rhythm coincided with the measurement of these variables in two patients, we successfully evaluated the entropy, low (LF) and high (HF) frequency component of the HRV during junctional rhythm and found that the occurrence of junctional rhythm is associated with marked decreases in the entropy, LF and HF of HRV. When evaluating autonomic control of the heart using HRV analysis, the decrease in HRV caused by the occurrence of junctional rhythm must be taken into account.

Accepted for publication 11 November 2005

Key words: junctional rhythm; entropy; heart rate variability.

Case reports

Two women (aged 44 or 62 years) were scheduled to have gynecologic elective surgery under general anesthesia. No premedication was given. After routine monitoring was initiated, anesthesia was induced with a target-controlled infusion of propofol (3 μg/ml, total dose 85 or 98 mg), 100 μg fentanyl and 0.15 mg/kg vecuronium bromide. After endotracheal intubation, their lungs were ventilated with 50% oxygen in air. Thereafter, anesthesia was maintained with sevoflurane (1.0–1.5%) and supplemental fentanyl. Fifteen or 20 min after tracheal intubation, they developed junctional rhythm during the inhalation of sevoflurane while HRV was measured in order to evaluate the autonomic nervous activity for another study, which had been approved by our institutional review board.

The ECG signal was obtained from a conventional anesthesia monitor (Model 66S; Hewlett Packard Palo Alto, CA, USA), digitized at 1000 Hz and transferred to a personal computer (Epson NT2700; Epson, Suwa, Japan). After the RR intervals were determined, on-line analysis of the HRV was made using the MemCalc method (Tarawa, Suwa Trust, Japan).
Japan). Then the averaged HR, the entropy of eight RR intervals, the power of low (LF; 0.04–0.15 Hz) and high (HF; 0.15–0.4 Hz) frequency components of HRV during normal sinus and junctional rhythm were calculated.

A representative fine tracing of RR intervals during sinus and junctional rhythm is shown in Fig. 1, respectively. In contrast to remarkable fluctuation of heart rate during sinus rhythm, fluctuation of heart rate is markedly decreased during junctional rhythm.

The trends of HR, the entropy, LF and HF of HRV from each patient are shown in Fig. 2. The occurrence of junctional rhythm suddenly decreased entropy, LF and HF near to zero (left). Junctional rhythm spontaneously reverted to sinus rhythm in each patient.

**Discussion**

Junctional rhythm is common in patients under anesthesia especially with halogenated anesthetic agents. Although it may result in decreased blood pressure or cardiac output especially in patients with heart disease, it is usually regarded as a benign arrhythmia. Although cells in the atrioventricular (AV) node do not act as pacemakers in normal sinus rhythm, ectopic activity may be generated in the atrioventricular junction in some cases and predominate the heart rhythm when the sinus node activity is suppressed. The administration of fentanyl might have contributed to the development of junctional rhythm in these patients.

In this report, we have found that the occurrence of junctional rhythm is associated with marked decreases in the entropy of HR, and the LF and HF of HRV. As shown in Fig. 2, the appearance and disappearance of junctional rhythm were followed by swift changes in HRV variables.

Surprisingly, this is the first report investigating HRV during junctional rhythm in humans. Usually this arrhythmia is transient and reverts spontaneously. As conventional methods of estimating HRV need a series of RR intervals for 5 min or more, it might be difficult to estimate HRV during junctional rhythm.
rhythm using these conventional methods. So we believe that the MemCalc method, which needs only 30 s for estimation of HRV and eight RR intervals for that of entropy, greatly contributed to the successful measurement of HRV during junctional rhythm.

In addition, many previous studies have evaluated the autonomic nervous activity by means of HRV. We suggest that one has to keep in mind the possibility that the calculation of HRV could be influenced by the occurrence of junctional rhythm.

In conclusion, the entropy and power of HRV was markedly decreased during junctional rhythms in patients anesthetized with sevoflurane, propofol and fentanyl. When evaluating autonomic control of the heart using HRV analysis, the decrease in HRV caused by the occurrence of junctional rhythm must be taken into account.

Acknowledgements

Support was provided solely from institutional and departmental sources.

References


Address:
Yoshihiro Fujiwara
Department of Anesthesiology
Aichi Medical University
21 Yazako Nagakute Aichi 480-1195
Japan
e-mail: yyoshiff@aichi-med-u.ac.jp