

Background

The Summating Potential-to-Action Potential (SP/AP) amplitude ratio is a key metric in ECoChG, assessed using three main methods: the Peak-to-Peak amplitude measurement (PP), which evaluates the absolute amplitude without a baseline; the Baseline method (BL), measuring amplitudes from a pre-stimulus baseline; and the Area-Ratio method (AR), calculating the total area under the SP/AP curve (Figure 1).

The BL method has limitations as it assumes a stable, neutral pre-stimulus period, but physiological factors or artefacts can violate this assumption, leading to inaccurate measurements. While the BL method reduces baseline shift influence, it may fail to capture subtle changes in the SP/AP complex morphology, which could be clinically relevant (McClaskey et al., 2018). In contrast, the PP approach does not require a baseline assumption but is potentially more susceptible to the effects of background noise and waveform distortion (Ferraro, 1999, 2003). Conversely, the area method (AR) aims to provide a more comprehensive assessment by integrating the entire SP/AP complex, potentially yielding a more robust and less noise-sensitive metric than peak-based measurements (Coats, 1986).

This study sought to evaluate and contrast the performance of these three approaches in determining the SP/AP ratio in a group of participants undergoing ECoChG.

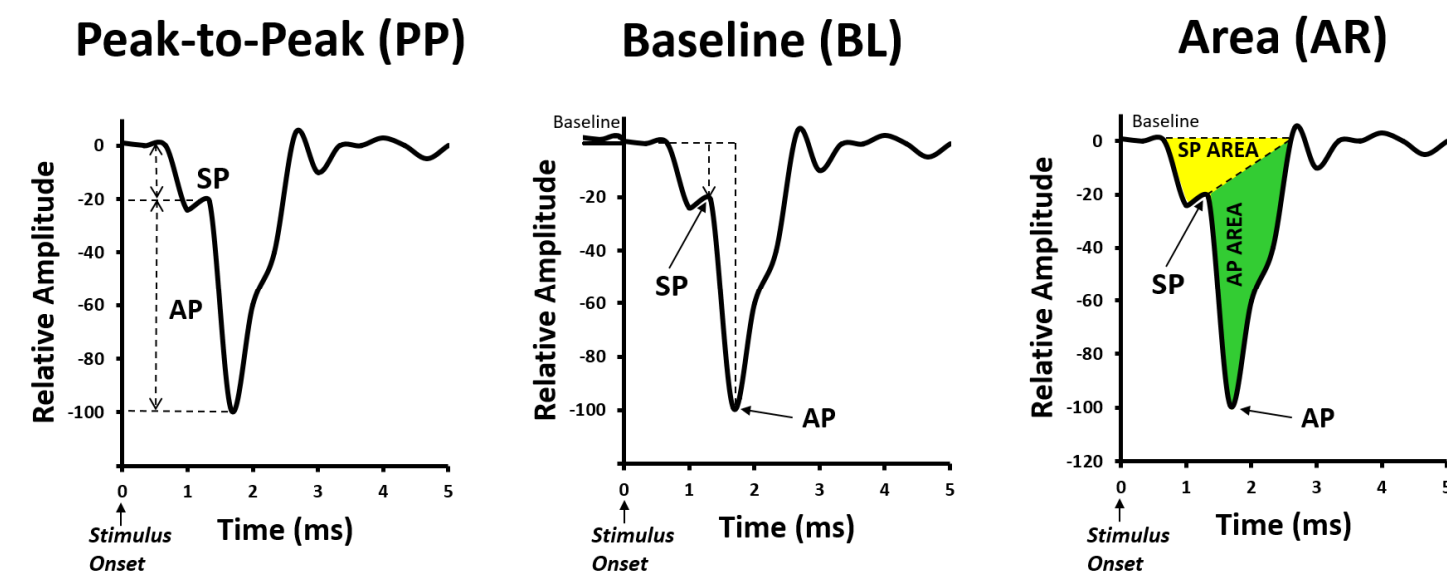


Figure 1: Peak-To-Peak (PP) method, Baseline (BL) method and Area-Ratio (AR) method employed in this study.

Results

RECORDING PARAMETERS	
Stimulus	
Transducer	Insertear Earphones (ER3)
Type	Click
Duration	0.1 ms
Polarity	Alternating
Ratio	7.1/sec
Intensity	95 dB nHL
Recording	
Electrodes	Lilly TM-Wick (Extratympanic)
Montage	Horizontal
Derivaciones	(+) Contralateral Mastoid (-) Tympanic Membrane (↓) Forehead
Filters	0,5 - 1500 Hz
Gain	x 75000
Window	-1 a 5 ms
Sweeps	1500

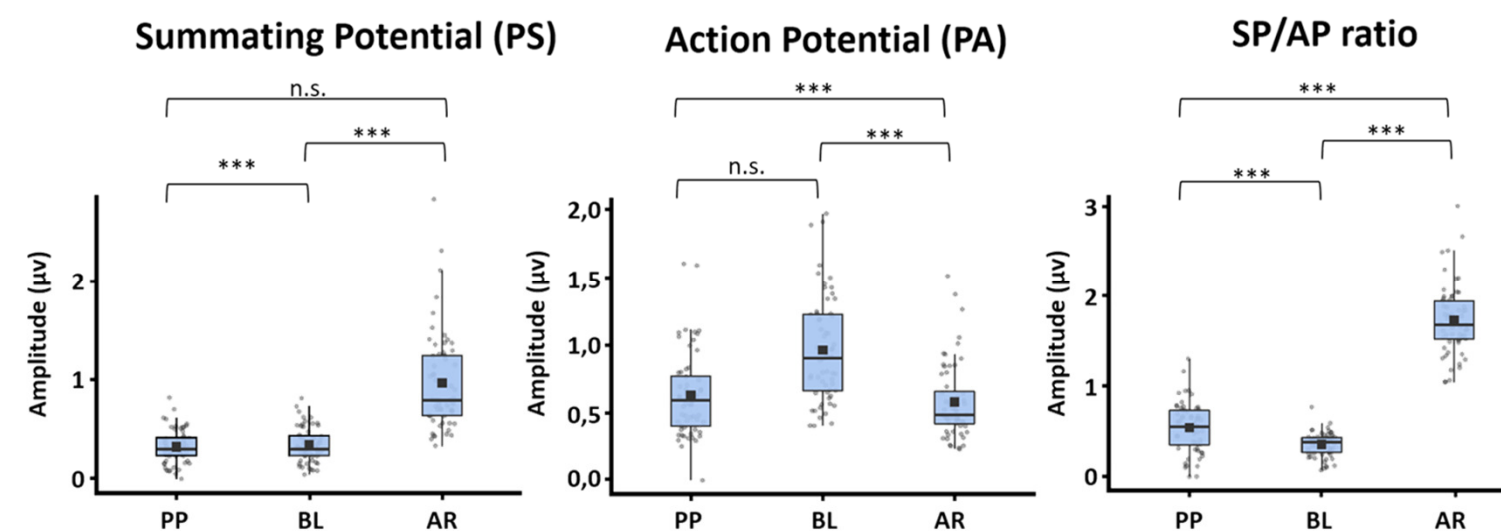


Figure 2: Analysis of Variance of the AP, SP, and AP/SP Ratio using the Peak to Peak (PP) method, Baseline method (BL) and Area method (AR).

A repeated measures analysis of variance showed that the PP and BL methods did not significantly differ in SP quantification, but the AR method was distinct. The BL method showed significant AP differences compared to AR and PP, which were similar (Figure 2). Correlations were analyzed for predictive accuracy: AB (0.29), LB (0.72), and AR (0.90). Confidence intervals were broadest for AB (0.04-0.51), narrower for LB (0.56-0.82), and most precise for AR (0.84-0.94), highlighting its robustness as a predictive model. Overall, AR was more precise, demonstrating significant advantages over PP and BL methods (Figure 3).

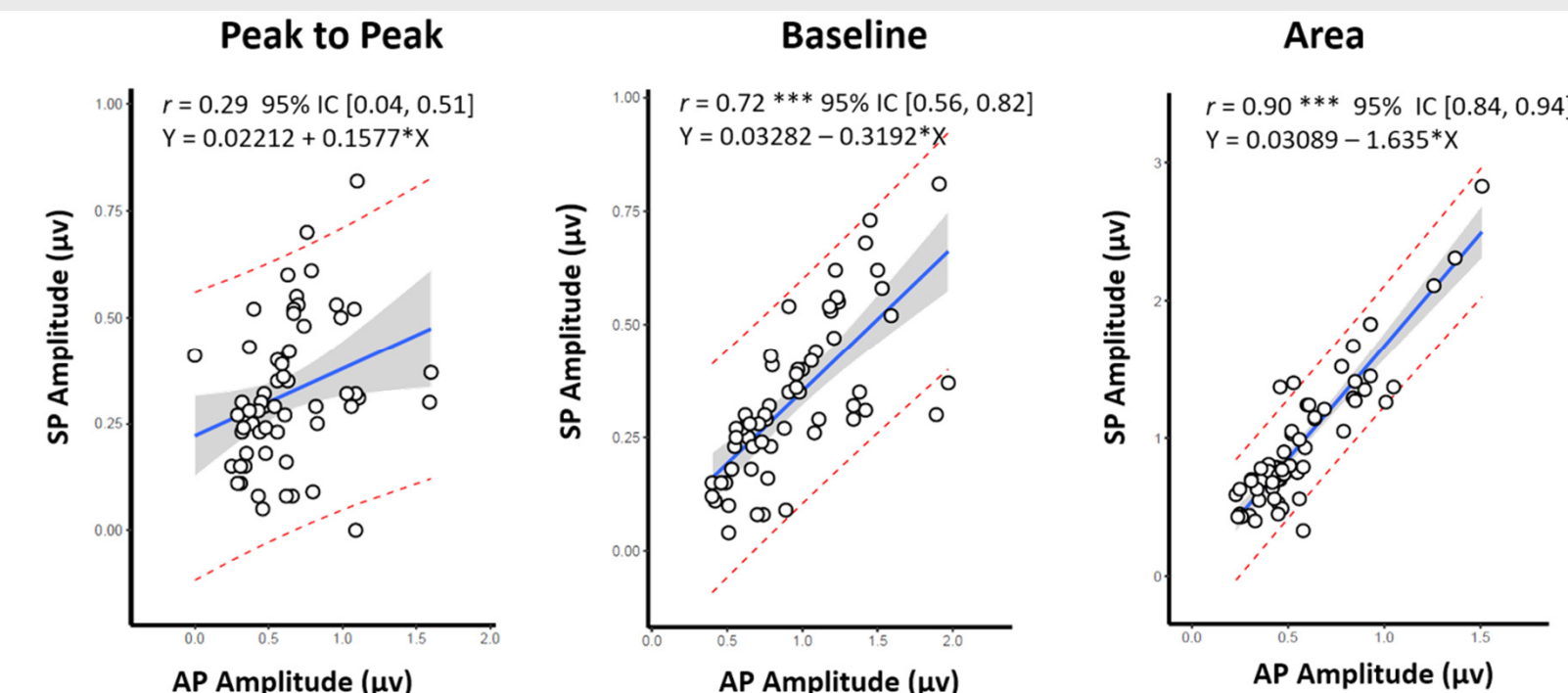


Figure 3: Analysis of Variance of the AP, SP, and AP/SP Ratio using the Peak to Peak (PP) method, Baseline method (BL) and Area method (AR).

Conclusion

The AR method proved to be the most effective, demonstrating a high correlation coefficient between SP and AP, suggesting superior predictive capability, precision, and reliability with narrow confidence intervals. The BL method showed moderate precision. However, its reliance on a stable pre-stimulus period limits its accuracy due to potential physiological artifacts. The PP method had the weakest correlation, indicating poor predictive ability and susceptibility to noise and distortion. Ultimately, the AR method was identified as the preferred technique for assessing SP/AP ratios in ECoChG.

References

Coats, A. C. (1986). The Normal Summating Potential Recorded From External Ear Canal. *Archives of Otolaryngology - Head and Neck Surgery*, 112(7), 759–768.

Ferraro, J. A., & Tibbils, R. P. (1999). SP/AP area ratio in the diagnosis of Meniere's disease. *American Journal of Audiology*, 8(1), 21–28.

Ferraro, J.A. (2003). Clinical Electrocochleography: Overview of Theories, Techniques and Applications. *Audiology On Line*.

McClaskey, C. M., Dias, J. W., Dubno, J. R., & Harris, K. C. (2018). Reliability of Measures of N1 Peak Amplitude of the Compound Action Potential in Younger and Older Adults. *Journal of Speech, Language, and Hearing Research*, 61(9), 2422–2430.