A NEURAL SPIKE DETECTION METHOD OF SYMPATHETIC NERVE ACTIVITY

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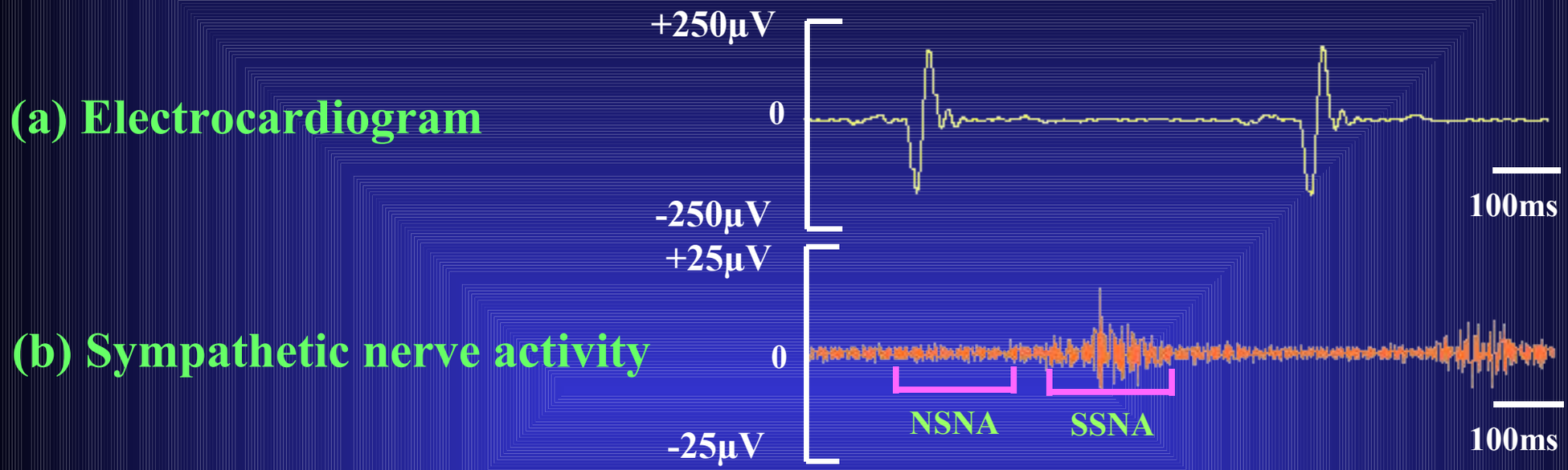
INTRODUCTION

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 methods of analysis can not precisely detect these variables, especially at width.

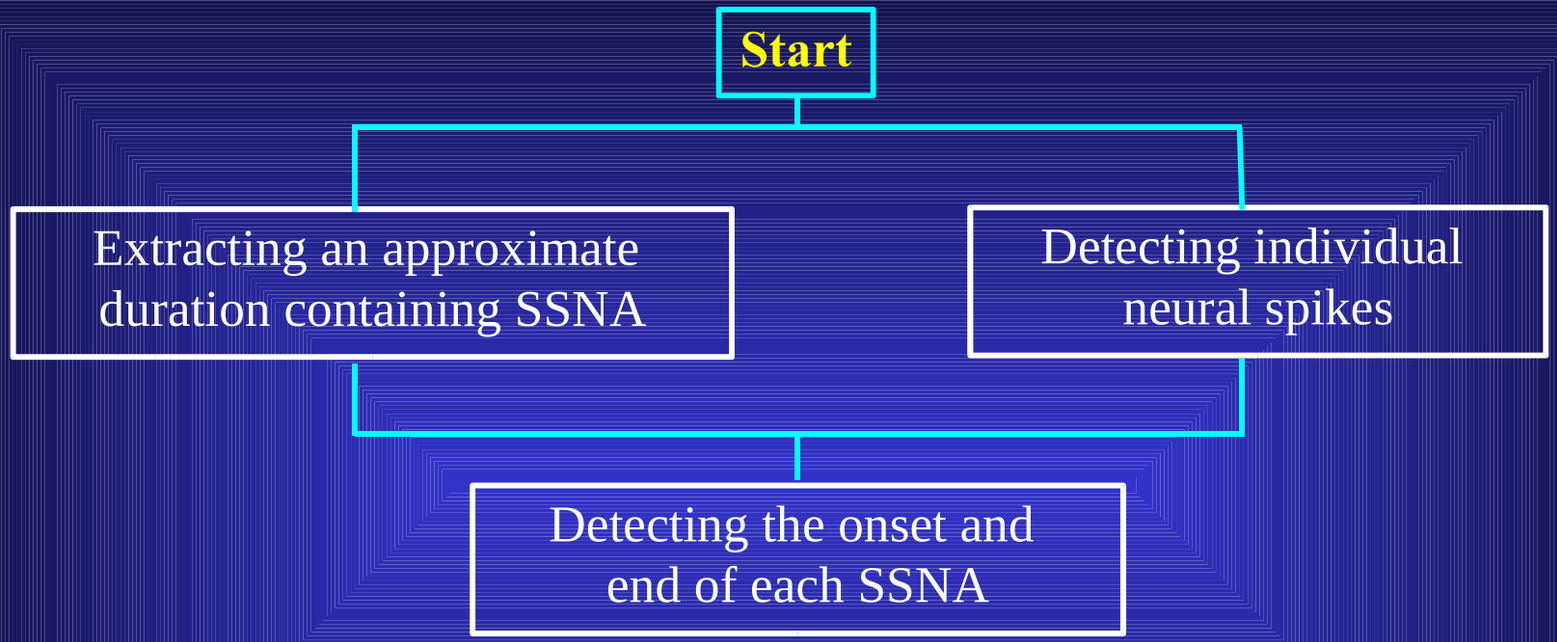
Electrocardiogram and sympathetic nerve activity



Sympathetic nerve activity (SNA) recorded in multifiber nerve preparation shows a grouped burst discharges, which is defined as synchronized sympathetic nerve activity (SSNA). On the other hand, the small amplitude signals in the neighborhood of the baseline are regarded as either small nonsynchronized neural discharges or noise, which are defined as nonsynchronized sympathetic nerve activity (NSNA).

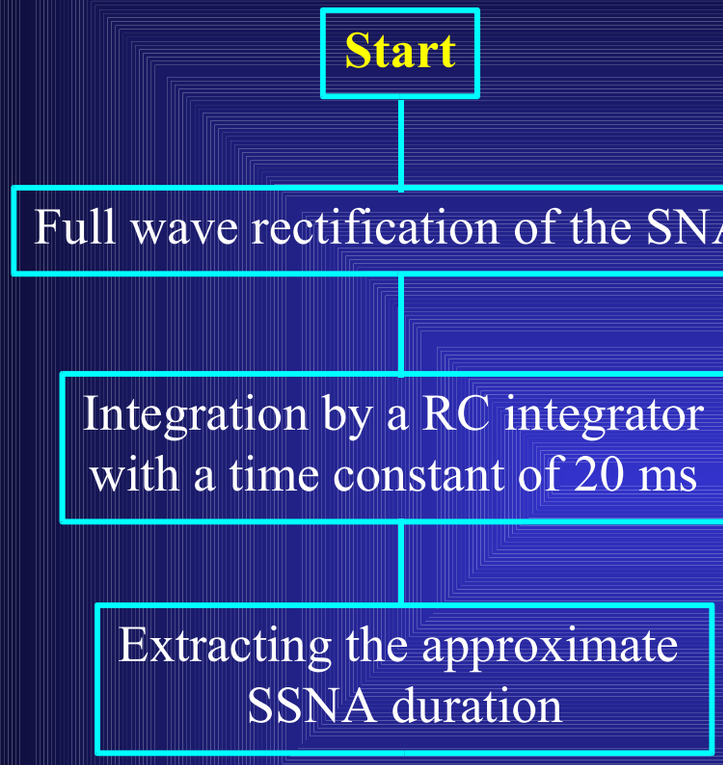
This study presents a new neural spike detection method for precise SSNA width detection.

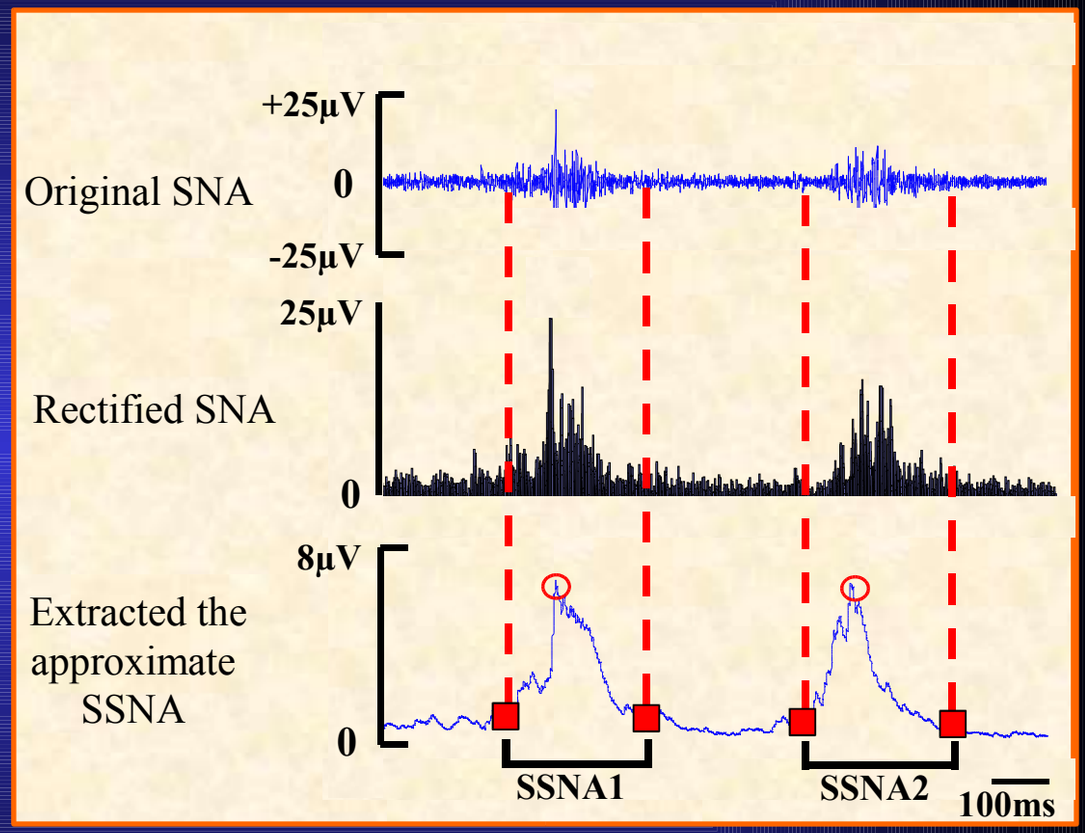
Detection method of synchronized sympathetic nerve activity



The detection algorithm consists of three signal processing techniques which involve: (1) extracting an approximate duration containing synchronized sympathetic nerve activity, (2) detecting individual neural signals from recorded sympathetic nerve activity and (3) detecting the onset and end of each synchronized neural signals.

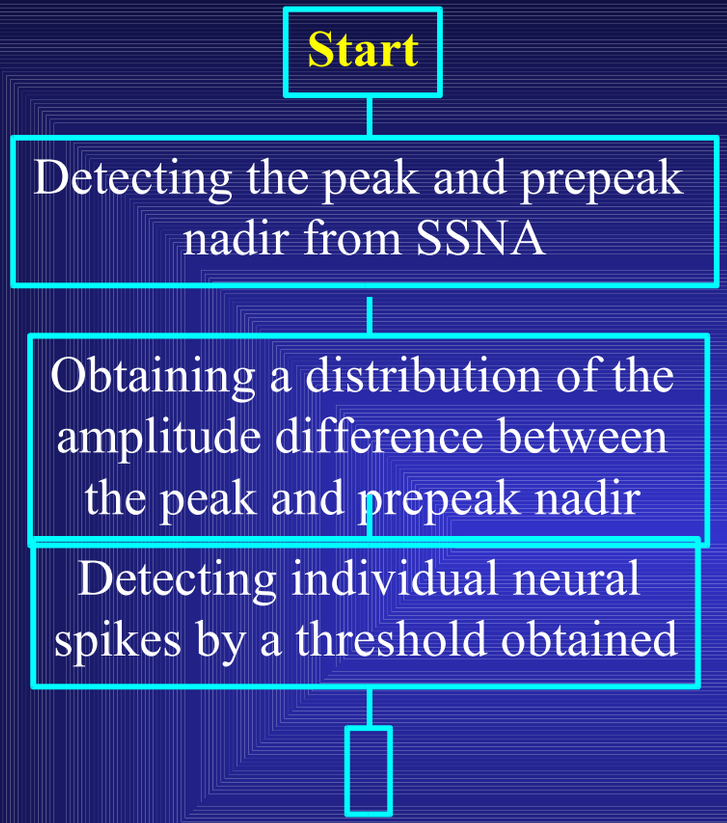
Extraction of the approximate duration containing SSNA

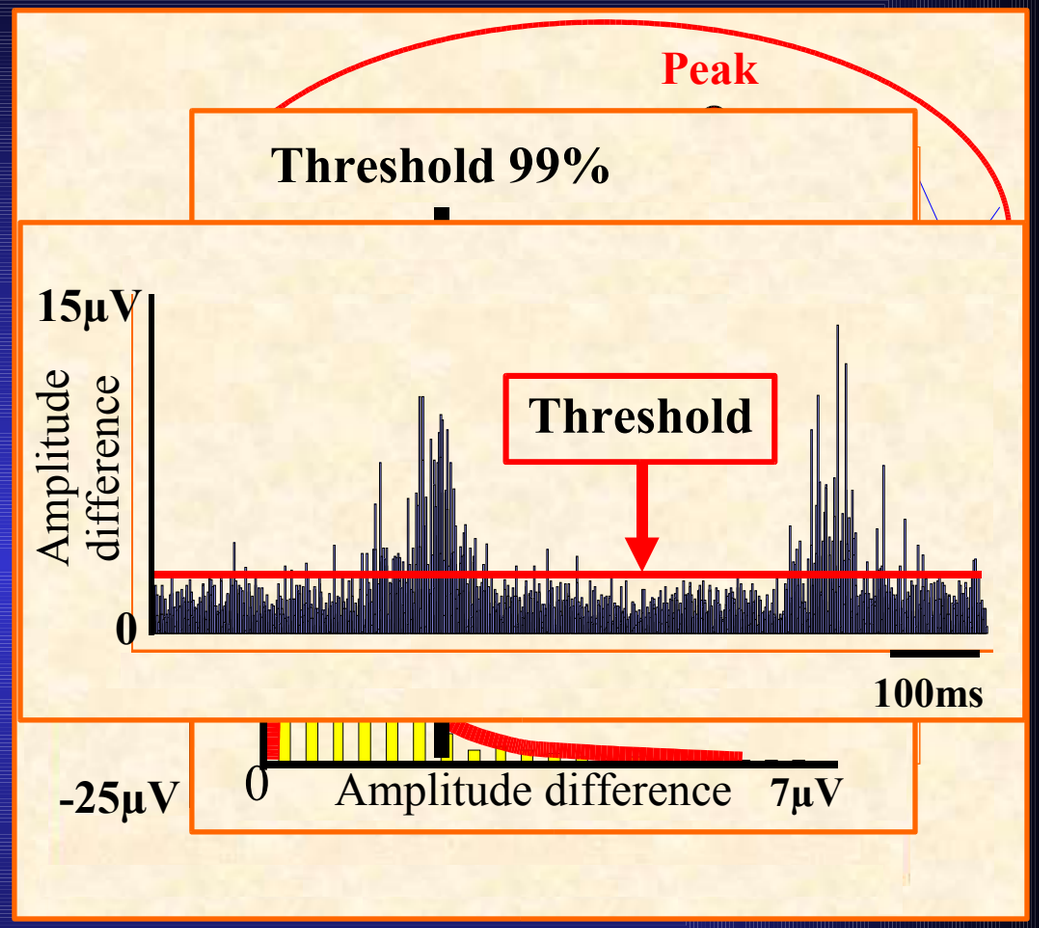




The approximate duration containing synchronized sympathetic nerve activity is extracted by a full wave rectifier, a leakage integrator and the cluster program.

Detection of individual neural spikes





Detection of individual neural spikes from the SNA can be done by use of a threshold, which is determined by the amplitude difference value in 99% of the gamma distribution.

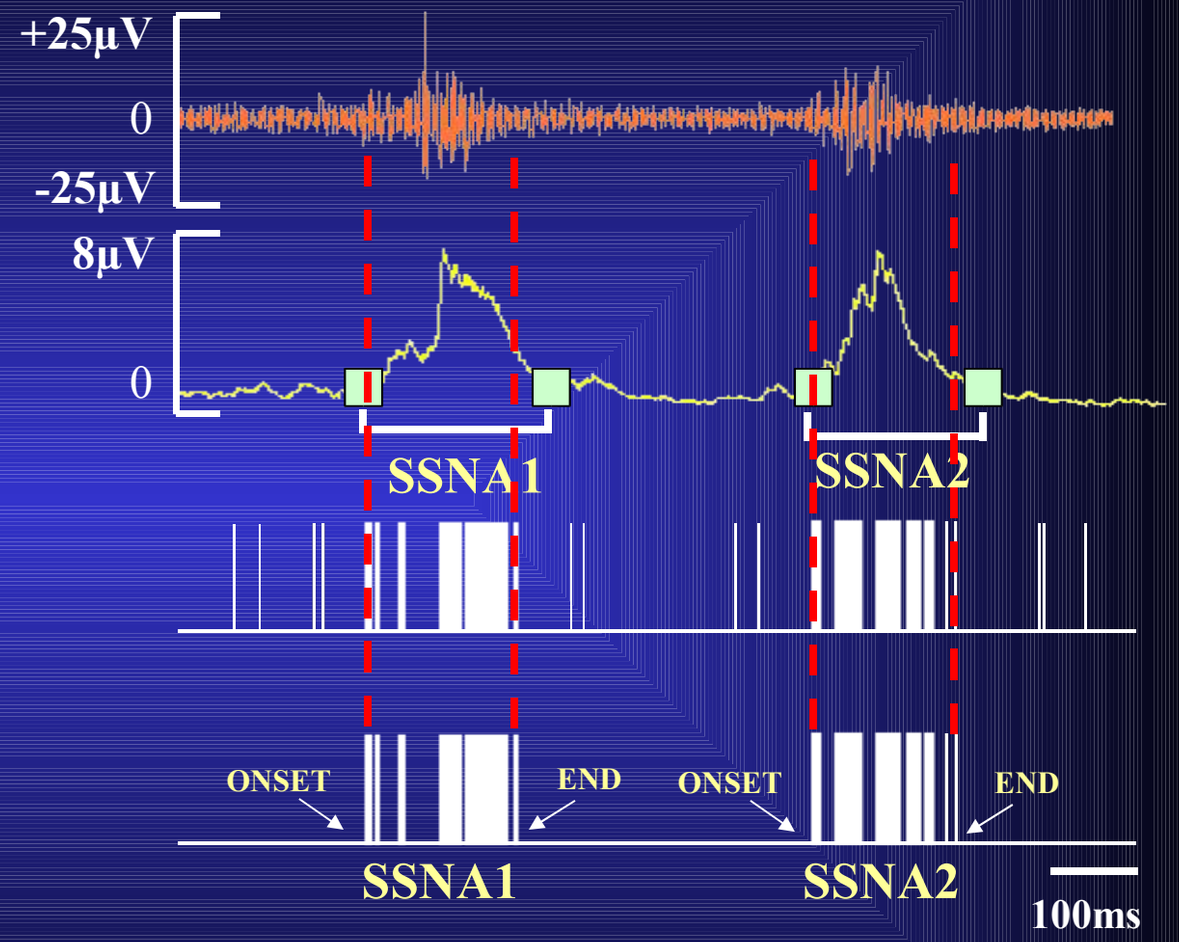
Result

(a) Original sympathetic nerve activity

(b) Detected approximate SSNA region

(c) Detected individual neural spikes

(d) Detected precise SSNA width



The onset and end of synchronized SNA were detected precisely by combining the individual neural spikes and the approximate region containing SSNA.

Conclusion

The developed algorithm presents a new neural spike detection method for precise SSNA width detection. This method could be applied to many types of sympathetic nerves that exhibit synchronized discharges.