

# Preface

Regional anesthesia has been long regarded as an “art” and success with these techniques appears to be confined to a small number of gifted individuals. The introduction of nerve stimulation some 30 years ago was the first step towards transforming regional anesthesia into a “science.” However, nerve stimulation also has its limitations. This technique relies on physiological responses of neural structures to electrical impulses. There is considerable inter-individual variation in physiological responses to nerve stimulation. Furthermore a number of other factors influence response to nerve stimulation including injectates, physiologic solutions (e.g. blood) and disease. Despite these limitations nerve stimulation was one of the first objective methods available in regional anesthesia to place, with some reliability, a needle in close proximity to a target nerve. The introduction of nerve stimulation techniques into regional anesthesia surprisingly did not result in a renewed interest in regional anesthesia. However it was a considerable boost to those of us who were already drawn to this most interesting pursuit.

One of the most exciting advances in technology in relation to regional anesthesia in recent years has been the introduction of anatomically-based ultrasound imaging. This is the first time in close to 100 years of regional anesthesia that we can actually see an image of the nerve we would like to block. This is a quantum leap in technology for those interested in this pursuit and is sure to draw a huge number of anesthesiologists back towards regional anesthesia. However let us not forget that despite the initial excitement over this advancement, ultrasound visualization is still indirect and images are subject to individual interpretation depending on one’s experiences and training and where that training and experience was obtained. Some individuals are gifted in their ability to interpret ultrasound images, however this is not the case with the majority. There is an extensive learning curve associated with ultrasound-guided regional anesthesia. To my knowledge, there is no existing textbook and/or atlas devoted entirely to ultrasound-guided regional blockade. In addition, I believe that we should not immediately abandon nerve stimulation techniques in favor of ultrasound-guided regional anesthesia. Instead I would like to suggest that we should combine the two technologies to further enhance our goal of 100% success with all of our blocks. We have already outlined some of the disadvantages of neurostimulation. Ultrasound-guided regional anesthesia is not without its flaws either. We can never be totally sure of the identity of the nerve that we are imaging, however by stimulating that nerve we can objectively determine its identity by the motor response to nerve stimulation. This atlas outlines the advantages of both technologies and I believe is the first attempt to do so.

The main objective of this book is to enable anesthesiologists who are beginning to use ultrasound-guided regional anesthesia to shorten their learning curve. For those anesthesiologists already experienced in ultrasound guidance during regional anesthesia, hopefully this atlas will further add to their knowledge in this field. Hopefully we will convince some of our readers not to hastily abandon nerve stimulation, but instead to combine it

with ultrasound-guided regional anesthesia. Our ultimate goal in publishing this book is to advance knowledge in regional anesthesia and in doing so our patients will be the beneficiaries.

The central theme of this book is anatomy. Knowledge of anatomy is the backbone of regional anesthesia. Labat, the father of regional anesthesia, made the following statement about this discipline: "Anatomy is the foundation upon which the entire concept of regional anesthesia is built. Anyone who wishes to be an expert in the art of regional anesthesia must be thoroughly grounded in anatomy." It is difficult to perform ultrasound-guided regional anesthesia or nerve stimulation without some knowledge of anatomy. This atlas is generously adorned with anatomic drawings, ultrasound images, MRI images, and information about optimal use of nerve stimulation in regional anesthesia.

The book layout is consistent throughout. In the clinical chapters, there is an initial description of relevant anatomy with illustrations from cadaver dissections and corresponding MRI and ultrasound images capturing the block location. This is followed by a clinical description of how to perform ultrasound imaging during regional block. These sections describe and illustrate the positioning of the probe, the specific needling technique used, how to use nerve stimulation, and pre- and post-local anesthetic application. I believe this sequential format gives the reader a realistic simulation of the management of each clinical situation.

The images used in this book are those from our everyday practice and are achievable by any newcomer to ultrasound for regional anesthesia. We have been mindful not to concentrate on anatomically perfect ultrasound images, occasionally obtained, but on those images which are representative of what you will encounter in an average day.

Ultrasound-guided regional anesthesia is an emerging field and the literature is replete with new ideas about how to best apply this new technology. In this book, we focus on the most common approaches used and supplement these by including alternative approaches in clinical pearls and notes, as described in the literature or by the consulting editors. This way the reader can select the most suitable approach for his/her own needs.

The book starts out with brief but relevant sections providing information on both ultrasound and nerve stimulation. Equipment and setup are also discussed. Chapter 4 is perhaps the most important, including many practical ideas and approaches for performance and training of ultrasound and nerve stimulation guidance during regional blockade. For this book, all the cadaver dissections were performed under ultrasound guidance in a similar fashion to performing ultrasound-guided regional block. In other words, the structures were first localized with ultrasound and followed by "minimally invasive dissection." The dissected area was preserved with minimal distortion of the normal anatomical relationships while clearly showing the targeted nerve (i.e., direct visualization).

To further illustrate the important neuroanatomy and its relation to other anatomical structures and also to provide a realistic perspective from living persons (i.e., Dr. Finucane and myself), MRI images were captured using scanning angles similar to typical ultrasound planes for specific regional anesthesia approaches. In addition, practical schematic drawings with simplified relevant anatomy are also included to enable easy, yet comprehensive, understanding of the anatomical relationships between nerves and of the nerves relative to their surroundings.

In order to maximize recognition and identification of the structures within the ultrasonographic images, unlabelled ultrasound images (both general and during clinical procedures) are placed next to identical but well labeled images. The reader should find these figures useful learning aids, as do my residents and colleagues. They have found this layout to be most effective for familiarizing themselves with the realistic clinical images as there is no distraction from multiple labels, yet at the same time they benefit from side-by-side reference to the same image, with labeling. Furthermore, as anatomical structures are not the only relevant items to localize with ultrasound, practical ways to insert, view and control placement of the needle within the tissues are incorporated throughout the text.

In terms of nerve stimulation, a new understanding of the relevant physics of electrical stimulation is discussed. For clinical integration, readers should find the trouble-shooting

tables in the nerve stimulation sections useful to help adjust needle placement in response to motor responses they may observe during needle insertion.

In preparing this book, I had the privilege of gathering close friends and colleagues as consulting editors and contributing authors. They are all highly respected experts internationally in their relevant fields. I had the opportunity to have my friend and colleague, Dr. Chan, professor at University of Toronto and current treasurer of the American Society of Regional Anesthesia, as consulting editor for the upper and lower limb sections. Dr. Chan is one of the forefront leaders in promoting ultrasound use for regional anesthesia in both Canada and the United States and indeed worldwide. Dr. Grau, a renowned colleague from Germany agreed to act as a consulting editor for the central neuraxial anesthesia portions. Dr. Grau, consultant anesthesiologist at BG-University Hospital, is one of the pioneers in introducing ultrasound use for central neuraxial blockade. It was a great honor to invite my colleague at the University of Alberta, Dr. Walji, as a consulting editor to ensure accuracy in the relevant anatomy as described in the atlas. Dr. Walji is a well known professor from the University of Alberta's Faculty of Medicine and Dentistry and was recently an editor of the latest edition of the renowned *Netter's Anatomy* atlas. I had the great pleasure to consult with Dr. Finucane, who is the past president of the American Society of Regional Anesthesia, the editor of two textbooks on regional anesthesia, the former department chair for Anesthesiology and Pain Medicine at the University of Alberta (where he still resides) and my mentor. I am forever indebted to Dr. Finucane for his continuous support and encouragement throughout my career and for introducing me to the challenges of regional anesthesia when I was his resident. Dr. Ganapathy from University of Western Ontario, a well-known Canadian regional anesthesia expert, was also kind enough to contribute an important chapter addressing ultrasound use in placing continuous catheters. My current fellow Dr. Dillane worked diligently on this project and inspired me to work together with him to create a chapter summarizing the practical tips from both the learner and trainer perspective in order to facilitate shorter learning curves in ultrasound guidance. My colleagues from the Diagnostic Imaging and Radiology department at the University of Alberta, Drs. Noga, Lou, and Bhargava, helped by facilitating me with obtaining MRI images as well as by contributing towards a basic ultrasound chapter. I also greatly appreciate Drs. Chan, Grau, and Ganapathy for sharing some of their clinical images in addition to their expert contributions, as well as Dr. Walji and the Division of Anatomy at the University of Alberta for providing assistance and facilitating me with the cadaver dissections. Last but not least, my niece, Carol Chan, a nursing student of University of Alberta, used her fine artistic talent to provide practical and meaningful medical illustrations to incorporate throughout the book.

In summary, anesthesiologists may encounter considerable difficulty identifying neural structures when learning ultrasound techniques and this may lead to frustration and failure, both of which deter anesthesiologists from adopting this technology. The concepts incorporated in this book collectively provide many reliable ways to become proficient at identifying neural structures prior to performing regional anesthesia. Throughout the book, dynamic and systematic scanning is emphasized. Instead of attempting to identify the target nerve as the initial step in performing ultrasound-assisted regional anesthesia, we strongly recommend first identifying obvious landmarks (usually blood vessels) in the vicinity of the target nerve, subsequently shifting the view to the corresponding neural structures, and tracing back along this neural structure to the specific target block location. More important, Labat's advice about the importance of anatomy is still as true today as it was some 90 odd years ago. So hold on to your anatomy books and continue to visit the dissecting rooms. Knowledge of anatomy is still the essence of regional anesthesia regardless of the advances in this field.

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Atlas of Ultrasound- and Nerve Stimulation-Guided  
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