



CLINICAL APPLICATIONS OF SOMATOSENSORY EVOKED

POTENTIALS IN PEDIATRIC NEUROSURGERY

A Thesis presented to the Department of Surgery,  
University of Adelaide, in fulfillment for the Degree  
of Doctor of Medicine.

by

Ian Roger Whittle

MB.BS., FRACS., FRCSEd (SN).

December 1985

*awarded 12-11-1986*

## CONTENTS

### SECTION

- SUMMARY (iii-iv)
- STATEMENT (v)
- ACKNOWLEDGEMENTS (vi)
- PUBLISHED WORK (vii-viii)
- ABBREVIATIONS USED IN THESIS (ix-x)
- 1 PREFACE (pp 1-2).
- 2 INTRODUCTION
- SHORT LATENCY CORTICAL, SUBCORTICAL AND SPINAL SEPs
- 2.1 HISTORICAL ASPECTS (pp 3-12).
- 2.2 METHODOLOGICAL CONSIDERATIONS (pp 12-27).
- 2.3 COMPONENTS OF THE SEP WAVEFORM (pp 27-40).
- 2.4 CLINICAL AND INTRAOPERATIVE APPLICATIONS  
IN NEUROSURGERY (pp 41-53).
- 3 SHORT LATENCY SEPs FOLLOWING TIBIAL AND MEDIAN NERVE  
STIMULATION IN CHILDREN; NORMATIVE DATA (pp 54-71).
- 4 THE EFFECTS OF SPINO-VERTEBRAL DISORDERS ON SHORT LATENCY  
SEPs IN CHILDREN (pp72-84).
- 5 SHORT LATENCY SEP FINDINGS FOLLOWING MAJOR HEAD INJURY IN  
CHILDREN (pp 85-95).

## CONTENTS (Cont)

- 6 THE EFFECTS OF CEREBRAL SPACE OCCUPYING LESIONS ON SHORT  
LATENCY SEPs IN CHILDREN (pp 96-104).
- 7 EXPERIENCE WITH INTRAOPERATIVE RECORDING OF CORTICAL SEPs AS  
A METHOD OF SPINAL CORD MONITORING DURING SPINAL SURGERY  
(pp 105-117).
- 8 EXPERIENCE WITH INTRAOPERATIVE RECORDING OF SPINAL SEPs AS A  
METHOD OF SPINAL CORD MONITORING DURING SPINAL SURGERY  
(pp 118-137).
- 9 AN EXPERIMENTAL STUDY OF THE EFFECTS OF HALOTHANE AND  
STIMULUS INTENSITY ON THE SHEEP SPINAL SEP RECORDED  
INTRAOPERATIVELY (pp 138-146).
- 10 FINAL DISCUSSION AND CONCLUSIONS (pp 147-153)
- APPENDIX 1 (p 154).
- APPENDIX 2 (p 155).
- REFERENCES (pp 156-173).

## SUMMARY

This thesis examines the utility of SEP studies in several areas of clinical and operative pediatric neurosurgery. The clinical studies use routine neurophysiological methods to record surface spinal, subcortical and cortical SEPs following electrical stimulation of the tibial and median nerves. Findings in normal children (100) were compared to those in children with surgical myelopathies (26), intracerebral lesions (7) and following major head injury (14).

In normal children characteristic SEP waveforms could be recorded over the lumbar and cervical spine, Erb's point and the scalp. Certain SEP components had latencies that were related to the age and size of the subject, whilst central conduction times showed no significant variation during the first decade. Many children with motor and sphincteric deficits due to congenital and neoplastic spinovertebral disorders had normal SEPs whilst those with impairment of dorsal column modalities had loss of SEPs. Children with intracerebral space occupying lesions often had either loss of short or long latency cortical SEP components and ipsilateral attenuation of waveform amplitude. Following severe head injury many children had normal short latency cortical SEPs and these patients had a favourable outcome. Children with bilateral distortion of the short latency cortical SEP had vegetative outcomes, whilst patients with unilateral distortion of this complex suffered focal neurological deficits.

The studies undertaken during spinal surgery utilized spinal SEPs (26 cases) and cortical SEPs (13 cases) to monitor spinal cord function. Intraoperative monitoring was much quicker and simpler using SEPs recorded from the epidural or subdural plane rather than cortical SEPs. Patterns of spinal SEPs were characteristic of different spinal segments. Distortion and asymmetry of baseline spinal SEPs was seen in several patients with intramedullary tumours. Loss of waveform components during surgery occurred with profound hypotension, overdistracted of the vertebral axis, dorsal midline myelotomy and removal of intramedullary tumors. Persistent loss of waveform components was associated with an acquired neurological deficit. Fluctuations in SEP amplitude were common but were not associated with post operative deficits. An experimental study in sheep revealed that some of this amplitude fluctuation may be attributable to halothane anesthesia.

These studies suggest that SEPs can provide prognostic information following pediatric neurotrauma, and that they are superior to the "wake up" test during spinal surgery for scoliosis. The use of SEPs to evaluate children with intracerebral and spinovertebral disorders, and to monitor spinal function during intramedullary and caudal spinal surgery is however limited by technical, anatomical, clinical and pathological factors.