COMMENTARY

THE STROKE ISSUE: PAUCITY OF VALID DATA, PLETHORA OF UNSUBSTANTIATED CONJECTURE

INTRODUCTION

The debate regarding chiropractic cervical adjustments (manipulation) and the potential risk of vertebrobasilar artery (VBA) dissection has become increasingly more emotional and political than scientific. As a scientist and a practitioner, I find it disconcerting that the published literature contains more unsubstantiated misinformation than useful scientifically valid information. Depending on which "expert" a person references, the chance of VBA dissection after chiropractic adjustment ranges anywhere from 1 in 5000 to 1 in 5 million.[1-8] How is such a range of expert opinion possible? The answer, quite bluntly, is due to the fact that none of these risk estimates are based on valid scientific information.

The question being begged is why none of the expert risk estimates are based on valid scientific information. The answer to this question is that there are absolutely no valid scientific data available from which to estimate the risk of having a stroke caused by a chiropractic adjustment. In fact, there are not even any valid data available to accurately estimate the chance of stroke associated with chiropractic adjustment. Studies which could validly address these questions simply have not been conducted and will likely never be conducted, because the amount of resources required to validly study something so rare would be beyond what is either available or prudent to allocate.[3,5,9] As has been recently pointed out by one of the world's most renowned experts in study design to determine causality, the incidence of stroke associated with chiropractic adjustment is so rare that this would require a subject pool of millions of patients and may not be humanly important to pursue.[9] This stance becomes even more logical when considering the fact that common medical procedures (including over-the-counter nonsteroidal anti-inflammatory drugs [NSAIDS]) for health problems stemming from the joints, nerves, and muscles of the neck have medically acceptable risk ratios far exceeding even the highest risk estimates for chiropractic.[4,10]

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DISCUSSION

A review of the literature regarding the relationship between chiropractic and stroke provides very little useful information. The vast majority of the published literature is comprised of case studies, case series, or case-control studies, none of which are capable of providing valid information regarding causation or risk. These types of studies can, of course, provide useful information with regard to suggesting a direction of future research, but they should never be interpreted as a valid means of determining causality. The only valid conclusion that can be reached from review of the available literature is that due to methodological shortcomings, there are literally no scientifically valid data that establish chiropractic adjustment as either a cause of stroke or as being associated with an increased risk of stroke.[11]

What one does find, however, and what is disturbing to those of us relying on peer review to ensure validity of published material are risk estimates and suggestions of causation published in peer-reviewed journals.[1,6,8] This problem becomes even greater when these unsubstantiated claims end up referenced in future papers and come to be considered factual. Many papers published on this topic contain statements that "in rare cases," chiropractic can cause a VBA dissection and then go on to provide risk estimates regarding chiropractic and stroke. What is so misleading is that none of these papers reference any valid data. This type of misinformation appears on informed consent forms and on chiropractic college patient information brochures.[2] Are these statements now so engrained in our consciousness that they are believed to be true or are they just poorly judged political statements designed to represent our profession as willing to admit risk? The truth is that asking a patient to sign an informed consent form that contains false information is a dangerous concept for both the patient and the practitioner no matter how politically correct it may appear.

Some may argue that the number of case studies published identifying chiropractic adjustment as the precipitating event in VBA dissection or occlusion provides evidence of causation or increased risk. This is an invalid conclusion for several reasons. First, it is irrelevant how much invalid information one has to support a hypothesis. An accumulation of invalid data provides no more or less validity than a stand-alone source of invalid data; validity,

like statistical significance, is a black-and-white issue. Second, the emergence of most commonly reported precipitating events in the case study literature is nothing more than a by-product of which cases are most commonly written up and published and not a reflection of which cases are truly most common. Furthermore, it is more likely that cases with a seemingly identifiable cause such as chiropractic adjustment or physical trauma will be written up and published and this can lead to the false impression that these events are more commonly associated with VBA dissection.[5] "VBAs are rare events with potentially dire consequences. When they occur in otherwise healthy young adults, the natural tendency to seek explanation (recall or remuneration bias) may exaggerate the apparent association with use of chiropractic services."[3] It may also be that the neck pain that can result from a VBA dissection actually causes a patient to seek out chiropractic care. "The association could also arise from confounding, in which some underlying pathology led to both the VBA and symptoms such as neck pain for which someone sought chiropractic care in the first place."[3] Even taking into account confounding and recall bias, the fact remains that the most commonly published cases of VBA dissection have not been associated with a chiropractic adjustment or trivial or major trauma but are, rather, classified as spontaneous.[5]

What can be extrapolated from the available data is that VBA dissections account for approximately 1.3 per 1000 cases of stroke,[3,5] that the overwhelming majority occur in the absence of any association with chiropractic cervical adjustment,[3] and that millions of chiropractic cervical adjustments are performed in the absence of VBA dissection every year.[2-6,8] Furthermore, the most commonly reported precipitating events associated with VBA dissection are classified as spontaneous (no identified precipitating event) and many others are classified as "trivial trauma" or as "mundane common activities of daily living," such as walking, kneeling to pray, and household chores.[5] This means that no case of VBA dissection in history has avoided being exposed to the most commonly identified precipitating events. In other words, whether or not a case of VBA dissection has been exposed to major trauma, trivial trauma, or chiropractic cervical adjustment, they have, without exception, also been exposed to several other more commonly identified precipitating factors or variables.

Further confusing the issue is that many case studies and reviews (some chiropractic) erroneously presuppose that an adjustment represents a potential traumatic event to the vertebral artery and that it can thus result in VBA dissection.[1,3,12,13] As an example, Norris et al[1] recently stated that "Most patients undergoing therapeutic neck manipulation will have no ill effects, but there is no doubt that chiropractic neck manipulation can result in dissection of the carotid or vertebral arteries leading to stroke." This is a puzzling claim, considering there are no data to support it; this statement was not referenced. What is unfortunate is that this statement appeared in the *Canadian Medical Association Journal* and most certainly had a great influence on many in both the medical and chiropractic professions who read it.

The only data available on the forces transmitted to the vertebral artery during a chiropractic cervical adjustment were published by Symons et al[14] and indicate that an adjustment represents less force to the vertebral artery than turning the head within the normal range of motion. In other words, a chiropractic adjustment represents less trauma than a mundane common activity of daily living. This is important information in light of the fact that both the chiropractic and medical literature contains information from "experts" that openly infer that a chiropractic cervical adjustment does represent potential trauma to the vertebral artery.

To illustrate the lack of methodological validity with respect to the literature regarding the issue of chiropractic and stroke, a short critique of 3 of the most recently published and most highly publicized articles is provided. One often quoted study used the number of lawsuits against chiropractors in relation to the number of chiropractic cervical adjustments as a method of estimating the risk of stroke associated with chiropractic adjustments.[8] This type of methodology could never provide any valid data. This is analogous to using the number of lawsuits against medical doctors in relation to the number of filled prescriptions to estimate the risk of adverse reactions to a particular drug. In my opinion, this offers a disturbingly clear example of how political and emotional, rather than scientific, this topic has become, even in the peer-reviewed literature. It is likely that this study was conducted as a response to the invalid claims that chiropractic adjustments have been linked to an increased risk of stroke. However, using risk estimates from this type of data will never represent a sound scientific defense regarding the safety of chiropractic. Future publication should be restricted to valid data and its analysis.

Two of the most commonly quoted and most controversial studies on the topic of chiropractic and stroke are the recently published case-control study conducted by Rothwell et al[3] and the case series by Norris et al[1] conducted in association with the Canadian Stroke Consortium. Neither of these study designs is appropriate in terms of determining causality. The Rothwell et al[3] study provided a template for future research in terms of risk ratios, but the paucity of numbers and the admirably self-admitted methodological flaws make the information from this study nothing more than speculative in terms of prevalence and incidence and completely useless (again self-admitted by the authors) in terms of causality. "This study design does not permit us to estimate the number of cases that are truly the result of trauma sustained by manipulation (chiropractic adjustment)."[3] Here again, we have researchers unscientifically presupposing that a chiropractic adjustment can result in trauma being sustained to an artery. What is even more

interesting is that not a single case of vertebrobasilar artery dissection was reported. Whether this is due to methodological shortcomings resulting in the inability to extrapolate this information or the fact that no dissections took place is impossible to ascertain. ''Positive validation of the type of stroke would require diagnostic imaging and invasive testing well beyond the scope of such a study.''[3] Nonetheless, based on the diagnostic codes that were used, the authors report that of the 582 cases, ''221 (38%) had occlusion or stenosis of the basilar artery; 283 (49)% had occlusion or stenosis of the vertebral artery; 28 (5%) had occlusion of both basilar and vertebral arteries; and 50 (9%) had injury to an unspecified blood vessel of the head and neck.''[3] To put the absolute numbers from this study in perspective, ''Of the 582 VBA cases, only 9 had a cervical manipulation within 1 week of their VBA.''[3] Once again, we have to wonder why research is being focused on 9 of the 582 cases when 573 cases remain to be explained. Certainly, it seems more logical and more scientific to identify what caused the 573 cases and control for this before considering a variable that is temporally associated with only 9 cases.

Perhaps the political, rather than scientific, nature of this disproportionate attention can be best elucidated with the following parallel. Imagine I conducted a study to ask whether or not chiropractic could cure cancer and, in parallel to Rothwell et al[3] and Haldeman et al[5], who report that VBA dissections represent 1.3 cases per 1000 stroke cases, I report that complete remission of cancer represents 1.3 cases of cancer per 1000. Now imagine that, as reported in the Rothwell et al[3] study, during the period between 1993 and 1998 there were a total of 582 cases of VBA occlusion or dissection (actually, there were no reported dissections) reported in Ontario, Canada and that I report during this time frame there were a total of 582 cases of complete cancer remission in Ontario, Canada. Now imagine that, as the Rothwell et al[3] study reported that 9 of the 582 cases of VBA were associated with a chiropractic cervical adjustment within 1 week of the VBA, I report that 9 of the 582 cases of cancer remission were associated with a chiropractic adjustment within 1 week. Is it reasonable to conclude that my study would be published in a peer-reviewed medical journal specializing in cancer, that it would be widely reported on in newspapers across Canada and the United States, and that there would be memos sent to virtually every medical center in Canada quoting my study as a valid source of evidence showing that chiropractic is a cure for cancer and that it should be immediately considered as one of the best available treatments? Or, based on your understanding of probability, causation, scientific methods, logic, and ethics, would you conclude that these data are grossly insufficient to consider them even remotely useful? Would you also not ask what was responsible for the other 573 cases of remission and whether the patients had undergone any forms of care or treatments other than chiropractic (especially if several of these had been reported in the literature to be more commonly associated with cases of cancer remission) and suggest allocation of resources to extrapolate this information before more funds were spent studying the relationship between cancer remission and chiropractic? I think the point is made.

The Norris et al[1] study shortcomings are perhaps best described in the words of his medical colleagues Kapral and Bondy,[15] who accurately state that it may provide some interesting information with regard to arterial injury associated with stroke but ''lack of blinding of the assessors may have led to bias in the assessment of exposure. In addition, case series such as this can never provide an estimate of risk of stroke or even establish a causal relationship between the exposure and the outcome because of the absence of a control group.''[15] Sadly, Norris et al[1] failed to realize these shortcomings and stated in their paper that ''Stroke resulting from neck manipulation occurred in 28% (21/74) of our cases.'' Since their study design clearly does not allow determination of cause (or what any of the strokes ''resulted'' from), it is confusing that a statement such as this would be made and perhaps alarming that it was published in a peer-reviewed journal and subsequently released to the media and distributed to many medical practitioners across Canada. When you consider that Norris released his information at a press conference shared with a lawyer for an alleged chiropractic stroke victim who was suing the treating chiropractor, the chiropractic institution the chiropractor had attended, the president of this chiropractic college, and the chiropractic association; that he gathered a group of 60 fellow neurologists and released unsubstantiated information to the media warning of the dangers of chiropractic cervical adjustment; and then went on the radio and announced that the risk of VBA dissection from chiropractic cervical adjustment was 1 in 5000, it becomes apparent that something other than science was being conducted here.[16]

In terms of a parallel to the Norris et al[1] study, this could be represented by imagining a case series study that I conducted, where after a case of cancer remission had been reported to a hospital, the only question posed to the patient was whether or not they had visited a chiropractor. If the answer was yes, regardless of any other things the subject may have done to treat their cancer or improve their health, I concluded that this represented a case of cancer cured by chiropractic. Now, imagine this study was published in a peer-reviewed medical journal and that I called a press conference and announced that I had conducted a prospective study that provided evidence that chiropractic cured cancer (please note that my study design was clearly retrospective, not prospective). Imagine also that this press conference was shared with a lawyer from a family of a victim of cancer who was suing the treating oncologist, the oncologist's medical school, the president of the medical school, and the medical association because the oncologist had failed to recommend chiropractic as a treatment for

cancer and was therefore to blame for the death of the cancer patient. Further, I gathered a group of 60 fellow chiropractors and released a statement to the press that we had evidence that chiropractic cured cancer. Imagine also, if it is possible to continue to consider such a scenario, that I subsequently went on television and radio and announced that chiropractic was responsible for over 28% of all cancer remissions. I strongly suggest that there are only 3 possible logical conclusions that you could arrive at, based on such a scenario. First, you may conclude that I was absolutely ignorant regarding research study design, data interpretation, the scientific method, and scientific ethics. Second, you may conclude that I had an agenda to harm oncologists and the field of medicine. Third, you may conclude that both these things were true.

Concluding Summary of Facts

Fact 1. The vast majority of VBA dissections and occlusions (and all forms of stroke) occur without any association to chiropractic cervical adjustment.[3-6,8] The best available data, and it cannot in any way establish a chiropractic cervical adjustment as the cause of any of the reported cases of VBA dissection or stroke, suggest that approximately 9 out of every 582 cases of VBA dissection or occlusion (it must be noted that there were no VBA dissections in this study) can be temporally associated with a chiropractic cervical adjustment within 1 week.[3] This figure represents 1.55%. Based on statistical analysis of the available evidence, it is unscientific and illogical to consider chiropractic adjustment as the most likely cause of any VBA dissection or occlusion.

Fact 2. There are millions of chiropractic cervical adjustments performed every year without incidence of VBA dissection, occlusion, or stroke.[3-6,8]

Fact 3. There are no valid scientific data available to establish the cause of any VBA dissection, because the only available data are from studies with methodologies incapable of validly establishing causation.

Fact 4. There are no valid data that can identify any variable as the cause of any VBA dissection. The data available can only identify precipitating events associated with VBA dissection but cannot determine if any of these events was the cause of the VBA dissection or even if any of these events are associated with a greater incidence of VBA dissection or occlusion.

Fact 5. The most commonly reported VBA dissection case reports in the literature have no identified precipitating factors and are classified as spontaneous.[5] Many more VBA dissection cases are said to be precipitated by events classified as ''trivial trauma'' or ''mundane common activities of daily living,'' such as turning the head while driving, sneezing, playing tennis, walking, kneeling to pray, and performing household chores.[5] This information must be further considered in light of the fact that it is more common to write up a case in which a precipitating event has been identified; therefore, many cases considered to be ''spontaneous'' or as occurring after mundane common activities of daily living are very likely not submitted as case reports. This can skew the published data and makes any reference to rate of risk of any particular precipitating event invalid speculation. There are no valid data available from which to extract rates of risk of VBA dissection or occlusion associated with any precipitating event.

Fact 6. The only data available on the forces transmitted to the vertebral artery during chiropractic adjustment indicate that a chiropractic adjustment represents less force to the vertebral artery than mundane common activities of daily living[14] (ie, less force than turning the head within the normal range of motion).

Fact 7. Every VBA dissection victim in history has had recent exposure to mundane common activities of daily living that have been identified as a common precipitating event in VBA dissection and occlusion and thus cannot be eliminated as the possible cause.

Fact 8. The fact that VBA dissection is so rare and the fact that so many millions of chiropractic cervical adjustments are performed each year would mean that a valid study to determine if there is a true risk from chiropractic cervical adjustment would require millions of subjects. Considering that common medical treatments (NSAIDS, surgery) for neck pain and other health problems stemming from the joints, nerves, and muscles of the neck carry a much greater known risk than that hypothesized with chiropractic adjustments and the fact that these are considered acceptable risks within the medical field, the importance of such a study does not seem to warrant the cost. Considering that more than 98% of VBA dissections and occlusions are associated with events other than chiropractic cervical adjustment, it becomes obvious that studies to identify these factors warrant much more attention and resources.[3]

Chiropractic can be proud of its exemplary standards in the areas of informed consent and the allocation of funding for research to study issues of safety. As a responsible, ethical, and caring profession, chiropractic must continue to look into the issue regarding the potential risk of chiropractic adjustment. At this time, it cannot be scientifically stated that there is no risk of VBA dissection from chiropractic cervical adjustment. It can, and in my opinion must, be scientifically stated that there is neither valid evidence of a causal relationship between chiropractic cervical adjustment and VBA dissection nor any valid data to estimate a risk of VBA dissection associated with chiropractic cervical adjustment. It can also be stated that the data that are available regarding the total number of adjustments performed each year, the total number of VBA dissections and occlusions that occur in the absence of chiropractic adjustment each year, and the data that indicate a chiropractic cervical adjustment represents less force to the vertebral artery than

movement within the normal range of motion make it more logical to assume a temporal rather than causal link between these 2 events. If any valid scientific data arise in the future which suggest that the risk of stroke is increased due to a chiropractic adjustment, I trust the chiropractic profession will do all it can to report this honestly and take appropriate measures to minimize any potential risk to patients. Until such data are available, the most scientific, ethical, and logical thing to do has been intelligently and scientifically stated by Haldeman et al.[5] "In the absence of such a definitive trial the current understanding of the exact mechanisms and risk factors for vertebrobasilar artery dissection must be considered no more than speculation."[5] Haldeman et al[5] go on to further state that "Until that happens (determination of causes of dissection), vertebrobasilar artery dissection after neck movement, trauma, or manipulation (chiropractic adjustment) should be considered a rare, random, unpredictable complication associated (not caused by) with these activities." It is my sincere hope that future literature, chiropractic press releases, and informed consent forms will incorporate this information.

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