A STATISTICALLY BASED COMPUTERIZED DETECTION ALGORITHM OF SYNCHRONIZED SYMPATHETIC NERVE ACTIVITY

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INTRODUCTION

Sympathetic nerve activity(SNA) recorded in a multifiber nerve preparation shows a grouped burst discharges, which is defined as synchronized SNA. The synchronized SNA signal is detected by using analog techniques. The recorded SNA is rectified and integrated, and then the peaks and pre- and postpeak nadirs of the integrated SNA are detected by a computerized peak detection algorithm(Cluster program)[1]. The occurrence of a peak in integrated SNA is defined as a significant increase followed by a significant decrease with a nadir on each side. The Cluster program requires a threshold of the minimum value to be classified as a peak. However the recorded SNA often contains nonsynchronized SNA and noise consisting of ECG and base-line drift due to spontaneous movement of the body. Therefore it is difficult to decide the threshold from SNA recorded with a poor signal-to-noise ratio and detected the synchronized SNA automatically. This study therefore presents a new algorithm of synchronized SNA detection.

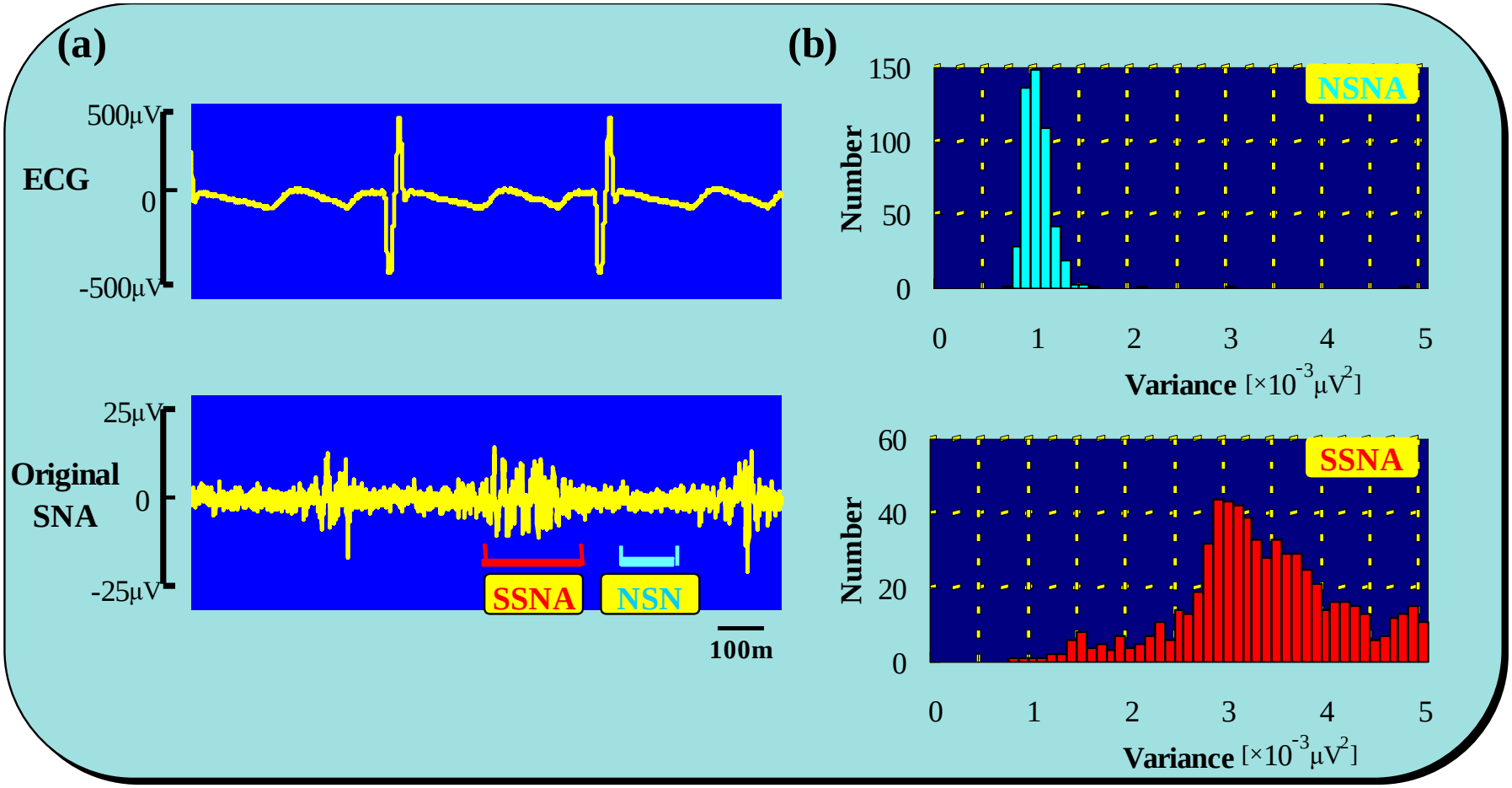

Fig. 1 (a) The recorded ECG and original SNA from one cat under control condition. (b) The variance calculated in each part of the large and small amplitude signals as shown in (a). The large amplitude signals have large variances, where as the small amplitude signals have the small variances.

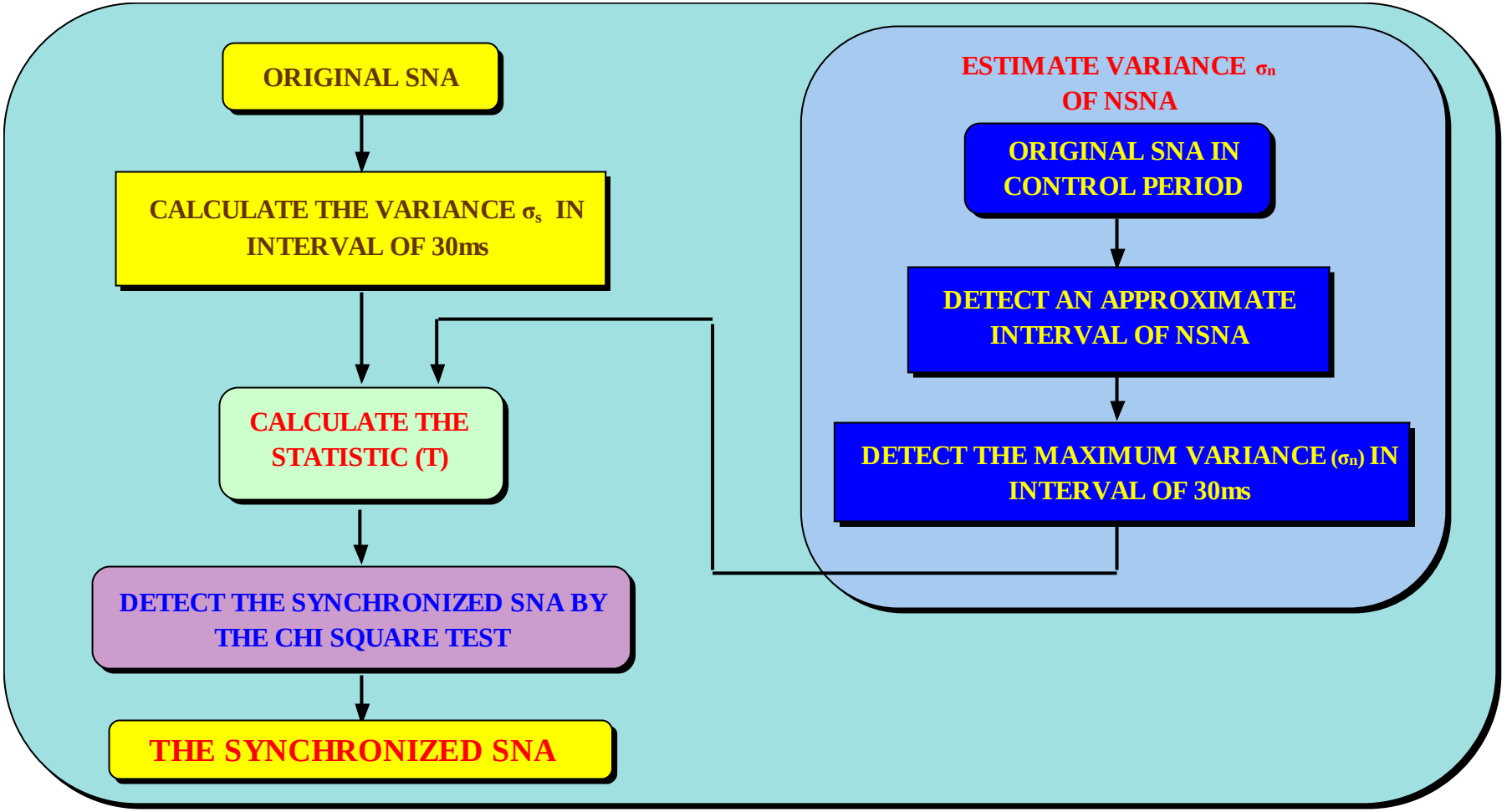

Fig. 2 Statistically based computerized detection algorithm of synchronized SNA. The algorithm consists of three signal processing techniques which involve : (1) extracting the approximate interval of nonsynchronized SNA including noise, (2) estimating a variance in the extracted interval and (3) detecting the synchronized SNA by a Chi square test. Therefore the computerized algorithm can detect accurately synchronized SNA automatically.

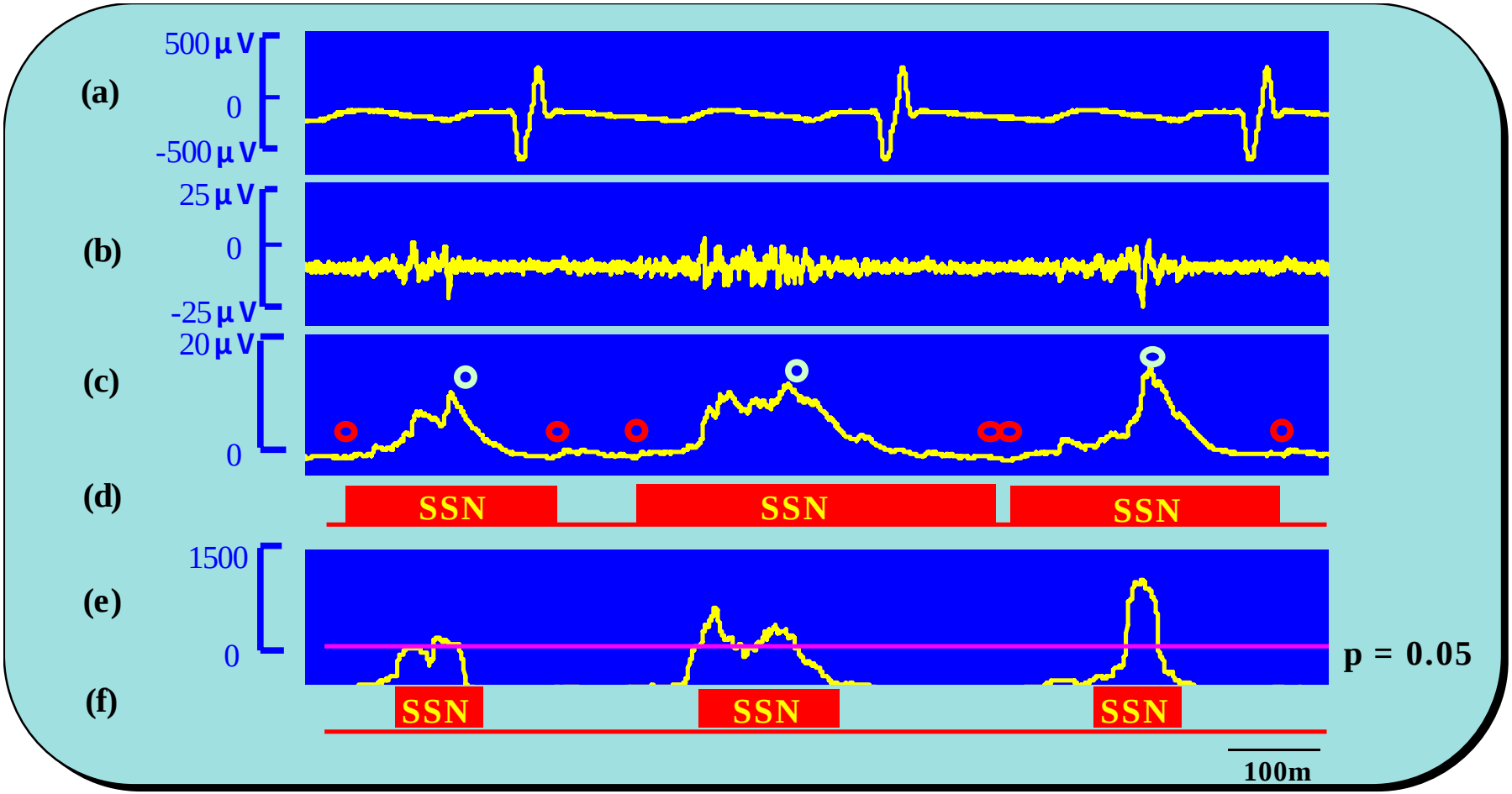

Fig. 3 An example of synchronized SNA detected from the original SNA in anesthetized cats. (a) ECG, (b) Original SNA, (c) Integrated SNA, (d) Synchronized SNA (SSNA) detected by previous Cluster method, (e) the statistics calculated in interval of 30ms sequentially, (f) SSNA detected by a Chi square test. The detected widths of synchronized SNA were agree approximately with the widths of large amplitude SNA.

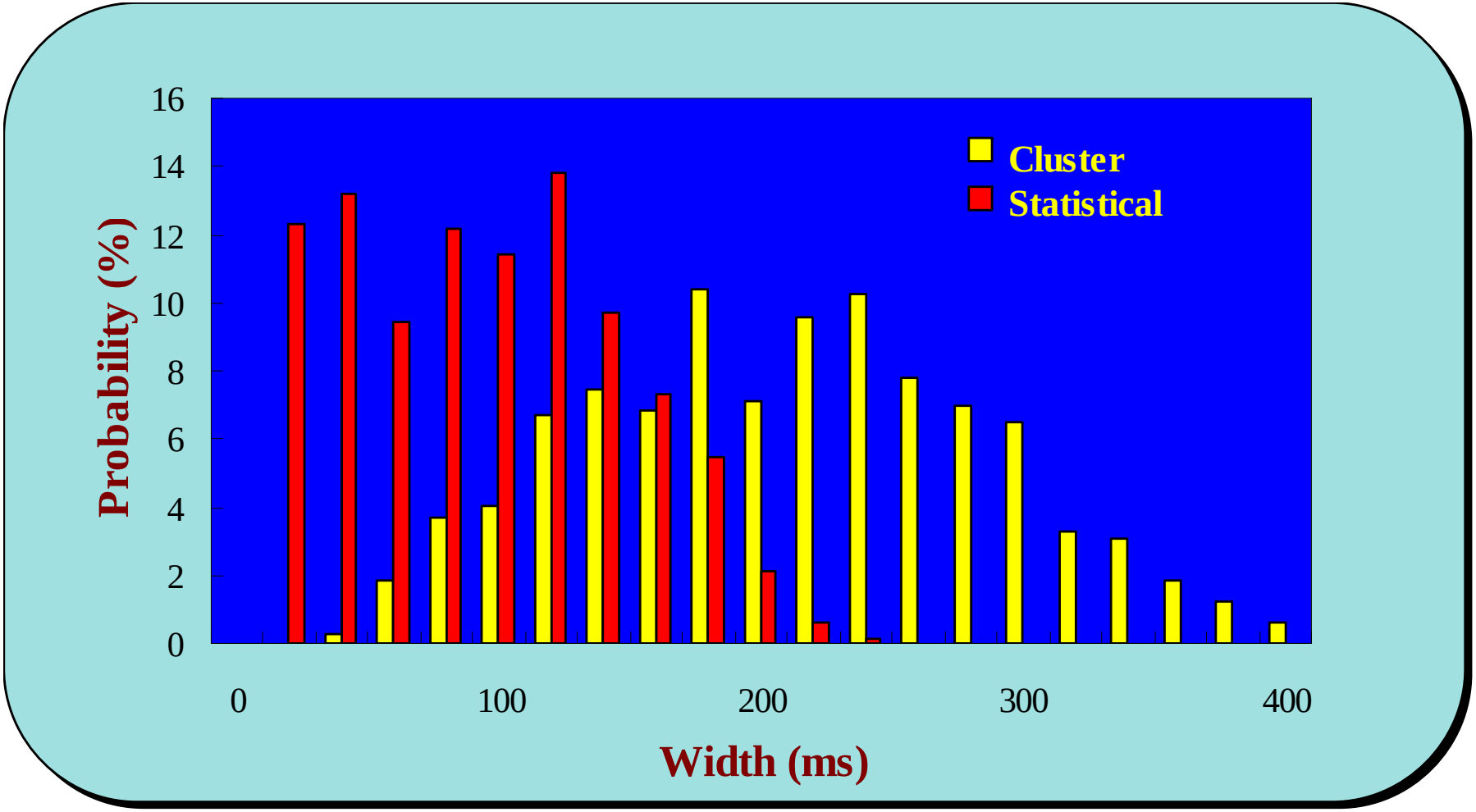

Fig. 4 Comparison of frequency histogram of widths detected by two methods. The widths measured by the statistically based detection algorithm ranging from 20 to 240 ms were significantly smaller than that measured by previous cluster method ranging from 60 to 400 ms. Therefore the developed statistically computerized detection algorithm can accurately detect the width reflecting changes in the conduction times of 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 these variables found in discharges of sympathetic nerve is essential for understanding the central organization of the autonomic nervous system. However current computerized algorithm of synchronized SNA detection can not precisely detect these variables. The developed computerized algorithm can detect the onset and end of synchronized SNA automatically and accurately detect the width. This algorithm could be applied to many types of sympathetic nerves that exhibit synchronized discharges.

REFERENCES

[1] S.C.Malpas and I. Ninomiya. "A new approach to analysis of synchronized sympathetic nerve activity," Am. J. Physiol., 263, pp.H1311-H1317, 1992.