The Connection

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Long-term Outcomes for Vestibular Schwannomas

By: Ryojo Akagami, MD, MHSc, FRCSC

A population-based analysis of patients treated with radiation or surgery in a multidisciplinary setting

This article summarizes preliminary data that was presented in poster format at the Canadian Association of Radiation Oncology meeting (2016). This poster is a preliminary review of our outcomes in patients from 2002-2009 (with >7 years follow-up). We are in process of supplementing this data with outcomes from patients treated up to 2012, totaling approximately 500 patients. We are also in the process of reviewing separately the surgical cohort to 2017 (also 500 patients). We will be happy to give readers an update when our manuscripts have been published and made public.

A few general comments:
It must be remembered that these are compiled numbers and not outcomes for individual patients. Acoustic neuroma patients are not randomized as patients can choose their treatment; the nature of the treatment, expected outcome and profile of complications are very different between the treatments.

There are factors that are relative contraindications for each treatment modality (such as Multiple Sclerosis, certain autoimmune disease or very large tumors in size that make radiation not a good option, and cardiac conditions, advanced age or anticoagulation that may make surgery less ideal). In general, for various reasons, larger tumors and younger patients are in the surgery group, and smaller tumors and older patients are in the radiation group. These differences in themselves would influence outcomes. Also, generally, the size of tumor affects outcomes but patients with fewer symptoms for the same size of tumor (better hearing preoperatively for example) results in better outcomes postoperatively. This preliminary review did not control or 'match' for these and other variables (something we are working on for the manuscript for better comparison between treatment modalities).

When looking at a cohort of patients accrued over years, a number of things can change

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during that period. Over the time course of the patients presented (and any papers with long term results), technology improved. On the radiation side, there are constant updates to machines and software. Although probably somewhat less operator dependent then surgery, the experience of the radiation oncology team matters. How tumors are contoured and treatment planned depends on experience. The amount of normal tissue/brain surface included to get adequate coverage of the tumor with radiation varies dependent on the radiation oncologist's interpretation of the images and knowledge of potential complications. Often for larger tumors, the dose of radiation at the tumor/brain interface are looked at closely, trying to limit potential injury to surrounding tissue but in doing so potentially sacrificing long term control by being too conservative and under-dosing peripheral parts of the tumor (the implication of which may not be discovered until a decade later when long term results become available).

On the surgical side, during the time covered in this review, we developed better monitoring techniques for following facial nerve function during surgery. We fine tuned the preoperative care and cocktail of medications that we use to prevent infections, reduce intraoperative bleeding, reduce swelling and reduce postoperative delayed facial palsies. There has been at least a couple of generations of microscopes that changed over the time course of the review presented (and a couple since). Finally, surgeon experience changes - where raw talent was more prominent early in any surgeon's career, as we get older experience compensates for maturing of talent, but at some point (just like any technical/physical task/professional athlete) there probably is an optimal time when surgeons are overall at their best (which is different for each individual surgeon). The long-term results in any paper is an average of these and may other factors over that period. Results in the beginning are different from results in the middle and different from the results today.

One should also remember that these are not just numbers. They refer to the interaction between patients and the treating team. And just as tumors are actually patients – surgeons/radiation oncologists (and the respective team) are also human. When I read papers, I always feel there is some human factor (both from the patient and treating physician perspective) that is missing. They do not capture the interaction, struggles (again both from patient and physician perspective – this group of patients are challenging!) and the mutual trust and respect, which is I think is important in management and treatment. I am always humbled by the by the bravery of patients and honored by the hope, dreams and lives they entrust in us as treating physicians.

http://www.redjournal.org/article/S0360-3016(16)31191-9/abstract

http://www.cureus.com/posters/1115-long-term-outcomes-for-vestibular-schwannomas-a-population-based-analysis-of-patients-treated-with-radiation-or-surgery-in-a-multidisciplinary-setting

Serge Markarenko, Ryojo Akagami

Long-term Outcomes for Vestibular Schwannomas

Vestibular schwannomas are benign growths of the vestibulocochlear nerve, the eighth cranial nerve. This is a nerve that carries information from the ear and the vestibular apparatus on hearing and balance. Because these lesions are benign and slow-growing, they are largely asymptomatic. However, as some vestibular schwannomas may become large, they can cause symptoms due to their pressure of adjacent neurologic structures. These symptoms are hearing loss, weakness of facial muscles, tinnitus, dizziness, vertigo, and in severe cases, symptoms secondary to brainstem compression that may lead to elevated intracranial pressure, seizures, headaches, nausea, and vomiting.

For treatment of these tumours, there is a growing body of evidence to support observation of the lesions that are small, stable in growth, and are relatively asymptomatic. Conversely, it is also generally recommended for patients that have larger, or growing lesions with symptoms to undergo treatment. For those patients with smaller lesions, either surgical resection or radiation has been used effectively for tumour control and preservation of the quality of life. In the event of failure, salvage therapy may be considered for those that do not achieve long term local control.

There is however limited evidence exploring long-term outcomes of patients treated in a multidisciplinary setting. Many current published studies investigate management of vestibular schwannomas by either the surgical, or the radiation oncology team separately. Our study aimed to characterize local control, facial nerve function, hearing preservation, and other symptoms following initial treatments for vestibular schwannomas as part of a population-based cohort in the province of British Columbia, Canada.

The treatment paradigm is unique for our patient population. The tendency in a lot of centres in North America is to treat vestibular schwannomas regardless of their size, growth pattern, and symptoms. However, tumours at our facility are treated only in the case if they are enlarging or symptomatic. In collaboration with the British Columbia Cancer Agency, decisions are made in a multidisciplinary setting after thorough review by a surgeon and a radiation oncologist. All patients are reviewed at a weekly stereotactic radiosurgery conference, and the surgical treatment is approached as a “gold standard” for definitive management of vestibular schwannomas. Those lesions that are large at diagnosis, have documented growth, or are sufficiently symptomatic are recommended for therapy. In general, large tumours (>3 cm on average) were recommended for treatment with surgery, while those that are in the small to medium range would have the option for radiation or surgery. Age, symptoms and comorbidities and patient preference influenced the treatment chosen. For example, at our facilities out of those patients that would be referred for treatment, roughly 60% would undergo microsurgical resection, and about 40% would be treated with radiation.

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For our study, we looked at all patients with vestibular schwannomas treated at Vancouver General Hospital and the BC Cancer Agency between 2002 and 2009. Patients that had been diagnosed with neurofibromatosis were excluded from this analysis. Radiation included those patients that received fractionated stereotactic radiation therapy (FSRT), and those that had received radiosurgery (SRS). The difference between the two includes one large dose of radiation versus the option of breaking it up into multiple treatments with reduced doses with the hope to reduce associated side effects. FSRT in general was used for larger tumours with brainstem compression and patients who had useful hearing. All charts were reviewed and results recorded and analyzed.

Data was collected on baseline patient characteristics, lesion anatomy, time from referral to intervention, lesion growth, residual tumour following surgery, etc. We assessed facial nerve function using House-Brackmann scale, while serviceable hearing was defined per the Gardner Robertson scale. Several assumptions were made regarding hearing pre-intervention whether it was serviceable or not. Perioperative symptoms were also recorded such as tinnitus, dizziness, and headaches. We then performed statistical analysis to compare the various groups of patients depending on the treatment they received.

We analyzed 206 patients undergoing surgery, and 136 patients with radiotherapy (91 for SRS and 45 for FSRT), with a mean age of 49 versus 61 (surgical versus radiotherapy cohorts) and a median tumour size of 2.4 cm (2.5 cm for surgical cohort versus 2.0 for the radiation group). Following surgery, 38.1% of patients retained serviceable hearing at 15 months. In the 12% of patients who presented with facial nerve dysfunction, facial nerve function improved in 38%. In the 88% of patients who presented with normal facial function, 12.6% experienced “any" weakness in the post-operative period, and for vast majority it was temporary. Overall complication rate following surgery was 4%, with one mortality, three patients experiencing a cerebrospinal fluid leak, and three requiring ventriculoperitoneal shunting for hydrocephalus.

For the group receiving radiation, 10-year freedom from tumour progression was 87.4%. In the group receiving radiotherapy, 28.7% of patients had their hearing preserved, no patients experienced improvement in facial weakness while 17% of patients had new or worsening facial nerve function. Overall complications of radiation included communicating hydrocephalus (1.5%), radionecrosis (0.7%), and steroid myopathy requiring admission to hospital (0.7%). 1 patient passed away related to the radiation therapy.

Overall, we found that all patients experienced improvement in tinnitus, vertigo, and trigeminal nerve dysfunction regardless of whether they had their vestibular schwannomas treated with surgery or radiation.

When investigated as a cohort (combining those treated with radiation and surgery as a group), the progression-free survival for patients with vestibular schwannomas was 93% at 5 years and 84% at 10 years. Ultimately, what our results show is that patients with vestibular schwannoma

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tumours overall do quite well managed at BC Cancer Agency and Vancouver General Hospital. Treatments are surprisingly comparable in terms of complications, and mortality. This is a large cohort combining multiple treatment modalities with a very long-term follow up. It should be kept in mind that this is a single-province/centre study, and as such the results are centre-dependent. Other centres that have a different management strategy might have different outcomes.

Dr. Ryojo Akagami, who has served as director and instructor in local/national/international skull base courses is the Program director and Clinical Associate Professor in the Division of Neurosurgery at UBC. He is presently a member of the World Federation of Neurological Societies Skull Base Surgery Committee. Dr. Akagami introduced the use of motor evoked potentials for monitoring cranial nerves during skull base surgery. His interests encompass quality of life and patient outcomes after surgery and investigating various molecular and genetic factors affecting induction and growth of acoustic neuromas. Current projects include hearing preservation in large >3cm acoustic neuromas and radiosurgery for growing acoustic neuromas vs the natural history of growing acoustic neuromas.

What You Can do to Manage Your Tinnitus

There are many steps you can take to manage tinnitus. Here are a few suggestions to educate yourself and get you started.

Acquiring accurate and helpful information about tinnitus is an important part of learning how to manage tinnitus. Your audiologist can provide you with preliminary information on its management. However, you may have more questions than your audiologist is able to answer in a short visit. Ask your audiologist if they can recommend reading materials on tinnitus, a local support group or a clinic that specializes in tinnitus care.

Some suggestions on where to look for accurate information on tinnitus on the internet are:

- Canadian Hearing Society and Canadian Academy of Audiology
- The American and British Tinnitus Associations
- “Tinnitus First Aid Kit” from the Ida Institute
- Tinnitus Retraining Therapy (TRT) or Habituation Therapy

Use caution – be careful about what you choose to read on the internet. Some internet sites may leave you feeling that tinnitus is unmanageable. Other sites will offer you a “cure” or unproven by research for tinnitus (although it may prove to empty your wallet).

Tinnitus self-help books written by professionals specializing in tinnitus can be very helpful in getting started on tinnitus management. Three excellent self-help books include: Tinnitus Treatment Toolbox by J. Mayes;Learning to Live with Tinnitus and Hyperacusis by L. McKenna, D. Baguley, & D. McFerran;and How to Manage Your Tinnitus: A Step-by-step Workbook by J.A. Henry, T.L. Zaugg, P.J. Myers & C.J. Kendall. All three books are available for sale on-line book and libraries.

When is a Vestibular Schwannoma Really Too Large for Radiosurgery?

By: David Mathieu, MD, FRCS(C)

Stereotactic radiosurgery (SRS) is now a recognized primary management option for small to moderate-size vestibular schwannomas. SRS is usually performed as an outpatient procedure, requiring only mild sedation and local anesthetics for head frame fixation. Patients can resume their usual activities after only a few days. It has been consistently showed in many studies that for eligible patients, tumor control rates are over 90%, which is equivalent to what is seen with microsurgical resection, but risks of complications are lower, and it provides better preservation of the quality of life of the patients.

When assessing the eligibility of a patient for radiosurgery, the important concepts to consider are the tumor volume and the clinical manifestations of the tumor. As a rule of thumb, tumors with maximum diameters of up to 3 cm are considered to have a size that is appropriate for SRS. The Koos classification, which evaluates tumor size and assess brainstem compression, is often used to guide patient management. Grade 1 to 3 tumors are smaller tumors with no brainstem compression. For these tumors, when it is felt that treatment is warranted, SRS should be given strong consideration as the initial option.

Grade 4 tumors are usually larger, and cause brainstem compression and deformation on diagnostic imaging. Because of this, many physicians will not offer radiosurgery to patients with grade 4 tumors, even when tumor diameter is less than 3 cm. However, Koos grade 4 tumors are not all the same, there can be a lot of variation in size and clinical presentation. In this situation, it is important to consider patient symptoms, and not just the results of imaging, when making a treatment decision.

Brainstem compression by itself can be well tolerated when it slowly develops, as is usually the case in benign slow-growing tumors such as vestibular schwannomas. Most tumors cause symptoms by affecting adjacent cranial nerves. This can manifest by progressive hearing loss and tinnitus (acoustic nerve), dizziness, vertigo and impaired balance (vestibular nerve), facial numbness or pain (trigeminal nerve) and rarely facial weakness or spams (facial nerve). When symptoms related to brainstem compression do occur, patients usually complain of headache, nausea, worsened imbalance and drowsiness. Patients with tumors causing symptomatic brainstem compression need to have an open resection to relieve symptoms. In this situation, SRS can be used as planed adjuvant treatment to provide long-term growth control if there is a residual or recurrent tumor. However, when patient symptoms are only due to cranial

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nerve dysfunction, the presence of brainstem compression on imaging does not preclude successful primary treatment by radiosurgery, and patients should not automatically be denied this treatment option.

To demonstrate this, we have recently reviewed our experience at the Centre Hospitalier Universitaire de Sherbrooke. We looked at all patients with Koos grade 4 tumors with a tumor diameter more than 2 cm that were treated with gamma knife radiosurgery between 2004 and 2014 and had a minimum follow-up length of 6 months. We excluded patients with neurofibromatosis type 2 and those with symptomatic brainstem compression or intracranial hypertension. Out of 335 patients with vestibular schwannomas treated during this period, 68 patients met the inclusion criteria for this study. We performed volumetric analysis of tumor volume change after treatment and assessed the evolution of the presenting symptoms, and the occurrence of complications. In this series, for most tumors (81%), radiosurgery was performed as the primary treatment, but 12 % had SRS as adjuvant treatment following partial tumor resection, and 7% for treatment of a recurrence following prior complete tumor resection. We found that the tumor was well controlled in 95% of cases at 2 years and 92% still at 10 years after radiosurgery. For patients who still had serviceable hearing at the time of SRS, it remained preserved in 89% at 2 years and still in 49% at 5 years after the treatment. No patient suffered from new facial weakness due to SRS. The majority of presenting symptoms improved after SRS. Specifically, when present before treatment, vertigo improved in 50% of patients, imbalance in 49%, tinnitus in 57%, facial pain in 100%, and facial numbness in 63%. Side effects from the SRS procedure included worsening of balance in 11%, facial pain in 10%, facial numbness in 5% and tinnitus in 10%. Most of these side effects were mild and transient. A short period of steroids was required in only 4% of patients to relieve those symptoms. Three patients eventually developed symptomatic hydrocephalus, which was relieved by performing ventriculo-peritoneal shunt insertion.

As we demonstrated in our study, many patients with vestibular schwannomas traditionally considered ineligible for radiosurgery based on size and brainstem compression on imaging can be successfully managed with this minimally-invasive treatment modality. When patients have mild symptoms related only to adjacent dysfunction, physicians should consider SRS for their patients if the global tumor volume allow it.

This illustration demonstrates a typical case of a patient with a minimally-symptomatic Koos grade 4 tumor that was managed with SRS. The top row shows the radiosurgery treatment plan. In the bottom row, from left to right, are the follow-up magnetic resonance images at 1,2,3 and 5 years after SRS, demonstrating gradual shrinkage of the tumor.

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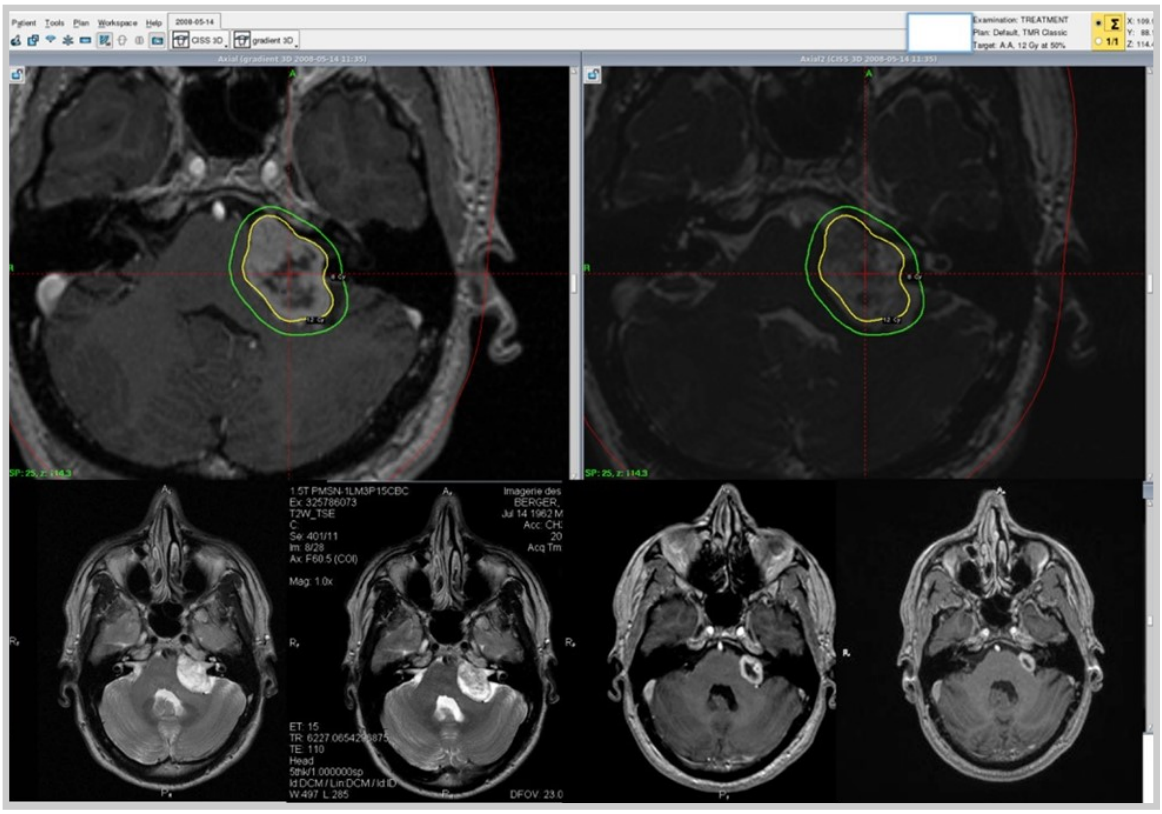

Dr David Mathieu M.D., F.R.C.S.(C) is Professor at the Université de Sherbrooke, in the Departments of Surgery, Division of Neurosurgery, and Nuclear Medicine and Radiobiology. He is the director of the Neurosurgery Division and of the Gamma Knife Radiosurgery Center at the Centre Hospitalier Universitaire de Sherbrooke (CHUS) and is also in charge of clinical research in neuro-oncology at the CHUS. He serves on the board of directors of the International Gamma Knife Research Foundation (IGKRF), a research organization dedicated to the development of multicentric Gamma Knife Radiosurgery trials. Dr. Mathieu's areas of expertise include neuro-oncology, stereotactic radiosurgery and functional neurosurgery. He is the authors of multiple publications related to these topics in peer-reviewed journals.

Stephen Covey, author of the popular book "The Seven Habits of Highly Effective People"

"I am not a product of my circumstances. I am a product of my decisions."

Covey takes full responsibility for his life - not blaming others or situations. He decided how to live and then lived accordingly. No wonder he made such an impact on business and culture. We can aspire to do the same with our lives by making decisions that serve us best.

What's up, Doc?

Meet the Chair of ANAC's Medical Scientific Advisory Committee

Gelareh Zadeh, MD, PhD, FRCSC

By: Judy Haust, Toronto

For those of you unfamiliar with the structure of our charitable organization, Acoustic Neuroma Association of Canada (ANAC) is made up of a **group of volunteers** across the country who support acoustic neuroma (AN) patients and their families through local chapter meetings where stories are shared, and practical information is dispensed. These volunteers in concert with our national executive director and ANAC's volunteer **board of directors** are crucial to the success of ANAC's mission, which includes four goals:

- to provide support and information to AN patients;
- to educate the public regarding symptoms;
- to furnish information on patient rehab to healthcare providers; and
- to promote and facilitate research into the causes and treatment of these benign tumours.

When it comes to the big picture, the fourth goal reigns supreme, and this is where our medical scientific advisory committee comes into play. Research is essential to discovering improved treatment options and, ideally, to eradicating ANs altogether. We are extremely fortunate to have Dr. Gelareh Zadeh, MD, PhD, FRCSC, as chair of this committee. She was the chief organizer and with Rex Banks, current president of ANAC, co-chaired ANAC's very successful 2016 Symposium last June at the BMO Education and Conference Centre affiliated with the Toronto Western Hospital. Let's learn a little more about this remarkable individual who plays such a significant role in our organization.

Born in Iran, Gelereh Zadeh grew up in England until the age of 16 when her family moved to Canada. She studied medicine at the University of Manitoba and, in 2006, completed a PhD in Brain Tumour Angiogenesis at the University of Toronto (U of T). She then returned to England for a couple of years as a consultant/lead in neurosurgery and neuro-oncology respectively at University College London. Since 2008, Dr. Zadeh has been affiliated with Toronto's University Health Network (UHN) practising, teaching, and conducting research in these two areas. She stands out in the crowd. She is one of just a handful of female neurosurgeons practising in Canada; an active member of the UHN's Gamma Knife radiosurgery program; and an Associate Professor in the Department of Surgery at U of T. Dr. Zadeh has received numerous honours and awards for her research and teaching, both locally and internationally, and currently holds 14 professional appointments, including the Head of Toronto Central Regional Cancer Program, Cancer Care Ontario, Head of Division of Surgical Oncology, University Health Network, and Board Member, Neurosurgery of the North American Skull Base Society of United States and the Wilkins Family Chair in Brain Tumor Research.

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Dr. Zadeh's lab at UHN is one of very few such labs in North America, and perhaps the only major one of its kind in Canada to focus on molecular mechanisms of tumour vascularization and response to radiation therapy, as well as understanding the genetics and molecular profile of skull base tumours, including vestibular schwannomas (acoustic neuromas) and meningiomas. Dr. Zadeh's clinical research focuses on establishing clinical trials for patients with brain metastases and vestibular schwannomas. Last fall, she and her team announced the results of some ground-breaking research into the causes of Schwann cell tumours, such as ANs. Overturning previous theories, the team found that a single mutation is not the sole cause for the transformation of normal Schwann cells into a tumour, based on the hypothesis that there were potentially multiple factors involved in the growth of such tumours. (For more information about the research and how drugs may play a role in the treatment, see the article by Dr. Sameer Agnihotri in the Fall 2016 issue of this newsletter.)

What are the implications of this research for AN patients? Currently our treatment options are radiation, surgery or ''wait and scan;" depending on the size, location and growth rate of the tumour. However, not everyone responds to these now standard treatments and they all have limitations, according to Dr. Zadeh. In recognizing that ANs are not all the same, this new research will lead to improved diagnosis, prognosis, and treatment tailored to the individual. It may eventually provide even more treatment options for AN patients, including the possibility of drug therapy. For the time being, however, the risks of administering targeted drugs for benign tumours far outweigh the benefits.

There is much more work to be done, but when it comes to drawing attention to these relatively uncommon benign tumours, finding sufficient research funding is always a challenge. We'll address that challenge in a future issue!

Judy Haust has an acoustic neuroma and is a member of ANAC's Board of Directors

George Herman "Babe" Ruth, an American major league baseball icon

"Every strike brings me closer to the next home run."

This is an amazing and humble statement. Babe Ruth continued to 'play the game' no matter what. He did not let success lessen his commitment to himself, to the team, or to the fans. Do you and I have the 'stuff' of Babe Ruth ? That's a question I want to ask myself each new day.

Cutting the Balance Nerve

By: Dick Barker

Why is the balance (vestibular) nerve cut during surgery for acoustic neuroma? Dr. Edward Cho, a staff otolaryngologist at the House Clinic in Los Angeles, was asked this candid question during a session dealing with "Balance Problems after Acoustic Neuroma Surgery" (September 18, 2015). He was temporarily taken aback by the question and responded that the 'why' of it was really in the province of surgeons to explain. He didn't know. But he believed there was a theory that if some balance nerve fibers are left during surgery they can sometimes misfire afterwards resulting in post-op dizziness problems for the patient.

However, researchers at Leiden University Medical Center in the Netherlands, for example, have reported on how acoustic neuroma patients presenting with disabling vertigo have had their quality of life significantly improved by translabyrinthine tumor removal; and a study at the International Neuroscience Institute in Hanover, Germany, concluded that retrosigmoid surgery was safe and very effective in providing relief for patients with disabling vestibular dysfunction, including vertigo.1

Cutting the vestibular nerve is in fact routine in acoustic neuroma surgery regardless of the presenting symptoms of the patient or the surgical approach employed. "When an acoustic neuroma is removed by microsurgery, the balance fibers in which the tumor is growing are removed along with the tumor."2 They have been compromised by the tumor and are for the most part either non-functioning or close to it. Cutting the nerve avoids any subsequent intermittent malfunctioning of damaged fibers. Of course, the result of cutting is an abrupt loss of balance input to the brain from the affected side. However, it's done in the knowledge that our amazing brain will soon be able to compensate for the loss. Some visualvestibular balance therapy will help.

Yes, things are different with radiation treatment. There is of course no cutting. Change in balance function does not occur as quickly as with microsurgery. "With radiation, change occurs more slowly, often with some persistence of balance function on the treated side."3 There is a potential for un- steadiness over a longer period of time. *This article appeared in* ANA **New Jersey's March edition 2017 newsletter.**

1 See W.P.Godefroy et al, "Translabyrinthine Surgery for Disabling Vertigo in Vestibular Schwannoma Patients," Clin Otolaryngol ,vol 32 (June 2007); and M.Samii et al, "Efficacy of Microsurgical Tumor Removal for Treatment of Patients with Intra-canicular Vestibular Schwannoma Presenting with Disabling Vestibular Symptoms," Jour Neurosurg, vol 17 (June 2016).

2 Improving Balance Following Treatment for Acoustic Neuroma (ANA Booklet, April 2004), p.5.

3 Ibid., p.7.

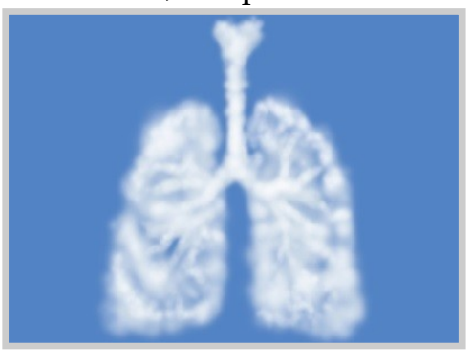
Dick Barker is a retired history professor who lives in Frenchtown, New Jersey. A graduate of the University of Rochester (1952) and Duke University (1957), he taught history for many years at Montclair State University in Upper Montclair, NJ. In 1991, at age 62, he had successful Gamma Knife radiosurgery at the University of Virginia for a 1.2cm acoustic neuroma. He has been a member of the Acoustic Neuroma Association of New Jersey (ANA/NJ) since 1995 and serves as Secretary on the executive board and Editor of the newsletter.

Your Breath is Your Brain's Remote Control

By: Crystal Goh

A new study has found evidence to show that there is a direct link between nasal breathing and our cognitive functions.

We have all heard this simple saying during times of trouble: "Take a deep breath in." Science being science, however, indicates that we may now have to update this old adage to read "Take a deep breath in it will help you be more emotionally aware but only if you inhale specifically through your nostrils and not your mouth—good luck."



While this may seem a lengthy tip to recall in the midst of uh-oh moments, the power of active breathing—voluntarily inhaling and exhaling to control our breathing rhythm—has been known and used throughout history. Even today, in tactical situations by soldiers, or in extreme cold conditions by the Ice Man, we know that slow, deep breathing can calm the nervous system by reducing our heart rate and activating the parasympathetic (calming) nervous system. In this way, our bodies become calm, and our minds also quieten. Recently, however, a new study has found evidence to show that there is actually a direct link between nasal breathing and our cognitive functions.

How Nasal Breathing Influences the Brain

Northwestern Medicine scientists were interested in understanding how breathing affects the brain regions responsible for memory and emotional processing. Through a series of experiments, they discovered that nasal breathing plays a pivotal role in coordinating electrical brain signals in the olfactory "smell" cortex—the brain regions that directly receive input from our nose—which then coordinates the amygdala (which processes emotions) and the hippocampus (responsible for both memory and emotions). We know that the "smell" system is closely linked to the limbic brain regions that affect emotion, memory and behaviour, which is why sometimes a particular smell or fragrance can evoke very strong emotional memories. This study shows, additionally, that the act of breathing itself, even in the absence of smells, can influence our emotions and memory.

Initially, the scientists examined the electrical brain signals of 7 epilepsy patients with electrodes in their brains, and found that the ongoing rhythms of natural, spontaneous breathing are in sync with slow electrical rhythms in our brain's "smell" region. Then, they also found that during nasal inhalation, the fast electrical rhythms in the amygdala and hippocampus became stronger. One way to understand this is to think of the system as an orchestra: our nasal breathing is the grand conductor, setting the tempo for the slow playing of the smell regions of the brain while weaving in the faster rhythms of the emotion and memory regions.

Your Breath is Your Brain's Remote Control

The In-Breath Encodes Memories and Regulates Emotions

To further understand these synchronous effects that nasal breathing has on our brain regions, the scientists then conducted separate experiments on 60 healthy subjects to test the effects of nasal breathing on memory and emotional behavior. Subjects were presented with fearful or surprised faces, and had to make rapid decisions on the emotional expressions of the faces they saw. It turns out that they were able to recognize the fearful faces (but not surprised faces) much faster, when the faces appeared specifically during an in-breath through the nose. This didn't happen during an out-breath, nor with mouth breathing. The scientists also tested memory (associated with the hippocampus), where the same 60 subjects had to view images and later recall them. They found that memory for these images was much better if they first encountered and encoded these images during an in-breath through the nose.

Our in-breath is like a remote control for our brains, directly affecting electrical signals that communicate with memory and emotional processing centers.

These findings show a system where our in-breath is like a remote control for our brains: by breathing in through our nose we are directly affecting the electrical signals in the "smell" regions, which indirectly controls the electrical signals of our memory and emotional brain centers. In this way, we can control and optimize brain function using our in-breath, to have faster, more accurate emotional discrimination and recognition, as well as gain better memory.

So taking a breath in through our nose can control our brain signals and lead to improved emotional and memory processing, but what about the out-breath? As mentioned earlier, slow, steady breathing activates the calming part of our nervous system, and slows our heart rate, reducing feelings of anxiety and stress. So while the in-breath specifically alters our cognition, the act of slow, deep breathing, whether the inhalation or exhalation, is beneficial for our nervous system when we wish to be more still. In fact, mindful breathing emphasizes not only the breathing component, but also the mental component of paying attention and becoming aware of mind, body and breath together.

By observing in a non-judgmental manner, without forcing ourselves to "get to" some special state, we are in fact then able to watch our minds and feel our bodies more clearly. This in turn becomes a path to insight and a practice we can keep working on. Our breath is powerful enough to regulate emotions and help us gain clarity, and to fully do so we must also make the effort to center our minds to the here and now.

Crystal Goh is an affiliate at the Applied Neuroscience Lab, which develops social-engagement programs with non-profits in Asia and USA, combining Neuroscience, Meditation and Environmentalism. Previously, she was a sleep scientist and cofounder of brain imaging company Araya. *This article was originally published on* ***Mindful.org***

Leaving A Legacy

The Acoustic Neuroma Association of Canada (ANAC), was born out of necessity, and continues over 30 years later to be the only organization of its kind in Canada dedicated to serving those affected by an Acoustic Neuroma. In 1983, Virginia Garossino, Velma Campbell and Linda Gray of Edmonton discovered there was little information and support for Canadians dealing with this rare, cranial tumor and established ANAC – a charity designed to support the complex needs of acoustic neuroma patients across Canada.

We are proud of what ANAC has accomplished, but we know that to continue to provide the tools and resources that all Canadians need to ensure early diagnosis and successful treatment, we rely on the generous support of the community, our members, donors and friends. Legacy gifts allow ANAC to plan for the future, and allow you to decide the kind of legacy you want to leave behind.

Give a Gift that Grows

When you include a gift to ANAC in your estate plans, you will join a group of compassionate individuals who are investing in providing the best possible support system and allowing ANAC to continue its best effective programs.

If you have any questions, please feel free to reach out to our Executive Director, Carole Humphries and talk to your financial advisor about adding ANAC into your after-life plans.

How it Works

There are many ways to remember ANAC in your Will. It doesn't have to be a large amount – every dollar makes a difference for a Canadian family facing an acoustic neuroma.

You Can Leave a Share of Your Assets

One way to help is to leave a percentage of what is left of your Estate or assets after all remaining gifts and debts have been paid, also known as a 'residual gift'. If you already have a Will and are considering adding a residual gift to ANAC, your lawyer or financial planner can help you understand just how far your gift can go.

You Can Leave a Fixed Sum of Money

You may wish to leave a specific amount to support a specific aspect of ANAC's work. This is known as a 'specific gift'. We would love to speak with you about how you can make a difference through a legacy gift of this kind.

Leaving A Legacy

You Can Leave a Specific Item of Value

You can choose to leave a particular item of value to ANAC, which can be sold to support our programming. It can be property or an item of value.

Why a Legacy Gift?

A legacy gift is a lasting statement of your generosity and an opportunity to say that you care about individuals who have an acoustic neuroma Once, it was you or a loved one who faced the reality of an acoustic neuroma. Your support will help make a lasting impact for generations of Acoustic Neuroma patients and their families.

Choosing to remember ANAC with a donation in your Will is the best way to ensure more Canadians facing an acoustic neuroma have access to the support system they need to live their life to the fullest, and empower them with the best possible information so they can make informed decisions about their health.

Enjoy tax benefits: By including charitable gifts in your Will, you may avoid significate taxes payable upon your death

There's no commitment: Things change, and that's ok. Because you are not making this gift during our lifetime, you can change your mind and you Will at anytime

If you have any questions, please feel free to reach out to: Carole Humphries, Executive Director and talk to your financial advisor about adding ANAC into your afterlife plans.

Make a difference to those Canadians will be diagnosed with an acoustic neuroma, so they won't have to face their uncertainty alone.

Every Gift has a Lasting Impact!

Robert Louis Stevenson, Scottish poet, and author of
The Strange Case of Dr. Jekyll and Mr. Hyde lived by his own words.

"Don't judge each day by the harvest you reap but by the seeds that you plant."
I find comfort in those words. As long as we are planting healthy seeds each day
we are sure to have a rich harvest.

The Acoustic Neuroma Association of Canada is working to develop support groups in each province across Canada to ensure people affected by Acoustic Neuroma receive the support they need. Volunteers are currently needed in British Columbia, Quebec and all East Coast Provinces. If you are interested in helping establish a new group in an under serviced area, please contact Carole Humphries at the National Office for an information package and support.

director@anac.ca **1-800-561-2622**

Upcoming Chapter Meetings Planned

KITCHENER—WATERLOO CHAPTER

Date: **Saturday April 29, 2017—10am—12 noon followed by a potluck lunch**
Location: Home of Tom & Helene Horlings
#30—50 Bryan Court
Kitchener, ON N2A 4N4
For more info: Linda Darkes
(519) 696-3445 / pdarkesc659@rogers.com
Helen Horlings
(519) 954-5581 / healto@rogers.com

BRITISH COLUMBA: COURTENAY/NANAIMO CHAPTER

Date: **Saturday June 3, 2017—12 noon—3pm**
Location: Atrium at Crown Isle Resort & Golf Community 399 Clubhouse Drive, Courtenay, BC
For more info: Evalyn Hrybko
(250) 282-3269 / wehrybko@saywardvalley.net

TORONTO CHAPTER

The upcoming meetings are:
Dates: **Tuesday, May 23, 2017**
Tuesday, July 25, 2017
Tuesday, September 26, 2017
Tuesday, November 28, 2017
Location: Canadian Hearing Society
271 Spadina Road, Toronto, ON (Parking in the rear)
For more info: Lynda Nash
(416) 282-0036 / lynda_lu123@sympatico.ca
Kathryn Harrod
(905) 891-1624 / tim.harrod@sympatico.ca

ANAC
P.O. Box 1005
7 B Pleasant Blvd.
Toronto, ON M4T 1K2

T: 1-800-561-2622
T: 1-416-546-6426
E: director@anac.ca

Website: www.anac.ca
Facebook: Acoustic Neuroma Association of Canada–ANAC
Twitter: @CanadaAN