Is this patient having a stroke? A report of 2 cases presenting to a chiropractic office

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DISCLAIMERS
Ethics Approval and consent to participate: This report was written in accordance with CARE guidelines.

Competing interests: The author was the treating provider for both patients in this report.

Fundings: None

ABSTRACT

Background

Serious conditions such as stroke and conditions that mimic stroke may present to the chiropractic office and have the potential to be overlooked and subsequently mismanaged with examination primarily aimed to rule out the specific condition. The following two cases illustrate uncommon vascular conditions presenting at a chiropractic clinic and the clinical reasoning and diagnostic skills necessary to properly identify and manage such conditions.

Case Presentation

Two adult patients presented to a chiropractic clinic with severe headaches, vomiting, and orthostatic headache. In case 1, history and exam appeared to rule out stroke and chiropractic care including cervical manipulation was provided. However, a report of an orthostatic component to the headache was overlooked and the patient was later admitted to a hospital, diagnosed with spontaneous intracranial hypotension with sequela of subdural hemorrhage, and successfully treated with an epidural blood patch. Case 2 was immediately referred to the emergency department based on its similarities with case 1 and she was subsequently diagnosed with an intimal tear of the subclavian artery. After evaluation and clearance from a vascular specialist, normal chiropractic care including cervical manipulation commenced. Both patients reported complete recoveries at follow up.

Conclusions

Potentially serious conditions, including some which may mimic stroke, may present to a chiropractic clinic. These conditions may be missed if clinicians are not aware of their unique etiologies and fall into cognitive bias. Future research should explore the spectrum of emergency conditions presenting to chiropractic offices to guide future chiropractic education.

KEY WORDS:

“Headache”, “Subclavian Artery”, “Intracranial Hypotension”, “Vertebrobasilar insufficiency”, “Case Report”, “Stroke”, “Differential Diagnosis”, “Chiropractic Manipulation”.

BACKGROUND

Cardiovascular diseases are the leading cause of mortality in the United States(1) and Australia(2), and many of those conditions have an acute nature requiring prompt intervention(3). These kinds of conditions are often encountered in emergency settings(4), but may also present in primary care settings(5), and in chiropractic settings(6). As such, it is important that portal of entry providers, such as chiropractors, have the ability to recognize such conditions and refer immediately to prevent serious injury to their patients.

Unfortunately, diagnostic error—in particular misdiagnosis—is not uncommon in medical practice(7,8), and cognitive bias is a common reason for medical error(8–14). Cognitive bias, among other reasons, is described as inherent or learned cognitive reasoning which may lead to deviations from rules of logic and probability and considered to be a basis for rational thought, and there are at least 30 different types of known biases which may affect medical decisions(15). Cognitive bias may lead to missing a crucial diagnosis when the initial examination focuses on a certain, expected condition and testing for the condition is normal, such that no further conditions are considered.

Fortunately, past mistakes are an opportunity for learning. Evidence suggests that providers who make medical mistakes improve after reflection on these errors(16–18), and it is one role of the case report in research literature(6,19).

What follows are two cases. The first illustrates an example of cognitive bias, and the second case demonstrates improved quality of care after reflection on errors made in the former.

CASE PRESENTATION

Case 1

A 60-year-old white male, 6’3” 265lbs (1.9m, 120.2kg, body mass index [BMI] 36.9) presented to a chiropractic provider with a chief complaint of headache with insidious onset 13 days prior. The headache was localized bilaterally to his face, frontal, parietal, and occipital regions. The patient described the headache as being an intolerable pain rated as a 9 on the 11-point verbal rating scale (VRS) and characterized it as a “clamping” sensation. He described concomitant symptoms of constant nausea and dizziness and lack of bowel movements over the past 3 days. The severity of his headaches, dizziness, and nausea had worsened since onset. The patient had no prior history of headache, and did not have difficulty with ambulation, speech, or signs of facial palsy. He denied any associated pain radiation into the extremities, numbness, or tingling. The patient reported obtaining relief with the use of hot and cold packs. At his second visit, the patient remarked that lying down significantly relieved his headache. The patient listed various

activities which aggravated his headache, including coughing/sneezing, household chores, self-care, bending, standing in place, and arising from a seated position.

At the time, the patient was taking warfarin and tacrolimus following a liver transplant 3 years prior due to alcoholic cirrhosis (side effects include bleeding, skin necrosis,(20) and hypertension, dyslipidemia, nephrotoxicity,(21) respectively). The patient denied past or present tobacco use and did not report any other significant relevant past medical, social, or family histories.

The patient stated he had visited his primary care provider (PCP), a Medical Doctor, 3 days prior for the same complaint which included a physical examination and advanced imaging. By this time in the interview, the examining chiropractor suspected the possibility of stroke and requested those records for review while a physical examination took place. Records were acquired while the physical exam was administered and reviewed immediately following its completion. They described a similar presentation and documented an unremarkable neurological examination. The PCP had ordered a magnetic resonance angiogram (MRA) of his brain and neck vasculature which was completed the same day. The MRA demonstrated patent vasculature without evidence of stenosis, occlusion, or aneurysm in his anterior and posterior cervical circulation, or brain.

Blood pressure at time of intake was 128/86mm Hg. Active cervical range of motion (ROM) was significantly limited and severely painful in all directions. The patient appeared to have antalgic forward head posture. He was tender to palpation in the upper, mid, and lower posterior cervical region and upper trapezius bilaterally with hypertonicity of the associated musculature. During orthopedic evaluation, Spurling's test and shoulder depression test reproduced moderate to severe pain in the cervical region bilaterally without radiating symptoms. Headache symptoms were not affected. Cervical distraction was negative and a cervical extension-rotation test did not exacerbate the patient's symptoms or produce nystagmus. There was no observed facial asymmetry, muscle clonus, nystagmus, or other gross visual evidence of neurological dysfunction observed. Further neurological examination (e.g. visual fields, Hoffman's reflex, deep tendon reflexes) was not completed.

Following the exam and review of records, a licensed chiropractic colleague was consulted for a second opinion before any treatment was administered during the visit. After this, it was determined that the patient did not likely have any serious pathologies of an urgent nature or that contraindicated high-velocity low-amplitude (HVLA) spinal manipulation of the cervical region, and he was assigned a diagnosis of tension-type headache and myalgia. Cervical manipulation was then administered during the initial visit with the patient reporting modest relief following therapy. The patient returned 4 days later for his second visit which included interferential deep muscle electrical stimulation and manual soft tissue therapies to the posterior cervical region, moist heat to the entire back, and spinal manipulation. The patient again reported modest relief. The patient did not report for his third appointment.

It was later discovered that the patient had been admitted to a hospital four days after his second visit, where a subdural hematoma (SDH) was identified. Initial computed tomography (CT) led the medical team to the opinion that this was a sequela of subarachnoid hemorrhage (SAH). Subsequent brain magnetic resonance imaging (MRI) findings were suggestive of intracranial hypotension and also noted a "cerebrospinal fluid (CSF) leak causing a shearing force on bridging veins resulting in SDH." A day later, the patient received an epidural blood patch, in which autologous blood is injected into the epidural space to allow clotting at the location of leakage18. This significantly improved his symptoms and he was discharged the following day for follow up CT in one week. Despite attempts to do so, no records of this medical follow up appointment could be obtained. At telephone follow-up by the treating chiropractic provider 18 months later the patient reported a full recovery with no residual symptoms.

Table 1: Patient 1 Timeline

Day 1	Approximate onset of initial symptoms
Day 11	Patient presents to PCP for evaluation Diagnostic MRA and Labs taken
Day 14	Patient presents for Chiropractic evaluation and treatment*
Day 16	Patient presents for follow-up visit at Chiropractic clinic*
Day 20	Patient admitted to Emergency Care facility
Day 22	Patient receives epidural blood patch
Day 23	Patient is discharged from EC facility with significant resolution of complaint
~18mos	Follow up call from chiropractic provider reporting no residual symptoms

*treatment included HVLA cervical manipulation

Case 2

A 64-year-old white female, 5'4" 140lbs (1.6m, 63kg, BMI 24) reported to the same chiropractor as in case 1 with neck pain and headache following a motor vehicle collision (MVC) which had occurred approximately 2 weeks prior with complaints of neck pain and headache. The patient reported that she was the restrained, left-sided driver in her vehicle, turning left at approximately <15 miles per hour (mph) when another vehicle struck the driver's side of her vehicle traveling approximately 25-40mph. The patient denied any loss of consciousness, bodily impact with interior of the vehicle, or airbag deployment. She stated that immediately she began having symptoms of neck and right arm pain and soreness and later reported onset of a headache. She reported progressive worsening of symptoms since onset.

The patient presented to an urgent care facility immediately following her accident where radiographs were taken of her cervical spine and muscle relaxants were prescribed. The

patient reported that nothing significant was identified on her radiographs aside from mild degenerative disc disease.

Her headaches began 2 to 3 days after the MVC and were characterized as pounding. The patient stated that she had vomited at least 5 times since their onset and at times felt symptoms of dizziness. She felt relief from her headaches if she lay supine, and symptoms increased if she lay on her side. Her neck pain was local to the posterior cervical region and right deltoid/upper trapezius region and characterized as sharp, stiff, and at times dull, and worsened with driving and getting in and out of her car. She denied any associated radicular symptoms including numbness, tingling, or shooting pains into the extremities. Overall, she rated her pain intensity as a “15/10” on the VRS scale, noting that her prescription could keep her pain between a 6 and 10, but that it only affected the symptoms in her neck, not her headache. Outcome assessment scores—obtained at the second visit—were 36/70 (51%), 34/70 (49%) and 56/100 (56%) for the Neck Bournemouth (NB), Back Bournemouth (BB) and Headache Disability Index (HDI) questionnaires, respectively.

The patient’s medical history included a transient ischemic attack 3 years prior, breast cancer treated by mastectomy over 3 years prior, and atorvastatin prescription for high cholesterol (side effects include primarily myopathies(22)). She also had a prior MVC in 2011, but did not report any residual complaints as a result.

Active cervical ROM was mild to moderately reduced with associated mild or moderate levels of pain and stiffness in most ranges accompanied by tenderness of the associated musculature and anterior head carriage. Spurling’s and cervical distraction produced mild pain in the cervical region. Shoulder depression produced moderate levels of pain in the cervical musculature. No radicular symptoms were reproduced during the exam. Neurological exam included evaluation of upper extremity deep tendon reflexes, dermatomes (gross touch), visual fields, and pupillary response to light, which were normal aside from a slight decrease in her pupillary light reflex in one eye.

Based on findings in the history and physical exam, the attending chiropractor began to suspect increased possibility of stroke, SIH, or other serious pathologies. The patient was then directed to seek emergency care immediately. As the patient was hesitant to immediately seek emergency care, she was counseled on the potential urgency of her symptoms. No treatment was administered in the chiropractic clinic at that time. After she left the clinic, records were faxed to the hospital she intended to visit, and a phone call was made to the emergency department (ED) alerting them of her arrival. When called the following day to review her emergency visit, the patient admitted she had not yet gone to the ED. The patient was again encouraged strongly to do so immediately, and she did so later that day.

She received a CT scan of her head and CT Angiogram (CTA) of her neck at the ED. The reports noted no evidence of acute intracranial abnormalities, injury, or intracranial

hemorrhage. It did note a “small focal dissection versus ulceration” at the origin of the left subclavian artery. No other findings were reported. The emergency physician then contacted the on-call vascular surgeon for a phone consult regarding the finding to clarify if it was “artifactual or a true focal dissection.” As a result of this specialist consult, the patient was prescribed clopidogrel and a referral was placed by the emergency physician to the consulting vascular surgeon based upon the specialist’s request to see her “in the near future”. She was seen by the vascular specialist two weeks later where she was encouraged to be compliant with her anticoagulation medication and follow up in six months for repeat CTA. Despite attempts to do so, no records of this medical follow up appointment could be obtained.

The patient returned for her second chiropractic visit one week after her ED visit to follow up and resume care. Cervical manipulation was deferred until clearance for cervical manipulation was obtained from the vascular surgeon (relayed verbally from the patient). Informed consent was also obtained from the patient and treatment resumed including cervical manipulation. The patient was discharged after a total of 12 visits (10 of which included cervical manipulation) over approximately 3 months with resolution of all complaints, no significant complications or reactions to treatment, and no significant residuals. She reported a pain level of 1/10 on VRS and final outcome assessment scores were 0/70 (0%, NB), 5/70 (7%, BB) and 36/100 (36%, HDI).

Table 2: Patient 2 Timeline

Day 1	Patient MVA Pain Begins Urgent Care Visit
~ Day 3	Headaches begin
Day 17	Patient presents at chiropractic clinic and is referred to ED
Day 18	Patient visits ED and receives advanced imaging
Day 26	Patient resumes care* at chiropractic clinic
Day 35	Patient has f/u with vascular surgeon
Day 40	Patient receives first cervical manipulation
Day 84	Patient discharged from chiropractic care without complication

*treatment excludes HVLA cervical manipulation at this point

DISCUSSION

Case 1 - Stroke Diagnosis

In case 1, history and exam focused on stroke, which led to insufficient diagnosis and delayed care. The act of focusing on one category of diagnosis so much that others are ignored in practice is not rare(8–14,17,18). And as was the case here, the misdiagnosis of stroke is not a problem unique to chiropractic physicians(23). This is likely because of the difficulty in diagnosis of the condition.

Concerning diagnosis of stroke, the literature describes two differential categories which are common confounding variables, both posing their own distinct challenges: stroke “chameleons” and stroke “mimics”(24–26). Stroke chameleons are strokes which present uniquely or lack clinically typical features such as focal neurological symptoms, usually becoming confused for other pathologies. Some conditions strokes may present as include vertigo/dizziness, monoplegia, altered mental status, and headache(26). Stroke chameleons are quite dangerous as misdiagnosis will inevitably lead to delaying life-saving treatment.

Stroke mimics are conditions which may present clinically as a typical stroke, possibly even receiving an initial diagnosis of such, but are not strokes. Common conditions which may mimic strokes include such things as migraine, seizure, hypoglycemia, tumor, and spinal epidural hematoma(26). The mismanagement of stroke mimics may not typically pose as serious a threat to patients as a chameleon stroke, however they may incur unnecessary expenses for the patient or result in the improper use of medical resources such as facilities, personnel, materials, etc.

Case 1 - Spontaneous Intracranial Hypotension

Spontaneous intracranial hypotension (SIH) is the condition referring to a collection of typical symptoms including orthostatic headache (OH) (27–33) which may follow idiopathic CSF leaks resulting in decreased intracranial pressure. The condition is categorized in the International Classification of Headache Disorders(27), and the most common symptom is OH; the presence of severe headache when standing which is relieved by recumbency(27–33). Other common symptoms include neck stiffness, nausea, vertigo, convulsions, and cognitive abnormalities(28,29). SIH is relatively uncommon, with an incidence of about 5 per 100,000(28). As the name suggests, SIH can precipitate based on any number of incidents from throwing heavy rocks to performing yoga stretches. Chiropractic manipulation is also among potential eliciting factors, but further investigation found that most incidents of manipulation occurred following onset of SIH, not before(30).

Subdural Hematoma is a possible complication of SIH(31–33), though relatively uncommon. Lai et al(31) found that only 8 in 40 consecutive patients evaluated in a hospital were found to have subsequent SDH. Notable is that the same study found patients with SDH in addition to SIH were more likely to experience neurological deficits than those without. This is remarkable because the patient in case 1 did not present with any neurological deficits on exam by his PCP, highlighting his relatively atypical presentation. The mechanism by which CSF leaks lead to SDH is uncertain(33), but potentially dangerous and may require different treatment to resolve the condition(33).

Diagnosis for SIH is typically accomplished through lumbar puncture or MRI(28,29,32), whereas angiogram and CT tend to be unreliable for this diagnosis(28,32,33). This is illustrated both by this case and two others presented by Chen et al(32) and de Noronha

et al(33), where cranial CT and/or angiogram were either essentially negative for any significant pathology or indicated an incorrect diagnosis.

There is some evidence that SIH can present in a chiropractic setting. A recent case report and literature review by Fernando et al.(34) identified 12 other case reports alongside theirs of SIH with symptoms that began following cervical spinal manipulation. Their findings highlight similarities to the one presented now: at presentation following onset of symptoms, 12 cases reported OH, 5 vomiting, and the case presented by Fernando et al. had a normal neurological examination. Spinal MRI (as opposed to other imaging methods, if obtained) was completed for 7 patients.

Table 3: Comparison of exam findings in Case 1 with common findings in the related conditions.

Patient History	**Related Conditions**		
Atherosclerosis	Stroke		
Arterial Dissection	Stroke		
Patient Signs/Symptoms	**Related Conditions**		
Dizziness/Vertigo	Stroke	SIH*	Case 1
Nausea	Stroke	SIH	Case 1
Vomiting	Stroke		Case 1
Neck Stiffness	Stroke	SIH	Case 1
Headache	Stroke	SIH	Case 1
Orthostatic Headache		SIH	Case 1
Neurological Deficit	Stroke	SIH	

Total Overlapping Items	**Stroke**	**SIH**
with Case 1	5	5

*Spontaneous Intracranial Hypotension

Case 2 - Improvement in Care

Following Case 1, the provider took time to consider the episode and 2 major issues were Identified. First, that a crucial diagnosis had been missed and treatment which was contraindicated (cervical manipulation) was administered. In particular, given that OH is a common symptom of SIH, this should have prompted an emergency referral when it was mentioned on the second visit. Second, that a more thorough neurological examination should have been conducted. Previous records were reviewed and did contain information on a neurological examination, however it is important to note that the practice of reliance on past exam for such information when suspecting stroke or similar conditions is not appropriate given how such findings may begin to manifest over time, and can be sudden(25).

As a result, an effort was made to improve care in case 2. In the second case a more complete examination was performed, which resulted in identifying a potentially relevant neurological deficit. Additionally, although the physical exam did not indicate stroke, the provider recognized similarities with case 1 and quickly referred the patient for emergency care. This led to the discovery of the final diagnosis, and resulted in proper care being delivered to the patient by a specialist.

Case 2 - Diagnosis

There was no direct diagnosis for the condition of the patient in case 2 by either ED or vascular specialist, the latter of which used “unspecified injury of left innominate or subclavian artery” as his diagnosis. The literature is relatively sparce on this kind of injury, although one condition that may explain the patient’s particular symptoms and serves as a good base for comparison is subclavian steal syndrome (SSS).

SSS is a condition well described in the literature(35–39) where disturbed blood flow in the subclavian artery ‘steals’ from branching vessels immediately distal to it such as the vertebral artery, resulting in a reversal of flow and possibly subsequent ischemia. Its prevalence may be as high as 6.4%, although that estimate is based on a population of patients with asymptomatic cervical bruit(35). SSS is commonly asymptomatic(36), and often goes undiagnosed(37),but when symptoms do present, they may include (by decreasing frequency) vertigo/dizziness(35–39), visual disturbances(37–39), limb paresis(35,37,38), paresthesia(37,38), and syncope(36–39). Headache is a possible but rare symptom (3%)(37,38). The most common cause of SSS is atherosclerotic disease, but may result from arteritis, congenital stenosis, or dissection(37,39). However, subclavian dissection is a rare diagnosis by itself(37). One hospital population survey of 35,256 trauma records for patients seen in a thirteen year span performed by Cox et al(40) calculated a 0.2% incidence rate (56 patients) for subclavian injury. Furthermore, the survey revealed that most injuries occur due to penetrating trauma, are typically located in the distal portion of the vessel, and predominantly occur in males. Despite the fact that vascular insufficiency of the vertebral arteries is common to both conditions(36,37), none of the literature encountered regarding stroke made mention of it or similar injuries as a potential differential diagnosis for vertebrobasilar insufficiency(24–26).

Table 4: Comparison of exam findings in Case 2 with common findings in the related conditions.

Patient History	**Related Conditions**
Location of lesion: Left Subclavian	SSS* Case 2
Atherosclerosis	Stroke SSS
Arterial Dissection	Stroke Case 2
Patient Signs/Symptoms	**Related Conditions**
Dizziness/Vertigo	Stroke SSS

Nausea	Stroke		Case 2
Vomiting	Stroke		Case 2
Neck Stiffness	Stroke		
Headache	Stroke	SSS	Case 2
Orthostatic Headache			Case 2
Neurological Deficit	Stroke	SSS	Case 2

Total Overlapping Items	Stroke	SSS
with Case 2	5	3

*Subclavian Steal Syndrome

Other Considerations

Rare and potentially dangerous conditions may present at any time to any healthcare provider, and those providers should be equipped with the knowledge to recognize such conditions, although it is important to better familiarize oneself with the 'more common' rarities that could be encountered in an individual provider's unique situation based on specialty(41,42), setting (hospital vs clinic, urban vs rural), and even other factors such as geography(43). There is evidence describing the distribution of emergent conditions which may present to emergent and primary care settings(4,5), however no literature to describe the same for populations attending a chiropractic office could be found. Instead, it seems most studies addressing such topics focus exclusively on stroke.

Understanding the breadth of serious conditions more likely to present in their offices and the differentials for those conditions would be advantageous for chiropractic providers, allowing them to become better equipped to properly triage patients. This knowledge would allow them to both quickly refer those with emergent conditions and avoid waste of important resources for more benign conditions.

CONCLUSION

Stroke is a known serious condition that can present with early signs (i.e. neck pain and headache) which may lead patients to seek out manual therapies such as HVLA manipulation. However, serious pathologies, including some lesser known stroke mimics with serious implications, may present in the chiropractic setting as equally challenging to diagnose. Some of these conditions may be exceedingly rare with no distinct signs and symptoms like an intimal tear of the proximal subclavian artery. Others may be relatively uncommon, but with distinguished pathologies and cardinal symptoms (i.e. OH) such as with SIH. These conditions and those like them may result in overlooked symptoms and/or negative advanced imaging results if providers are not aware of their distinct etiologies, signs, and symptoms and they become victim to cognitive biases. These overlooked symptoms and negative results in such a situation can result in a false sense of security, leading to a delay in proper care, improper treatment, or even severe injury to

the patient. Therefore, chiropractors should take care to familiarize themselves with the related literature to sharpen their diagnostic acuity.

However, it seems that there is a gap in the literature describing the variety and incidence of emergency conditions presenting to chiropractic offices. Future research describing these trends would be helpful in better guiding education of new and experienced chiropractic providers in managing these potentially urgent situations.

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Author's Contributions

All study components were completed by the sole author including physical exam and treatment of both patients, requesting and review of all and any relevant clinical documentation, and creation of the manuscript and tables.

Acknowledgements

Much thanks to Robert Trager, DC and Clinton Daniels, DC who contributed significantly to the development of this paper. Also thanks to Mark Pfefer, DC, who contributed as well. Their insights during revision were integral to the completion of this project.

LIST OF ABBREVIATIONS (in alphabetical order)

Back Bournemouth (BB)
Body mass index [BMI]
Cerebrospinal fluid (CSF)
Computed tomography (CT)
CT Angiogram (CTA)
Emergency department (ED)
Headache Disability Index (HDI)
High-velocity low-amplitude (HVLA)
Magnetic resonance angiogram (MRA)
Magnetic resonance imaging (MRI)
Miles per hour (mph)
Motor vehicle collision (MVC)
Neck Bournemouth (NB)
Orthostatic headache
Primary care practitioner (PCP)
Range of motion (ROM)
Spontaneous intracranial hypotension (SIH)
Subarachnoid hemorrhage (SAH).
Subclavian steal syndrome (SSS)
Subdural hematoma (SDH)
Verbal rating scale (VRS)