A NEW SEGMENTATION ALGORITHM FOR DETECTING SYNCHRONIZED SYMPATHETIC NERVE ACTIVITY

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INTRODUCTION

Compound action potentials (CAP) recorded from multifiber nerve preparations show grouped burst discharges, which are defined as synchronized sympathetic nerve activity (SSNA). The SSNA signal is detected by using analog techniques. The recorded CAP is rectified and integrated, and then the peaks and pre- and postpeak nadirs of the integrated CAP are detected by a computerized peak detection algorithm (Cluster analysis) [1]. The integrated CAP between pre- and postpeak nadirs is defined as the SSNA and a duration of pre- and postpeak nadirs is defined as width of SSNA. However the width varied significantly due to technical limitations.

This study therefore presents a new segmentation algorithm to detect the width of individual SSNA from the recorded CAP by employing a Chi square test [2] and cluster analysis.

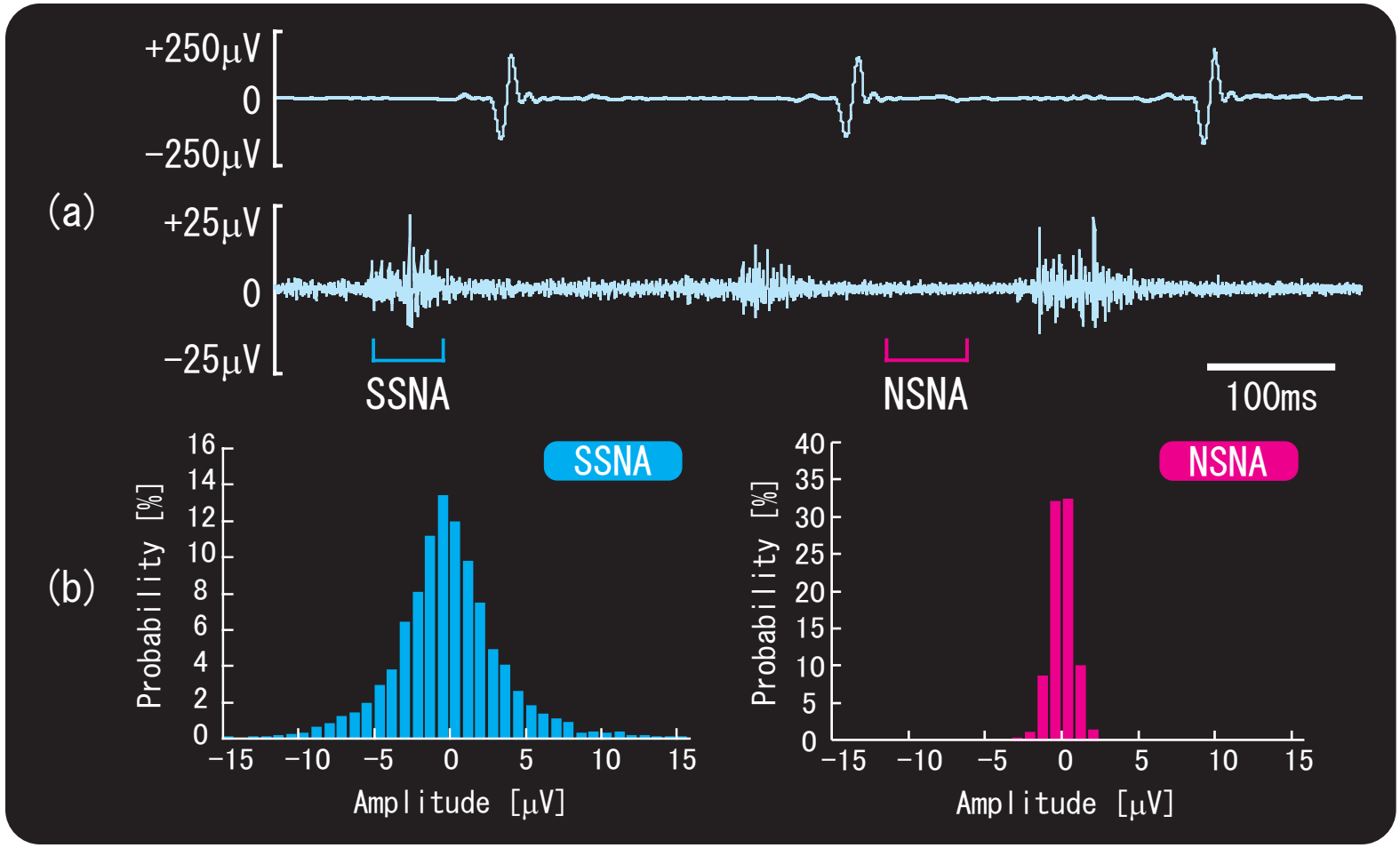

Fig.1 (a) The recorded ECG and original RNA from one cat under control condition. (b) The amplitude histograms calculated in each part of the large and small amplitude signals as shown in (a). The large amplitude signals have large variances, whereas the small amplitude signals have the small variances.

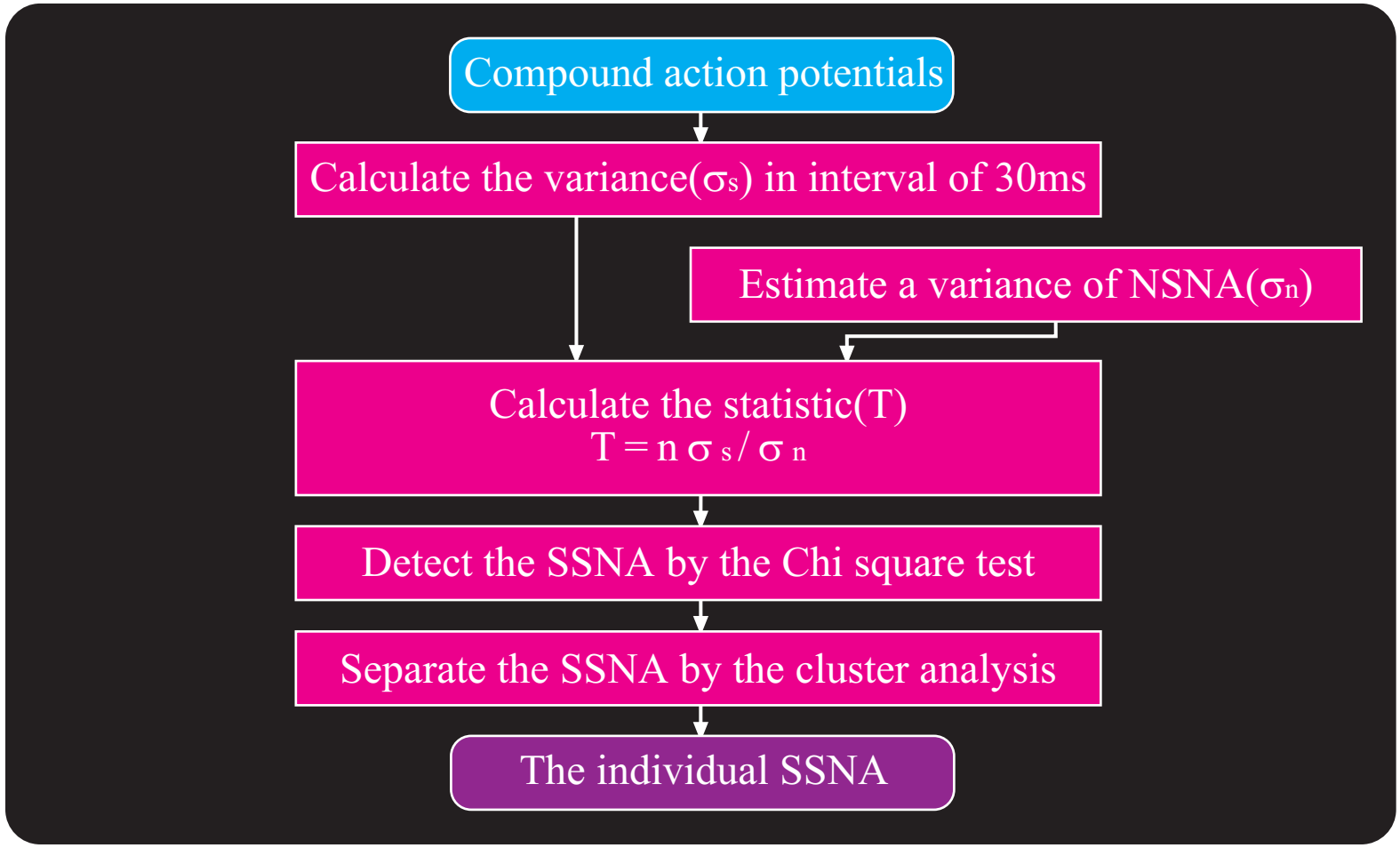

Fig.2 Computerized segmentation algorithm of synchronized sympathetic nerve activity. The algorithm consist of two signal processing techniques which involve : (1) detecting the SSNA by the Chi square test and (2) separating a individual SSNA by the cluster analysis.

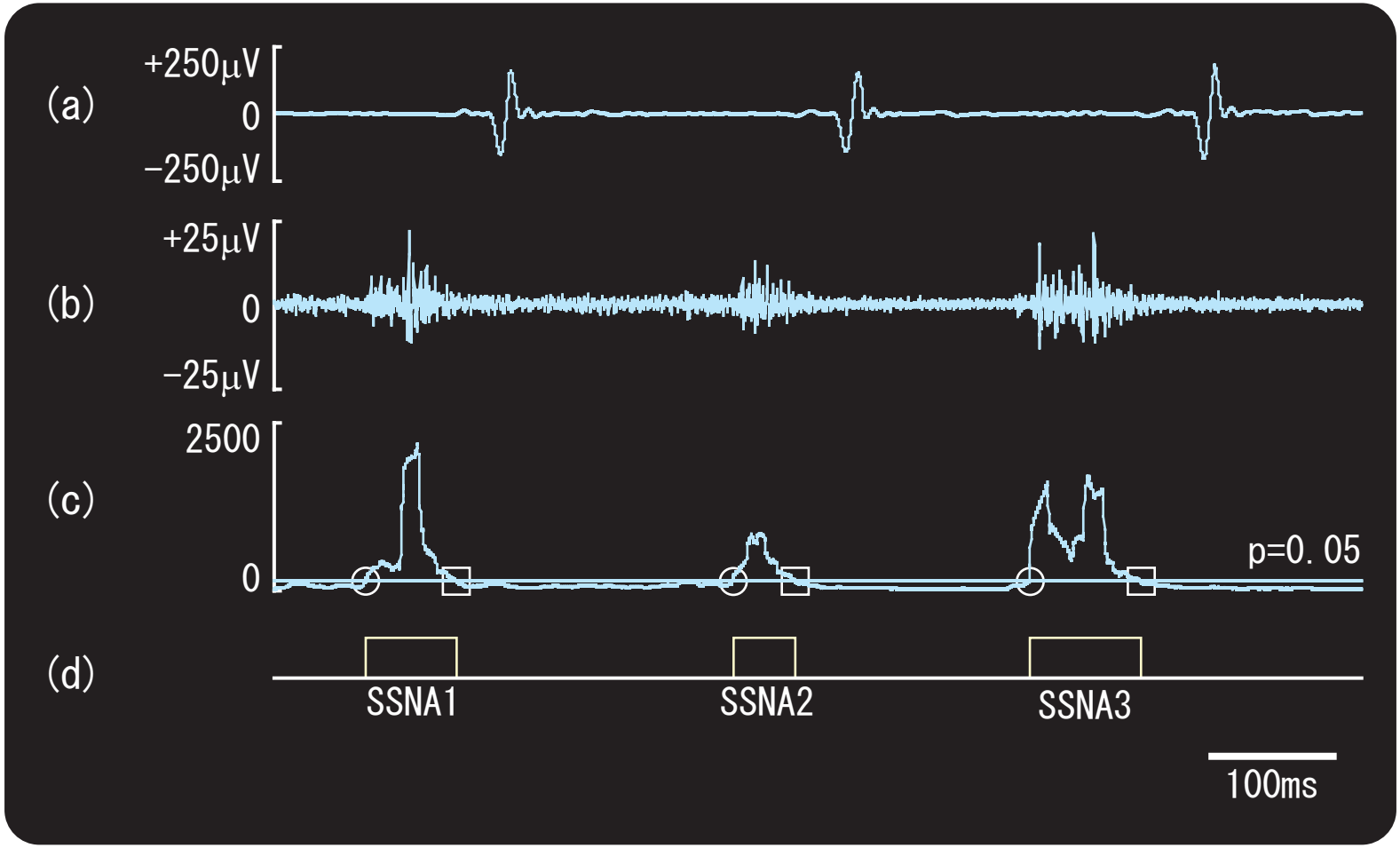

Fig. 3 Representation of segmenting the SSNA detected from anesthetized cat. (a) ECG. (b)Original CAP. (c) Statistic of the CAP. The onsets (open circles) and ends (open squares) are detected by the Chi square test. (d) Each of SSNA1, SSNA2 and SSNA3 widths is defined as between onset and end positions.

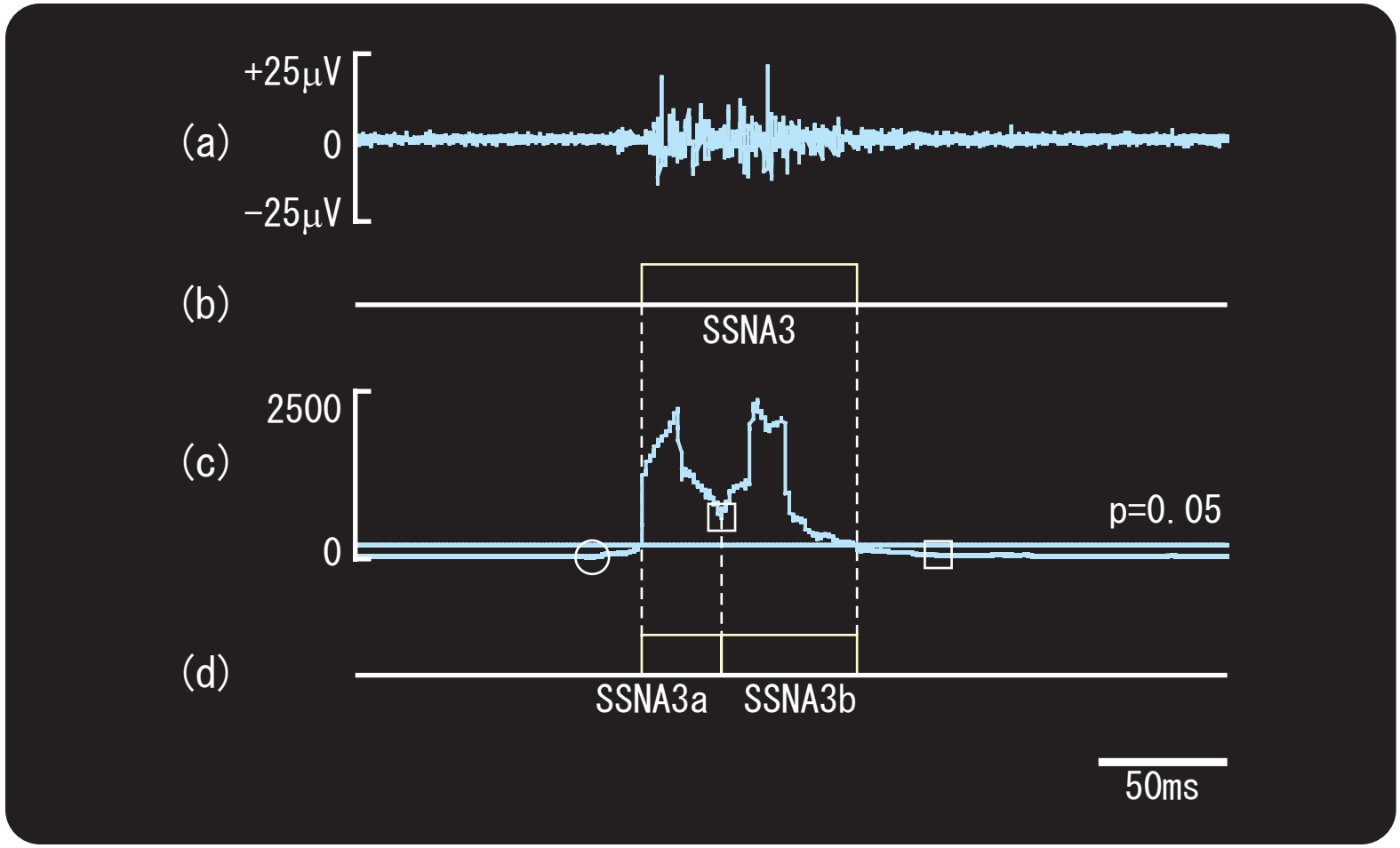

Fig.4 Separation of individual SSNA from the detected SSNA3. (a) Original CAP. (b) Detected SSNA3 by a Chi square test. (c) Statistic of the CAP. The two peaks indicate that the SSNA3 consists of two SSNA. The approximate interval of individual SSNA is defined as between prepeak nadir and postpeak nadir detected by the Cluster analysis. (d) The SSNA3a and SSNA3b detected by the Cluster analysis and Chi square test.

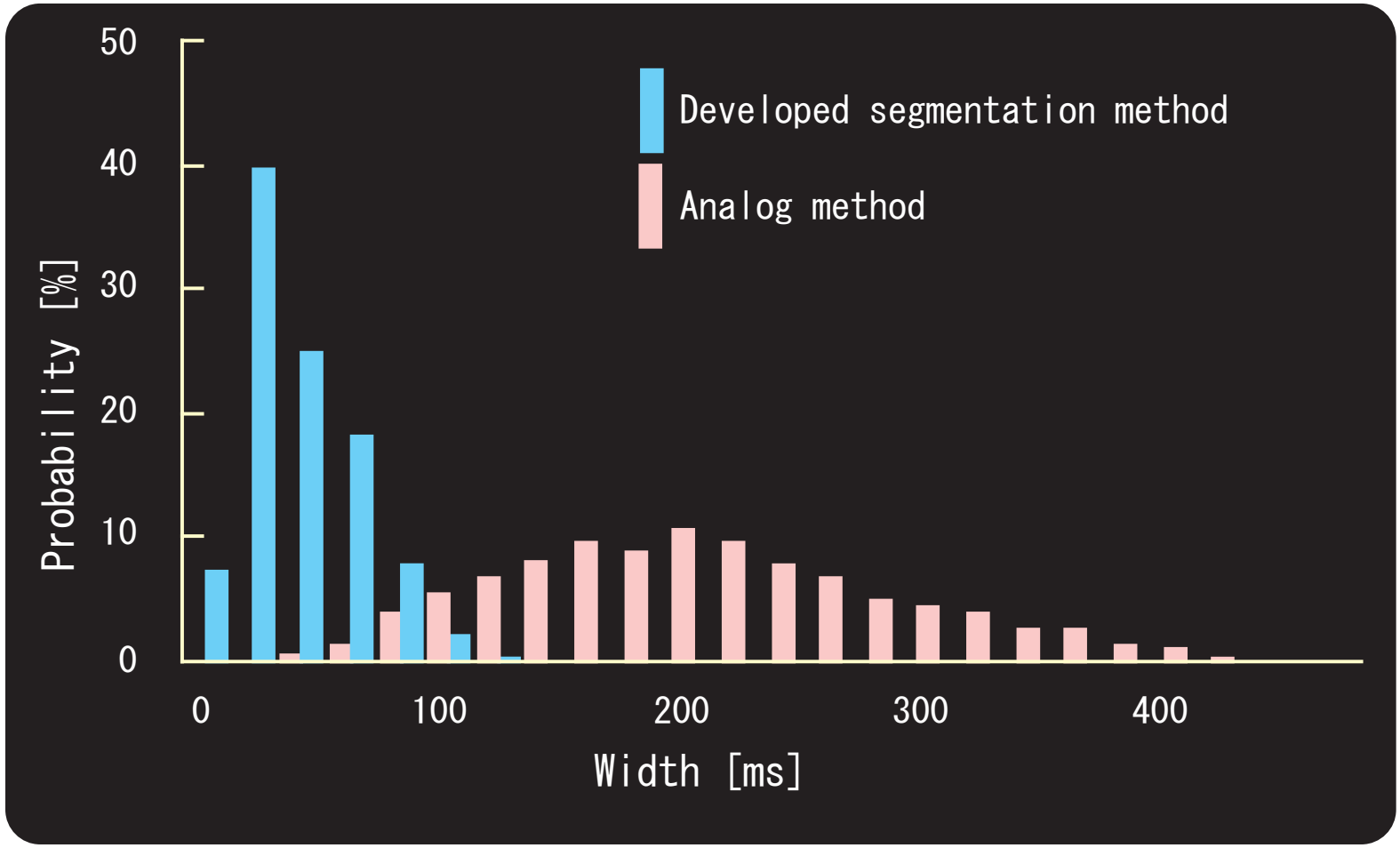

Fig.5 Frequency histogram of width detected by two methods. The widths ranging from 10 to 120 ms detected by the new segmentation algorithm were significantly smaller than that detected by previous method ranging from 50 to 450 ms. Therefore, the developed segmentation algorithm can accurately the width reflecting change in the conduction times of individual active fibers.

CONCLUSION

The SNA recorded from the multifiber preparation is a continuously fluctuating variable in terms of period, amplitude and width, reflecting a coordinated tonic level of output from the vasomotor center. Therefore analysis of those variables found in discharges of sympathetic nerve is essential for understanding the central organization of the autonomic nervous system. However current computerized algorithm of SSNA detection can not precisely detect these variables. The developed computerized algorithm can detect the onset and end of SSNA automatically and accurately detect the width. This algorithm could be applied to many types of sympathetic nerves that exhibit synchronized discharges.

REFERENCES

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