Studies of sensory conductions

Comparison of latencies of orthodromic and antidromic sensory potentials

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SYNOPSIS Latencies of orthodromic and antidromic sensory potentials were compared in 16 normal median nerves. Peak latency was longer in the antidromic sensory response in every case. The peak latency of the antidromic sensory response depended on the distance between the recording electrodes; with shorter interelectrode distances it was similar to that of orthodromic sensory response.

Sears (1959) stimulated the median nerve at the wrist and recorded the antidromically evoked sensory potential from the fingers. Since a larger response is usually obtained with antidromic conduction (Buchthal and Rosenfalck, 1966), and as its latency has been believed to be identical with that of orthodromic conduction (Campbell, 1962; Ruskin and Rogoff, 1964; Goodgold and Eberstein, 1972), this technique is now often preferred in daily electrodiagnostic practices. In the present study, we compared the latencies of orthodromic and antidromic sensory potentials. The negative peak latency was found to be longer in antidromic sensory conduction, and the latency to depend on the distance between the recording electrodes.

METHOD

Sixteen normal right upper extremities of subjects ranging in age from 21 to 63 years, with an average of 38 years, were used. The median nerves were studied.

ORTHODROMIC SENSORY CONDUCTION For stimulation, square pulses of electricity with a duration of 0.2 ms and a supramaximal intensity (approximately 100 V) were delivered to the index finger through digital ring electrodes (TECA 6032). The inter-electrode distance was 3.0 cm and the proximal electrode was connected to the cathode of the stimulator.

The evoked sensory potential was recorded through disc electrodes at the wrist. The active electrode was placed over the median nerve at the distance of 13.0 cm from the stimulating (proximal) digital electrode, and the companion indifferent electrode was placed in a proximal position on a radial side of the forearm 3.0 cm from the active electrode. The earth (ground) electrode was placed on the skin of the palm.

ANTIDROMIC SENSORY CONDUCTION Digital ring electrodes, which were used as stimulating electrodes in the case of orthodromic sensory conduction, were used as recording electrodes in antidromic conduction without any replacement. The proximal electrode was connected to G1 and the distal to G2 of the amplifier. For stimulation square electric pulses with a duration of 0.2 ms and a supramaximal intensity were delivered percutaneously over the median nerve at the wrist where the active electrode was placed in the case of orthodromic conduction. The distance between stimulating electrode (cathode) and recording electrode was therefore exactly the same in orthodromic and antidromic sensory conductions (13.0 cm). The temperature of the room in which this study was performed was 22–25°C.

MEASUREMENT OF LATENCIES The time course from the beginning of the stimulus to the onset of the negative deflection, abbreviated as the 'onset latency' in this study, and that to the negative peak of the response, abbreviated as the 'peak latency', were determined in both orthodromic and antidromic sensory conductions.

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FIG. 1 Sensory potentials recorded orthodromically (top) and antidromically (bottom). Three responses were superimposed in each photograph. Calibration: vertical, $10 \mu\text{V}/\text{div}$; horizontal, $1 \text{ ms}/\text{div}$. Negative deflection is upward. Arrows show stimuli.

RESULTS

Typical sensory potentials recorded orthodromically and antidromically are shown in Fig. 1. The orthodromic sensory potential shows a small positive deflection followed by a large negative deflection, whereas the antidromic potential begins with a large negative deflection followed by a large positive deflection. The amplitude was always higher in the antidromic potential.

Onset latencies of the orthodromic sensory potentials ranged from 2.00 to 2.95 ms with an average of 2.49 ms and a standard deviation (SD) of 0.31 ms. Onset latencies of the antidromic sensory potentials ranged from 2.00 ms to 2.98 ms with an average of 2.53 ms and a SD of 0.30 ms. There was no significant difference between these mean values. In each case, the onset latency of the antidromic sensory potential was subtracted from that of the orthodromic sensory potential. The values ranged from $+0.12$

to -0.25 ms with an average of -0.04 ms and a SD of 0.09 ms. There was no significant difference between the average and zero.

Peak latencies of the orthodromic sensory potentials ranged from 2.40 to 3.40 ms with an average of 2.93 ms and a SD of 0.33 ms. Peak latencies of the antidromic sensory potentials ranged from 2.56 to 3.68 ms with an average of 3.19 ms and a SD of 0.37 ms. There was no significant difference between these averages. In each case, peak latency of the antidromic sensory potential was subtracted from that of the orthodromic sensory potential. All subjects showed longer peak latencies for antidromic sensory potentials. The values ranged from -0.10 to -0.43 ms with an average of -0.25 ms and a SD of 0.09 ms. This mean value is significantly smaller than zero ($P < 0.01$).

Latencies of antidromic sensory potentials were determined while changing the distance between two digital electrodes in three cases. Only the distal electrode was moved, so that the distance between stimulating and recording electrodes was constant. In each of these cases, peak latencies were constantly decreased when the distance between electrodes decreased, and they approximated to those of orthodromic sensory potentials with a distance of 1.0 cm.

FIG. 2 Relationship between latencies and interelectrode distance. ● ▲ ■: subjects; ○ △ □: latencies of orthodromic responses.

Onset latencies of antidromic sensory potentials also decreased when the distance of electrodes decreased. However, the changes were less marked and variable (Fig. 2).

DISCUSSION

Since Sear's original report (1959), several works have referred to the comparison of orthodromic sensory conduction (Campbell, 1962; Ruskin and Rogoff, 1964; Buchthal and Rosenfalck, 1966; Liberson *et al.*, 1966; Goodgold and Eberstein, 1972). Campbell (1962) indicated that the latencies determined to the initial deflection were entirely similar using orthodromic and antidromic methods. Ruskin and Rogoff (1964) determined peak latency in antidromic sensory conduction. They reported the identity of orthodromic and antidromic sensory latencies using a picture which, however, shows approximately 0.2 ms longer peak latency in antidromic sensory potential. Goodgold and Eberstein (1972) mentioned in their monograph the equality of latencies measured orthodromically and antidromically. Buchthal and Rosenfalck (1966) indicated that the antidromic sensory potential is the difference between two potentials recorded bipolarly, and that the shape of a bipolarly recorded potential depends on the distance between the electrodes. Conduction times were found to be identical in orthodromic and antidromic potentials.

In the present study, no significant difference was found between mean values of onset or peak latencies of orthodromic and antidromic sensory potentials. However, the peak latency was longer for the antidromic sensory potential than for the orthodromic potential in every case studied and these differences were statistically significant. This result makes sense when we think of Buchthal and Rosenfalck's indication that the antidromic sensory potential, recorded bi-

polarly, is 'the difference between two potentials more or less displaced in time'. If this temporal displacement is reflected in peak latency, it being likely that on summation of the two potentials latency changes in one potential will be more obvious in high amplitude components of the compound potential and depends as it must on the spatial separation of the recording electrodes, it should be possible to alter peak latency by changing interelectrode distance. When we shortened the distance between the digital electrodes in antidromic study, the peak latency decreased and at a distance of 1.0 cm it became similar to that of the orthodromic sensory potential. Onset latency, affected more by low amplitude components and therefore less sensitive, was changed to a lesser degree and without any regularity.

From the present study, it seems preferable to record distal sensory latencies by the orthodromic method. When of necessity the antidromic sensory potential is recorded, the distance between recording electrodes should be short (1.0 cm).

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