EVIDENCE-BASED Interventional Pain Medicine

According to Clinical Diagnoses

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Foreword

by Menno E. Sluijter MD, PhD, FIPP

Seeing this book makes me proud of my university city Maastricht, where I have left so many footsteps and where I still have many friends. It is a great honor for me to have been invited to write this foreword.

Besides accurately describing the various techniques in detail, this book has an accent on evidence-based medicine. This comes naturally for the Dutch since soberness and standing firmly on the ground belong to their prominent features. It makes the book into a solid and reliable guide for many pain practitioners.

My first footsteps in the world of invasive pain treatment date back to a very different period. My mentors and teachers were Jur Bouma in the Netherlands and legendary names, such as Sampson Lipton and Mark Mehta, who played such a pivotal role in their time. Those were the days when solitary observations easily sparked attention or even a trend. Epidural phenol at T12 has been recommended for anal pain for about a decade, one author copying it from another because it was so bizarre. Ondine's syndrome, as a complication of a cordotomy, received undue attention probably because of its romantic name. Evidence-based medicine was still a far cry.

This book therefore symbolizes for me how invasive pain treatment has become mature within a relatively short period. This process of growth has taken place despite a head wind that is specific for the subject. Many of the procedures are intricate, and success or failure may depend on seemingly trivial details, causing differences in results between researchers. Also pain is a subjective experience and this has various consequences. It makes it particularly difficult to translate results into numbers that are suitable for meaningful statistical analysis. It may even influence results. I firmly believe that a procedure that is performed by a friendly, interested doctor in a friendly environment has a greater chance of success than a procedure under less favorable circumstances. If this is placebo, so be it. It makes pain treatment different from putting a stent into a coronary artery or from removing a tumor under general anesthesia.

Maturity is a sign of growth and it has to be encouraged. Evidence-based medicine will be an indispensible and welcome element of invasive pain treatment in the time to come. It will save patients from getting useless treatments and it will convince insurers to follow up on reasonable demands. It will hopefully discourage those who seek financial gain from a vulnerable group of patients. It will also provide interventional pain treatment with the respected place in the medical community that it deserves.

But, on the other hand, maturity may also be taken as a sign of immanent old age. When reading this book the reader should also realize that all these procedures have once been done for the first time. This reflects a mixture of prudence and courage, but also alertness to observations and the urge to make it a better world for patients who could not be helped before. This process of growth and renewal must not be lost. It should be seen as a complement of evidence-based medicine rather than as a contradiction. After all, without ideas and innovation the need for evidence would soon dry up, and what good is a new procedure without evidence?

The book underscores the need for proper training. The prevalence of chronic pain is such that, despite the laudable efforts of World Institute of Pain, there is still a shortage of well trained doctors who can provide this type of treatment. This is a problem because reading even this book is not enough and practical training is costly in terms of material and manpower. It is to be hoped that the increasing number of potential trainers will gradually resolve the problem.

I recommend this book as a standard manual in the library of every interventionalist. Happy reading!

Foreword

by P. Prithvi Raj MD, FIPP

Jan Van Zundert, Jaap Patijn, Craig Hartrick, Arno Lataster, Frank Huygen, Nagy Mekhail, and Maarten van Kleef, all internationally renowned pain physicians, have embarked on writing "Evidence-Based Interventional Pain Medicine According to Clinical Diagnosis". They have devoted most of their lives to improving the pain management of patients globally. At their request, I am honored to write a Foreword for their new book.

To emphasize the importance of this book, I need to reiterate the statistics available to us on chronic pain today. Chronic pain prevails globally, the total number of persons living with this specific disease or condition with feeling of pain, ranges from 54% in Sweden to 13% in Japan. These studies show that in the rest of the developed countries, such as United States, United Kingdom and Australia, the incidence is somewhere in between. Studies also show that pain imposes a huge economic burden on all countries; for example, in the United States it was calculated that in 1991, the USA spent eighty-six billion dollars on chronic back pain management. Today, because the elderly are living longer, the prevalence of chronic pain is rising with age. Another problem one needs to recognize is that only one billion people in the developed countries have the luxury of utilizing the most advanced pain management techniques. The other five billion people, who have medium to low standards of living, are unable to receive the benefits of these new techniques of pain management.

The World Institute of Pain (WIP) and its members have been aware of this problem and the disparities between countries in terms of standard of care and practices of pain management. Since 1994, WIP's mission has been to train pain physicians and certify their competency in interventional pain management. By all accounts, this mission has become very successful globally.

Pain practice today is fortunate to have many physicians taking this practice as a professional part of their career. They come from all specialties and the book now has to reflect the advances in Pain Practice of all those specialties, not just those in Anesthesiology. The debate is still raging whether a single pain specialist can deliver better pain management than a group of specialists together. The cost of managing such multidisciplinary clinics has been called into question especially by the reimbursement agencies. A program developed by a multidisciplinary clinic is nowadays rejected outright by the reimbursement agencies, and even if it is approved, the efficacy of such programs is questionable. More and more the patients are referring themselves to the Pain Clinics where their pain will be relieved over the short-term rather than addressing the long-term goal of improving the patient's function and quality of life. That is why one finds a prolific growth of Interventional Pain Management Clinics and decrease in University-based Multidisciplinary Clinics. This is certainly the case in the USA and is also becoming common in other countries.

Pain Physicians have not tackled at all the discrepancy in pain practices between developed, developing and under developed countries. There is no factual account of the epidemiology of pain the world over; one cannot say for certain how many Pain Physicians are available per capita in any community. We certainly have made advances in understanding the new theories of pain, and in some pain syndromes, the longitudinal natural course, but we are far from having a reliable algorithm for any pain disorder. It is still hit and miss.

The challenge today is to train Pain Physicians in such a way that they have a standardized curriculum during their Residency and Pain Fellowship programs, followed by skilled practical training, either in Anesthesiology, Neurosurgery, Physical Medicine and Rehabilitation or Psychiatry. Once trained, they need to be examined and tested periodically for their competency. This will raise the standard of pain practice, not only in the USA, but all over the world.

Evidence-based medicine (EBM) or evidence-based practice (EBP) aims to apply the best available evidence gained from scientific methods to clinical decision making. It seeks to assess the strength of evidence of the risks and benefits of treatments (including lack of treatment) and diagnostic tests. Evidence quality can range from meta-analyses and systematic reviews of double-blind, placebo-controlled clinical trials at the top end, down to conventional wisdom at the bottom.

Let me explain the history of evidence-based medicine's origin. Traces of evidence-based medicine's origin can be found in ancient Greece. Although testing medical interventions for efficacy has existed since the time of Avicenna's The Canon of Medicine in the 11th century, it was only in the 20th century that this effort evolved to impact almost all fields of health care and policy. Professor Archie Cochrane, a Scottish Epidemiologist, through his book Effectiveness and Efficiency: Random Reflections on Health Services (1972) and subsequent advocacy caused increasing acceptance of the concepts behind evidence-based practice. Cochrane's work was honored through the naming of centers

of evidence-based medical research—Cochrane Centers—and an international organization, the Cochrane Collaboration. The explicit methodologies used to determine "best evidence" were largely established by the McMaster University research group led by David Sackett and Gordon Guyatt. Guyatt later coined the term "evidence-based" in 1990. The term "evidence-based medicine" first appeared in the medical literature in 1992 in a paper by Guyatt et al. Relevant journals include the British Medical Journal's Clinical Evidence, the Journal of Evidence-Based Healthcare and Evidence-Based Health Policy. All of these were co-founded by Anna Donald, an Australian pioneer in the discipline.

There has been discussion of applying what has been learned from EBM to public policy. In his 1996 inaugural speech as President of the Royal Statistical Society, Adrian Smith held out evidence-based medicine as an exemplar for all public policy. He proposed that "evidence-based policy" should be established for education, prisons and policing policy, and all areas of government

This book "Evidence-Based Interventional Pain Medicine According to Clinical Diagnoses" fits the void where literature should conform to local necessities for information to be useful in that society. The format of the book is excellent; each chapter is consistent in describing an interventional technique in simple terms from history to complications and efficacy, stressing at all times the technique.

The reader who is interested in learning, training and practicing interventional pain medicine will find this book extremely useful and informative. It illustrates not only the usual common techniques but also the emerging techniques; this makes it unique and different from the usual text books on pain. I wholeheartedly recommend the interventional pain physician to have this book in their library.

Introduction

The use of interventional pain management techniques has gradually become integrated into the treatment plan of patients suffering from chronic pain. After a long period of empirical use, it is time to move on to the professionalization and standardization of this practice. Interventional pain management techniques are *target specific*. There is evidence that better patient selection increases the success ratio.[1] Therefore, a standard patient evaluation to "fine-tune" the clinical pain diagnosis is mandatory. A detailed description of the technical performance provides a guideline for the standardized interventional pain procedure.

The efficacy of these techniques has been described in randomized controlled trials, observational studies, retrospective studies, and case reports. Evidence-based practice guidelines provide a good review of the literature in a context that makes it accessible and useful to both the clinician and researcher.[2,3]

The available evidence is summarized by treatment option or technique. There are, however, several studies indicating that the chances for treatment success increase with better patient selection.[1,4–7] A wellformed management strategy starts with an accurate evaluation process to identify the pain diagnosis. It is of utmost importance to first check for the so-called red flags that may be indicative of an underlying primary pathology, which needs adequate treatment prior to symptomatic pain management techniques. The treatment relies on accurate use of conservative interventions, potentially in association with interventional pain management techniques. Consequently, evidence-based practice guidelines are of greater practical value when they are specific for each different pain diagnosis.

Guideline development

In daily practice the important goal of pain medicine is to use a specific treatment, conservative and/or interventional, for the right patient at the right moment. Therefore, treatment selection should be according to clinical diagnoses. To improve recognition and information retrieval, the articles have been organized according to a strict structure:

Introduction
Diagnosis
History
Physical examination
Additional tests
Differential diagnosis
Treatment
Conservative management
Interventional management
Complications of interventional treatment
Evidence for interventional management
Recommendations
Treatment algorithm
Techniques
Summary

Although the scientific literature is predominantly Anglo-Saxon and most doctors use the English denominations of anatomical structures, in this series, anatomical structures were indicated with the Latin denomination (Terminologia Anatomica) and the English denomination was, where appropriate, added between brackets.[8] This option was specifically chosen to help people around the world to use the correct denomination when expressing themselves in a language other than English.

This series has focused on interventional pain management techniques, because they have undergone a rapid evolution in recent decades with additional well-conducted research being published regularly. The use of these techniques for the right indication may improve the quality of life of carefully selected patients. Moreover, for correct application of interventional pain management techniques, both good theoretical knowledge and practical experience are mandatory. These skills can only be acquired through training and continuing education.

The strict rules used to establish EBM guidelines may lead to exclusion of relatively new treatments that are only supported by noncontrolled trials. For the interventional pain management techniques covered in this series, in-depth literature searches on efficacy, side effects, and complications have been performed. The incidence of side effects and complications was largely derived from three reviews that specifically address the complications of interventional pain management techniques.[2,9,10] Disease and diagnosis related information was retrieved from high-quality review articles.

Guideline rationale

To make informed recommendations, the available evidence must be assigned "weight." When scoring the evidence of interventional pain management techniques, perhaps even more than for any other treatment modality, the principle "*Primo non nocere*" holds true. The "weighted" rating must consider the evidence for effect and balance this evidence against the incidence and severity of side effects and complications. The scoring system that best observed these considerations was published by Guyatt et al.,[11] "Grading strength of recommendations and quality of evidence in clinical guidelines." The method was then adapted specifically for interventional pain management techniques.[12]

First, a determination was made as to whether the potential benefits outweigh the risk and/or burden. The benefit/risk assessment was assigned a *numerical value* of 1 if the benefit because of the effectiveness of the treatment was greater than the risk and burden of potential complications. A value of 2 was given when the benefit of the effect was closely balanced with the risk and burden of possible side effects.

The *grade* of the evidence was then indicated by a letter: A, B, or C. Following this system, a value of A indicates the highest level of evidence (various randomized controlled trials [RCTs] of good quality), B represents evidence derived from RCTs with methodological limitations or large observational studies, and C is assigned when the evidence is limited to observational studies or case series. Additionally, a score of "0" is given for techniques that are only described in case reports. Finally, the evidence was interpreted for outcome, indicated as follows: positive outcome (+), negative outcome (−), or, when both positive and negative studies were included, (±) was used.

The grading and subsequent implications are summarized in Table 1.

In the recommendations, the practical *implication* "study related" is used for treatment options currently having low-level evidence as determined by systematic recording of the following:

- Patient characteristics
- Diagnostic process
- Treatment including the details of the technique concerned
- Evaluation of the result (preferably Global Perceived effect, VAS, EuroQol, and a complaint-specific scale at 3, 6, and if necessary at 12 months)
- Side effects and complications

Systematic reporting of results can help to accumulate information that further enables estimation of the "value" of a technique when it has been applied to a larger number of patients. This information may form the motivation for a prospective randomized study.

Certain pain management techniques require an extensive expertise and specialized materials and equipment. Therefore, it is appropriate that those specific techniques should be performed in specialized pain centers.

Table 1. Summary of Evidence Scores and Implications for Recommendation.

Score	Description	Implication
1 A +	Effectiveness demonstrated in various RCTs of good quality. The benefits clearly outweigh risk and burdens	Positive recommendation
1 B +	One RCT or more RCTs with methodological weaknesses, demonstrate effectiveness. The benefits clearly outweigh risk and burdens	
2 B +	One or more RCTs with methodological weaknesses, demonstrate effectiveness. Benefits closely balanced with risk and burdens	
2 B ±	Multiple RCTs, with methodological weaknesses, yield contradictory results better or worse than the control treatment. Benefits closely balanced with risk and burdens, or uncertainty in the estimates of benefits, risk and burdens.	Considered, preferably study-related
2 C +	Effectiveness only demonstrated in observational studies. Given that there is no conclusive evidence of the effect, benefits closely balanced with risk and burdens	
0	There is no literature or there are case reports available, but these are insufficient to prove effectiveness and/or safety. These treatments should only be applied in relation to studies.	Only study-related
2 C −	Observational studies indicate no or too short-lived effectiveness. Given that there is no positive clinical effect, risk and burdens outweigh the benefit	Negative recommendation
2 B −	One or more RCTs with methodological weaknesses, or large observational studies that do not indicate any superiority to the control treatment. Given that there is no positive clinical effect, risk and burdens outweigh the benefit	

Each diagnostic process has been well described and the evidence for management options reviewed within the context of a specific diagnosis. For recommended interventional techniques, a detailed description for performance is provided. Other common treatment options are beyond the scope in this series. Importantly, the literature for the pharmacological treatment is not covered in depth and little attention is paid to the multidisciplinary management and the role of cognitive behavioral treatment in this series.

This book was initially based on practice guidelines written by Dutch and Flemish (Belgian) experts that are assembled in a handbook for the Dutch-speaking pain physicians. After translation, the articles were updated and edited in cooperation with U.S./International pain specialists. Because this updating process and the sequential publication of articles, the latest literature update varies from one article to another. Sixty authors, each expert in their field, have contributed to this series.

The validation of the guidelines was carried out in a process of peer review in two stages.

The first edition of the guidelines in Dutch was submitted to the members of the Associations of anesthesiologists with special interest for pain management from the Netherlands (Nederlandse Vereniging voor Anesthesiologie sectie Pijngeneeskunde [NVAsP]) and the Dutch-speaking part of Belgium (Vlaamse Anesthesiologische Vereniging voor Pijnbestrijding [VAVP]). During the review process, more than 200 remarks and questions were raised by the members and treated by the authors. In this way, the guidelines were accepted by means of a broad consensus.

Secondly, as part of the publications of this series in Pain Practice, each translated and updated chapter was reviewed and updated by minimum two U.S. coauthors and each article underwent the journal's peer review.

The evidence rating of the interventional techniques is summarized in Table 2.

Table 2. Summary of the Evidence Rating Per Diagnosis.

Trigeminal neuralgia		
Radiofrequency (RF) treatment of the Gasserian ganglion	2 B +	Recommended
Pulsed RF treatment of the Gasserian ganglion	2 B –	Negative recommendation
Cluster headache		
RF treatment of the pterygopalatine ganglion (sphenopalatinum)	2 C +	To be considered
Occipital nerve stimulation	2 C +	To be considered in specialized centers and study related
Persistant idiopathic facial pain		
Pulsed RF treatment of the ganglion pterygopalatinum (sphenopalatinum)	2 C +	To be considered
Cervical radicular pain		
Interlaminar epidural corticosteroid administration	2 B +	Recommended
Transforaminal epidural corticosteroid administration	2 B –	Negative recommendation
RF treatment adjacent to the cervical ganglion spinale (DRG)	2 B +	Recommended
Pulsed RF treatment adjacent to the cervical ganglion spinale (DRG)	1 B +	Recommended
Spinal cord stimulation	0	Study related in specialized centers
Cervical facet pain		
Intra-articular injections	0	Study related
Therapeutic (repetitive) cervical ramus medialis (medial branch) of the ramus dorsalis block (local anesthetic with or without corticosteroid)	2 B +	Recommended
RF treatment of the cervical ramus medialis (medial branch) of the ramus dorsalis	2 C +	To be considered
Cervicogenic headache		
Injection of nervus occipitalis major with corticosteroid + local anesthetic	1 B +	Recommended
Injection of atlanto-axial joint with corticosteroid + local anesthetic	2 C –	Negative recommendation
RF treatment of the cervical ramus medialis (medial branch) of the ramus dorsalis	2 B ±	To be considered
Pulsed RF treatment of the cervical ganglion spinale (DRG) (C2–C3)	0	Study related
Whiplash-associated disorders		
Botulinum toxin type A	2 B –	Negative recommendation
Intra-articular corticosteroid injection	2 C –	Negative recommendation
RF treatment of the cervical ramus medialis (medial branch) of the ramus dorsalis	2 B +	Recommended

Continued

Table 2. Continued.

Occipital neuralgia		
Single infiltration of the nervi occipitales with local anesthetic and corticosteroids	2 C +	To be considered
Pulsed RF treatment of the nervi occipitales	2 C +	To be considered
Pulsed RF treatment of the cervical ganglion spinale (DRG)	0	Study related
Subcutaneous stimulation of the nervi occipitales	2 C +	To be considered in specialized centres
Botulinum toxin A injection	2 C ±	Only study related
Painful shoulder complaints		
Corticosteroid injections	2 B ±	To be considered
Continuous cervical epidural infusion	2 C +	To be considered
Pulsed RF treatment of the nervus suprascapularis	2 C +	To be considered
Thoracic pain		
Intercostal block	0	Study related
RF treatment of thoracic ganglion spinale (DRG)	2 C +	To be considered
Pulsed RF treatment of thoracic ganglion spinale (DRG)	2 C +	To be considered
Lumbosacral radicular pain		
Interlaminar epidural corticosteroid administration	2 B ±	To be considered
Transforaminal epidural corticosteroid administration in "contained herniation"	2 B +	Recommended
Transforaminal epidural corticosteroid administration in "extruded herniation"	2 B –	Negative recommendation
RF lesioning adjacent to the lumbar ganglion spinale (DRG)	2 A –	Negative recommendation
Pulsed RF treatment adjacent to the lumbar ganglion spinale (DRG)	2 C +	To be considered
Spinal cord stimulation (FBSS only)	2 A +	Recommended in specialized centers
Adhesiolysis—epiduroscopy	2 B ±	To be considered in specialized centers
Pain originating from the lumbar facet joints		
Intra-articular corticosteroid injections	2 B ±	To be considered
RF treatment of the lumbar rami mediales (medial branches) of the dorsal ramus	1 B +	Recommended
Sacroiliac joint pain		
Therapeutic intra-articular injections with corticosteroids and local anesthetic	1 B +	Recommended
RF treatment of rami dorsales and rami laterales	2 C +	To be considered
Pulsed RF treatment of rami dorsales and rami laterales	2 C +	To be considered
Cooled / RF treatment of the rami laterales	2 B +	Recommended
Coccygodynia		
Local injections corticosteroids/local anesthetic	2 C +	To be considered
Intradiscal corticosteroid injections, ganglion impar block, RF ganglion impar, caudal block	0	Study related
Neurostimulation	0	Study related
Discogenic low back pain		
Intradiscal corticosteroid administration	2 B –	Negative recommendation
RF treatment of the discus intervertebralis	2 B ±	To be considered
Intradiscal electrothermal therapy	2 B ±	To be considered
Biacuplasty	0	Study related
Disctrode	0	Study related
RF of the ramus communicans	2 B +	Recommended
Complex regional pain syndrome		
Intravenous regional block guanethidine	2 A –	Negative recommendation
Ganglion stellatum (stellate ganglion) block	2 B +	Recommended
Lumbar sympathetic block	2 B +	Recommended
Plexus brachialis block	2 C +	To be considered
Epidural infusion analgesia	2 C +	To be considered
Spinal cord stimulation	2 B +	Recommended in specialized centers
Peripheral nerve stimulation	2 C +	To be considered in specialized centers
Herpes zoster and post-herpetic neuralgia		
Interventional pain treatment of acute herpes zoster		
Epidural corticosteroid injections	2 B +	Recommended
Sympathetic nerve block	2 C +	To be considered

Table 2. Continued.

Prevention of PHN		
One-time epidural corticosteroid injection	2 B –	Negative recommendation
Repeated paravertebral injections	2 C +	To be considered
Sympathetic nerve block	2 C +	To be considered
Treatment of PHN		
Epidural corticosteroid injections	0	Study related
Sympathetic nerve block	2 C +	To be considered
Intrathecal injection	?	
Spinal cord stimulation	2 C +	To be considered in specialized centers
Painful diabetic polyneuropathy		
Spinal cord stimulation	2 C +	To be considered in specialized centers
Carpal tunnel syndrome		
Local injections with corticosteroids	1 B +	Recommended
Pulsed RF treatment median nerve	0	Study related
Meralgia paresthetica		
Lateral femoral cutaneous nerve (LFCN) infiltration with local anesthetic ± corticosteroid	2 C +	To be considered
Pulsed RF treatment of LFCN	0	Study related
Spinal cord stimulation	0	Study related in specialized centers
Phantom pain		
Pulsed RF treatment of the stump neuroma	0	Study related
Pulsed RF treatment adjacent to the spinal ganglion (DRG)	0	Study related
Spinal cord stimulation	0	Study related in specialized centers
Traumatic plexus lesion		
Spinal cord stimulation	0	Study related in specialized centers
Pain in patients with cancer		
Epidural and intrathecal administration of analgesics		
Intrathecal medication delivery	2 B +	Recommended
Epidural medication delivery	2 C +	To be considered
Unilateral oncologic pains below the shoulder or dermatome C5		
Cervical cordotomy	2 C +	To be considered in specialized centers
Upper abdominal pain due to cancer of the pancreas/stomach		
Neurolytic plexus coeliacus block	2 A +	To be considered
Neurolytic nervus splanchnicus block	2 B +	Recommended
Visceral pain due to pelvic tumors		
Neurolytic plexus hypogastricus block	2 C +	Recommended
Perineal pain due to pelvic tumors		
Intrathecal phenolization of lower sacral roots of cauda equina	0	Study related
Spinal pain due to vertebral compression fractures		
Vertebroplasty	2 B +	Recommended
Kyphoplasty	2 B +	Recommended
Chronic refractory angina pectoris		
Spinal cord stimulation	2 B +	Recommended in specialized centers
Ischemic pain in the extremities and Raynaud's phenomenon		
Ischemic vascular disease		
Sympathectomy	2 B ±	To be considered
Spinal cord stimulation	2 B ±	To be considered in specialized centers
Raynaud's phenomenon		
Sympathectomy	2 C +	To be considered
Pain in chronic pancreatitis		
RF nervus splanchnicus block	2 C +	To be considered
Spinal cord stimulation	2 C +	To be considered in specialized centers

Future guidelines

Thanks to the continual development of more specific diagnostic tools and to the improved understanding of the pathophysiology, and consequently the mechanism of action of the different treatment options; it is believed that treatment selection for chronic pain syndromes will become more mechanism based. Careful attention to this evolution is warranted and, when necessary, an update of the guidelines should be made.

This book on interventional pain management. can be considered an ongoing project. The methodology for literature retrieval and selection of the publications to be withheld, as well as the method for evidence scoring, should evolve with each update.

A treatment can only be recommended when the effect is proven in well-designed trials. Randomized controlled trials provide the highest level of evidence. With interventional pain management techniques, however, blinding patients and investigators can be problematic. The most important obstacle encountered during the conduct of a double-blind randomized sham-controlled trial is the patient inclusion. When explaining that there is a chance for a sham or placebo treatment, patients frequently refuse to give informed consent, and even when they are included in the study, they may withdraw, opting to go *medical shopping*. Therefore, the methodology for randomized clinical trials on interventional pain management techniques should be revisited.

The *prerandomization* design may form a solution for the inclusion problem, because patients are randomized to the interventional group or to the conservative treatment group prior to requesting consent. Patients in the control group are asked to fill out questionnaires relative to their health at regular time points, because it is the objective to carefully evaluate the treatment effect.[1]

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Supporting information

Please note: Wiley–Blackwell are not responsible for the content or functionality of any supporting information supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.

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Search strategy and evidence rating

For the non-interventional treatments, reviews of the most recent information was retrieved. For the interventional treatment options, it was the objective to have the most accurate information.

We searched PubMed with the following search strategy:

("Indication/epidemiology"[Mesh] OR "Indication/etiology"[Mesh] OR "Indication/pathology"[Mesh] OR "Indication/physio pathology"[Mesh] OR "Indication/therapy"[Mesh])

The search for the first chapter of this book was finished in November 2008 and for the last article in October 2010.

A research associate selected all the abstracts that reported on: injection therapy, epidural steroid injection, radiofrequency, pulsed radiofrequency, neurostimulation/neuromodulation and other interventional pain therapy.

The full publications of the selected abstracts were retrieved and the reference list of those articles and important review articles were hand-searched for additional information.

The authors were experts in the field of the specific indication and well-aware of the most up-to-date information, including abstracts and posters presented at congresses, which were excluded from the evaluation.

Two independent reviewers (MvK and JVZ) assessed the studies and proposed an evidence rating based on the rating described in above (Table 1).

Afterwards two other editors, one anesthesiologist and one neurologist, validated or adapted the proposed rating (FH, JP).

All articles were submitted for review and comments to the entire Dutch speaking anesthesiologists pain physicians community (Netherlands and Flemish part of Belgium). After one month all questions and remarks were discussed at the annual national meeting and a broad consensus was reached. In the second stage at least two key opinion leaders of the US have reviewed, updated and finally validated the content and the evidence rating for each article.

The last phase consisted of submission for publication in the peer reviewed journal *Pain Practice*.

1 Trigeminal Neuralgia

Maarten van Kleef, Wilco E. van Genderen, Samer Narouze, Turo J. Nurmikko, Jan Van Zundert, José W. Geurts and Nagy Mekhail

Introduction

"Trigeminal Neuralgia is the worst pain in the world," declared Peter J. Jannetta, MD in "*Striking Back!*", a layman's guide for facial pain patients.[1] Trigeminal neuralgia, or "Tic Doloureux", is a painful condition of the face. This pain has been known since ancient times; there are descriptions of facial pain by Ibn Sina (980–1073) in an Arabic text. An example of early interventional treatment is that by Locke in 1677, who applied sulphuric acid to the face of the Duchess of Northumberland in an attempt to treat her trigeminal neuralgia.

A survey conducted in 6 European countries indicated that trigeminal neuralgia significantly impacted the quality of life and the socioeconomic functioning of affected patients.[2] Trigeminal neuralgia is the most common form of facial pain in people older than 50 years of age. Various epidemiological studies have shown the annual incidence to be about 4–5 new patients per 100,000. The highest incidence occurs in the ages between 50 and 70 years; in 90% of the cases the symptoms begin after the age of 40 years. Trigeminal neuralgia is more prevalent in women than men with a ratio of 1.5:1.[3]

The pathophysiology is unclear. Based on clinical observations, compression of the nervus trigeminus near the origin of the brain stem, the so-called root entry zone, by blood vessels or tumor, may cause trigeminal neuralgia. Local pressure causes demyelination that leads to abnormal depolarization resulting in ectopic impulses.

Symptoms

Trigeminal neuralgia is recognized by unilateral short-lived, strong, sharp, shooting pains in 1 or more branches of the fifth cranial nerve. The description of the pain is very important; it must be sharp, shooting, lancinating, and "electric shock". The pain can be brought on by ordinary stimuli, such as eating, washing, shaving, cold, warmth, and draught. The distribution of the pain in the various branches of the nervus trigeminus is given in Table 1.1.

In the case history, 6 questions should be asked:

1 Does the pain occur in attacks?
2 Are most of the attacks of short duration (seconds to minutes)?
3 Do you sometimes have extremely short attacks?
4 Are the attacks unilateral?
5 Do the attacks occur in the region of the nervus trigeminus?
6 Are there unilateral autonomic symptoms?

In this way, a differential diagnosis can be made relatively quickly and an impression can be formed of whether it is essential trigeminal neuralgia.

Physical examination

Neurological examination seldom reveals any abnormalities in patients with idiopathic trigeminal neuralgia, but all cranial nerves do need to be tested. Patients who have neurological disorders often have a so-called secondary trigeminal neuralgia whereby the trigeminal neuralgia is a symptom of another disease, e.g., tumor of the angulus pontocerebellaris or multiple sclerosis.

Additional test

When the diagnosis of trigeminal neuralgia is made, the patient needs to undergo an magnetic resonance imaging (MRI) scan to exclude specific pathologies such as a tumor or multiple sclerosis, which could cause a secondary trigeminal neuralgia. The

Evidence-Based Interventional Pain Medicine: According to Clinical Diagnoses, First Edition. Edited by Jan Van Zundert, Jacob Patijn, Craig T. Hartrick, Arno Lataster, Frank J.P.M Huygen, Nagy Mekhail, Maarten van Kleef.
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Table 1.1. Pain distribution in the various nerve branches in trigeminal neuralgia.

V1 only	4%
V2 only	17%
V3 only	15%
V2 + V3	32%
V1 + V2	14%
V1 + V2 + V3	17%

See Rozen.[3]

MRI scan can also be used if there is a suspected compression of the nervus trigeminus in the fossa cranialis posterior. Sometimes the MRI scan is sensitive enough to detect blood vessels that have come in contact with the nervus trigeminus. The role of venous compression in the pathogenesis of trigeminal neuralgia is controversial.[4,5] Notably, on MRI scanning, compressing blood vessels are seen in one-third of asymptomatic patients. A recent evidence-based review concluded that there is insufficient evidence to support or deny the usefulness of MRI to identify neurovascular compression.[6]

Differential diagnosis

Less frequently trigeminal neuralgia is seen in younger patients. It is important that multiple sclerosis always be considered in the differential diagnosis, especially in bilateral cases. The International Headache Society described the following criteria for essential trigeminal neuralgia.[7]

A Paroxysmal pain that lasts from a fraction of a second to 2 minutes, occurring in 1 or more branches of the nervus trigeminus, and fulfilling criteria B and C.

B The pain has at least one of the following characteristics:
- **1** intense, sharp, superficial or stabbing.
- **2** precipitated from trigger areas or by trigger factors.

C The attacks are stereotypically described by the patient.

D There are no signs of neurological disorders.

E The attacks are not caused by other disorders.

The International Headache Society have suggested their own diagnostic criteria for trigeminal neuralgia (Table 1.2).[8] The differential diagnosis of essential trigeminal neuralgia is extensive and involves all unilateral pain in the pathway of the nervus trigeminus. The most important differential diagnostic considerations are specific facial pain, nonspecific facial pain, temporomandibular arthrosis, dental disorders, and vascular migraine. A detailed overview of the differential diagnosis of facial pain can be found in Table 1.3.[9]

Table 1.2. Trigeminal neuralgia: clinical diagnostic criteria.

Characteristic	Description
Character	Shooting, like an electric shock, stabbing, superficial
Seriousness	Moderate to very intense
Duration	Each pain attack lasts seconds but a number of different attacks can occur simultaneously after which there is a pain free interval
Periodicity	Periods of weeks to months without pain
Location	Distribution of T. neuralgia, mainly unilateral
Emanation	Within the area of the trigeminal nerve
Trigger factors	Light touching, such as when eating, talking or washing
Alleviating factors	Frequent sleep, anti-epileptics
Accompanying characteristics	Trigger zones, weight loss, poor quality of life, depression

Treatment options

Conservative treatments

The selection of the pharmacological treatment is based on a systematic review of data of relatively older studies[10] or on a more up-to-date Cochrane database.[11] The medication of choice is carbamazepine. From an observational study, it appears that carbamazepine can reduce the pain symptoms in about 70% of the cases. Oxcarbazepine has shown similar efficacy.[6] Other medications that can be tried, although there is no clinical evidence for their efficacy, are gabapentin, pregabalin, and baclofen. Rozen summarized the recommendations for the medical treatment of trigeminal neuralgia in Table 1.4.[3]

Interventional treatments

If the medical treatment is unsuccessful or has too many side effects, an invasive treatment can be carried out. In this case, there are currently 5 clinically appropriate possibilities:

1 Surgical microvascular decompression (MVD).[12]
2 Stereotactic radiation therapy, Gamma knife.[13]
3 Percutaneous balloon microcompression.[14]
4 Percutaneous glycerol rhizolysis.[15]
5 Percutaneous radiofrequency (RF) treatment of the Gasserian ganglion.[16]
6 Gasserian ganglion stimulation/neuromodulation (*experimental*).[17]

Surgical MVD

During MVD, the vessels that are in contact with the root entry zone are coagulated and arteries are separated from the nerve using an inert sponge or felt.[18]

Stereotactic radiation therapy, Gamma knife

The Gamma knife, a stereotactic radio therapeutic method, entails high dose irradiation of a small section of the nervus trigeminus. This results in nonselective damage to Gasserian ganglion. The advantage is that this is a noninvasive treatment that