

Effects of Osteopathic Manipulative Treatment on Diabetic Gastroparesis

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As the number of diagnoses of diabetes mellitus continues to increase, so does the incidence of diabetic complications, such as gastroparesis. The current case report examines the effect of osteopathic manipulative treatment (OMT) on the symptoms of diabetic gastroparesis in a patient with type 1 diabetes mellitus. After a prescribed regimen of OMT, the patient's Gastroparesis Cardinal Symptom Index score improved from 13 to 8, and his hospitalization stays decreased from once every 6 to 8 weeks to once in 6 months. After 6 sessions of OMT, the patient experienced a reduction in and subsequent relief of diabetic gastroparesis symptoms and improved quality of life. The role of OMT needs to be further investigated as a cost-effective adjunctive treatment for patients with diabetic gastroparesis.

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The rate of diabetes mellitus (DM) diagnoses in the United States is increasing.¹ According to the American Diabetes Association, 29.1 million people in the United States currently live with DM, and an additional 1.7 million new cases are diagnosed each year.¹ Approximately 24% to 48% of patients with DM have gastroparesis.^{2,3} Despite the advances in methods of glucose control and monitoring, the total number of people with uncontrolled DM continues to increase.¹ Because people are living longer with chronic diseases such as DM, we may see an increase in the rate of diabetic complications, including gastroparesis, stroke, hypertension, kidney problems, and amputations.

Gastroparesis is a dysfunction of normal gastric motility and emptying in the absence of an obstruction.^{2,4} Symptoms of diabetic gastroparesis include nausea, vomiting, early satiety, upper abdominal discomfort, anorexia, and stomach fullness.^{2,4} Diabetic gastroparesis can devastate the quality of life of those affected and can lead to costly medical bills. In a study of 1476 patients hospitalized with DM and gastroparesis, Bell et al⁵ found that in 7850 days, hospital charges of \$11,378,386 had accumulated, with an average cost of \$7709 per hospital stay. With millions of people currently having a diagnosis of diabetic gastroparesis,⁶ decreasing the symptoms associated with it may not only improve quality of life but also create enormous savings in health care costs.

Although many causes of diabetic gastroparesis have been proposed, including loss of pyloric nitric oxide synthase, impairment of the pacemaker interstitial cells of Cajal, and smooth muscle dysfunction, a consensus in the literature exists that impaired neural control—specifically, the vagus nerve—is likely a major contributor.^{2,4} Because osteopathic manipulative treatment (OMT) can influence the vagus nerve by manipulating the surrounding structures that might impair its function, we postulated that it might alleviate symptoms of diabetic gastroparesis.

The current clinical standard of treatment for patients with diabetic gastroparesis includes metoclopramide, erythromycin, tegaserod, bethanechol, or a combination. If these medications fail, gastric pacemaker placement or surgical intervention may be needed. However, many of the current treatments for patients with gastroparesis are not highly effective in managing the condition, and many of them have adverse effects²; therefore, alternative, cost-effective methods are needed.

The following case demonstrates the effect of OMT on the symptoms of diabetic gastroparesis as assessed by the Gastroparesis Cardinal Symptom Index (GCSI)⁷ questionnaire. Because of the intensive follow-up with the patient, institutional review board approval was obtained.

Report of Case

A 49-year-old white man with type 1 DM presented with nausea, which was worse in the morning and which he described as lasting 5 to 7 days per week for the past several years. He had been hospitalized approximately every 6 to 8 weeks for dehydration, nausea, and vomiting. The patient also reported an intermittent decrease in appetite and headaches once per week, which were relieved with ibuprofen. He also complained of right shoulder pain. He denied fevers, chills, night sweats, syncope, chest pain, palpitations, exertional dyspnea, cough, shortness of breath, hematemesis, or changes in bowel or bladder habits, sleeping habits, vision, and weight.

He was currently taking metoclopramide for his diabetic gastroparesis, but it did not relieve his symptoms. He had “tried everything that you can imagine in the past” for the condition without relief. Other medications included amlodipine, aspirin, atorvastatin, insulin aspart (subcutaneous), levothyroxine, losartan, metoprolol succinate (extended release), and sertraline.

The patient had multiple complications of type 1 DM, including coronary artery disease, diabetic gastroparesis diagnosed 3 years previously, diabetic retinopathy,

and hypertension. His hemoglobin A_{1c} measurement 3 months previously was 8.6%. His medical history was also notable for depression, anxiety, migraines, hypothyroidism, and hypercholesterolemia.

His surgical history included a cardiac stent placed 1 year previously. He underwent colonoscopy and upper endoscopy that year because of gastrointestinal bleeding, but the results were inconclusive. He had 4 surgical procedures for diabetic retinopathy. Ten years previously he sustained a head injury from a motor vehicle accident during which he also fractured his lower right ribs. He had not sought medical attention for his injuries. He reported multiple undiagnosed ankle sprains from dirt biking. His family history was unremarkable.

His social history included a 90-pack-per-year smoking habit, which he quit 5 years previously, and occasional marijuana use, but he denied any other illicit drug or alcohol use. He occasionally drank caffeinated beverages. He received disability payments and was in a long-term relationship.

Treatment Course

The patient continued to receive the standard of care for diabetic gastroparesis, which included metoclopramide. In addition, he was scheduled to undergo 6 sessions of OMT. Before the first appointment, 2 weeks after the third appointment, and after the sixth appointment, the patient was asked to fill out the GCSI survey.

Owing to the patient’s extensive medical history, multiple comorbidities, and fragile state, the researchers conducted a structural examination of all body regions at the initial visit but restricted treatment to the 4 diaphragms regardless of the somatic dysfunctions noted. This protocol ensured that the fluids were able to flow freely without restriction at the choke points and that the patient was not overtreated. At each visit, the patient was reassessed using structural examinations to gauge the effects of the previous treatment and then treated for any apparent somatic dysfunctions.

Study Introduction (Week 1)

The patient completed the GCSI survey at the introductory appointment, and his most recent hemoglobin A_{1c} levels were reviewed. At this time the OMT sessions were scheduled approximately 2 to 4 weeks apart, with the first appointment scheduled for 1 hour and the remainder for 30 minutes each. The same investigator (V.J.V.) performed all treatments under the supervision of 2 physicians (S.J.H. and J.H.S.).

OMT Session 1 (Week 2)

The patient was a thin man of pleasant demeanor and was alert and oriented to person, place, and time. His vital signs were within normal limits, lungs were clear to auscultation bilaterally, and breaths were diminished. The right drop arm test result was positive, with 4/5 strength on right shoulder (supraspinatus muscle). His biceps and plantar reflexes were 1/4 bilaterally, and patellar reflexes were 0/4 bilaterally, which the patient stated had been consistent as long as he could remember. The remainder of the physical examination results were unremarkable.

STRUCTURAL EXAMINATION FINDINGS

Sphenobasilar compression was noted with SR_L , with cervical rotation range of motion 55° bilaterally. C4 was extended, rotated, and sidebent to the right (ERS_R). Left suboccipital tension was increased; suboccipital boggi-ness was noted bilaterally; left scapula was superior and protracted; right innominate was rotated posteriorly; sacral extension, right unilateral; T3 was ERS to the left (ERS_L); thoracic inlet was rotated left and sidebent right ($R_L S_R$); hypertonicity of erector spinae muscles was seen at T9-10; and left diaphragm inhalation ease was observed. Respiration was noted to stop at the umbilical region instead of engaging the pelvic diaphragm as would be observed in ideal respiration.

OMT

Ligamentous articular release (LAR) to the thoracic inlet, abdominal diaphragm, and pelvic diaphragm; sub-

occipital release; and rib raising were performed. Subsequent decreased boggi-ness and tension in the suboccipital region, increased respiration down to the pelvis, and decreased discomfort were observed.

OMT Session 2 (Week 6)

The patient reported overall improvement, with no adverse effects of the OMT. His nausea had resolved for 2 weeks after the first session, and then he had minimal nausea for 4 weeks. The pain in his right shoulder had lessened after the first OMT session. Although his appetite was normal, he was unable to eat solid foods because 4 teeth had been extracted between appointments. The remainder of the physical examination results were unremarkable.

STRUCTURAL EXAMINATION FINDINGS

Suboccipital hypertonicity, without edema or boggi-ness, and sphenobasilar compression were observed. The occipitoatlantal (OA) joint was rotated right and sidebent left ($R_R S_L$); T3 was flexed, rotated right, and sidebent right ($FR_R S_R$); T6 was extended, rotated right, and sidebent left ($ER_R S_L$); and L5 was $E_R S_R$. Exhalation dysfunction was seen at the right lower ribs (respirations reached the pelvis, and the thoracic inlet remained symmetric). Minimal restriction of the celiac and inferior mesenteric ganglion and no restriction of the superior mesenteric ganglion were observed.

OMT

Ligamentous articular release was applied to the lower extremity. Decompression of the OA joint was successful. After treatment, cranial rhythm increased. Also, the lower extremity was notably less tender and demonstrated increased range of motion.

OMT Session 3 (Week 10)

For 2 weeks after the second treatment session, the patient reported feeling good, with no nausea or vomiting. In the past month he had 1 episode of nausea, vomiting, and dry heaving, which required hospitalization for dehydration 2 weeks after the second session. Potassium

chloride was added to his medications. The patient expressed satisfaction with the treatment plan thus far. He had been used to being hospitalized every 6 to 8 weeks for similar episodes, but it had been 4 months between his last 2 hospitalizations. Since the most recent hospitalization, he had bilateral ankle edema and periorbital edema in the morning. His blood pressure was 130/90 mm Hg, and the remainder of the physical examination findings were unremarkable.

STRUCTURAL EXAMINATION FINDINGS

The patient's cranial rhythm was normal. The right temporal bone was internally rotated, and left suboccipital hypertonicity was observed. The thoracic inlet was SR_L; C3, ES_RR_L; C6, ERS_L; T4, FRS left (FRS_L); and L5, ES_LR_R. In addition, he had right first rib inhalation ease, superior mesenteric ganglion tension, left forward sacral torsion, right anterior innominate, decreased internal rotation of the right shoulder, and external bilateral rotation of the right tibia. The swelling of his hands bilaterally was due to multiple attempts at drawing blood. No tenderness in the navicular region was noted.

OMT

The lumbar spine, thoracic inlet, sacrum, and pelvis underwent LAR along with suboccipital condylar release and balance of the temporal bones. Somatic dysfunction of the cranium, sacrum, pelvis, and lumbar regions resolved. The patient filled out his second GCSI questionnaire 2 weeks after this third session. His nausea and retching decreased in severity from 4 to 1; loss of appetite improved from 2 to 1; and not being able to finish normal-sized meals and feeling excessively full after meals improved from 1 to 0.

OMT Session 4 (Week 13)

The patient reported feeling good and that his physical activity, energy, and appetite had increased. In the past 3 weeks, he woke up with nausea on only 2 occasions. His shoulder pain had decreased and no longer awakened him at night. Between the third and the current OMT

Table.
Gastroparesis Cardinal Symptom Index^a Scores Over the Course of 6 Osteopathic Manipulative Treatment Sessions in a Patient With Type 1 Diabetes Mellitus

Symptom	Week		
	1 ^b	12 ^c	19 ^d
Nausea	4	1	2
Retching	4	1	0
Vomiting	1	1	1
Stomach fullness	0	0	1
Unable to finish normal-sized meal	1	0	1
Feeling excessively full after meal	1	0	1
Loss of appetite	2	1	1
Bloating	0	0	1
Visibly larger belly	0	0	0

^a Patients are instructed to rate the severity of their symptoms during the past 2 weeks, as follows: 0=no symptoms; 1=very mild; 2=mild; 3=moderate; 4=severe; 5=very severe.

^b Week 1 scores were obtained before the first treatment session.

^c Week 12 scores were obtained 2 weeks after the third treatment session.

^d Week 19 scores were obtained 2 weeks after the sixth and final treatment session.

sessions, the remainder of the patient's teeth were extracted. His vital signs were normal. His upper extremity strength was 5/5 bilaterally, right drop arm test result was negative, and right shoulder impingement test result was positive. The remainder of physical examination findings were unremarkable.

STRUCTURAL EXAMINATION FINDINGS

The thoracic inlet was RS_R, T4 was FRS_R, and the left erector spinae was hypertonic. Inhalation ease of the right lower 6 ribs and diaphragm, and celiac and superior ganglion restriction were noted. Standing and seated flexion test results were negative. A tender point was found on the right pectoralis major muscle. No restriction or tenderness was noted in the ankles or feet. Decreased internal rotation of the right shoulder and

decreased arm swing bilaterally were observed. No inferior ganglion restriction was present.

OMT

The cervical spine region, thoracic inlet, and upper extremity received LAR along with rib raising. Decreased erector spinae hypertonicity and decreased thoracic pain resulted. Increased respiration to the pelvis and increased symmetry of ribs and thoracic inlet were observed. The patient stated that he felt that he could breathe more easily and deeply.

OMT Session 5 (Week 15)

The patient reported “feeling great.” He had entertained visitors and had thrown a baseball without pain for the first time in 3 years. However, he stated that he had probably overdone it, because his right shoulder felt tight. He continued to have an increased appetite, but his newly fitted dentures were uncomfortable, which made eating difficult. The physical examination findings were unremarkable.

STRUCTURAL EXAMINATION FINDINGS

The suboccipital hypertonicity had resolved. Spinal findings included FRS_R of C3 and FSR_L of T5. Minimal restriction on the left side of the thoracic inlet was observed. Inhalation ease of rib 5 on the right and inhalation ease of the diaphragm, left forward sacral torsion, right anterior innominate rotation, bilateral protraction of scapulae, decreased external rotation of the left shoulder, and decreased internal rotation of the right shoulder were noted.

OMT

The upper extremity, ribs, thoracic region, and diaphragm underwent LAR. The Becker sacropelvis technique was also performed. Seated and standing flexion test results were negative when retested. Increased range of motion of the shoulder and scapulae bilaterally were demonstrated. After this fifth session, his hemoglobin A_{1c} was 9.2%.

OMT Session 6 (Week 17)

The patient reported no nausea or vomiting since his last appointment; he had been nausea-free for more than a month. He also had no migraines for approximately 3 months, whereas before the OMT sessions, he had migraines a few times per week. He presented with muscular shoulder pain and explained that he had played catch during the past few weeks. He was scheduled to undergo laser surgery for diabetic retinopathy in his left eye the following day. His dentures had been adjusted but remained uncomfortable, and he maintained a healthy appetite. His blood pressure was 130/80 mm Hg, and his other vital signs were within normal limits. Arm swing was bilaterally symmetric, patellar deep tendon reflexes were 1/4 bilaterally, and bicep deep tendon reflexes were 2/4 bilaterally. Physical examination findings were otherwise unremarkable.

STRUCTURAL EXAMINATION FINDINGS

The cranial rhythm was normal. Other findings included sphenoid SR_L ; C3, FRS_L ; cervical rotation, 70° bilaterally without pain; T5, ERS_L ; sternum ease to the left; right rib 5, ERS_L ; thoracic inlet, SR_L ; right abdominal diaphragm inhalation ease; restricted superior ganglion without restriction in the celiac or inferior ganglion; negative seated flexion test; left posterior innominate rotation; decreased internal rotation of the right shoulder; decreased external rotation of the left shoulder; and external rotation of the hips bilaterally.

OMT

In the thoracic region, LAR and functional methods were performed. In the diaphragm, pelvis, and upper extremity, LAR alone was performed. Facilitated position release was performed on the lower extremity. The patient demonstrated increased range of motion in the lower extremity and upper extremity, and decreased ganglion and diaphragm restriction was observed.

Final Assessment (Week 19)

Two weeks after the last OMT session, the patient filled out the final GCSI questionnaire (*Table*). He expressed a desire to continue receiving OMT because it was the only treatment that seemed to relieve his symptoms and not produce adverse effects.

Discussion

The vagus nerve exits the skull through the jugular foramen between the occipital and temporal bones. From there, it travels through the neck in the carotid sheath into the abdominal cavity via the esophageal hiatus of the diaphragm. Restriction of either the suboccipital or abdominal diaphragms may affect the vagus nerve's ability to function optimally, which would negatively affect digestion. The stomach is situated beneath the diaphragm. Therefore, if the diaphragm is restricted, it can affect the stomach's ability to function appropriately. Also, the abdominal diaphragm plays a large role in lymphatic flow, assisting in moving fluid out of the abdominal cavity so that it does not overcrowd the organs around the stomach. If the abdominal diaphragm is not functioning efficiently, lymphatic flow decreases and fluids can build up. This pressure on the abdominal organs decreases their functional capacity.

The thoracic duct lies between the aorta and the right crus of the diaphragm; thus, if the diaphragm is flattened, lymphatic drainage through the thoracic duct is decreased, and the resulting buildup of fluid in the abdominal cavity and its organs hinders their ability to work effectively.⁸ A buildup of waste products can decrease circulation, oxygenation, and nutrition to tissues and organs.

Because external structures and tissues may influence the diaphragm and cause dysfunction, it is important to examine all of these regions for somatic dysfunction. With a history of fractured lower right ribs, the patient was more susceptible to diaphragm dysfunction and may have needed a longer time to resolve these somatic dys-

functions. Furthermore, treating the patient's lower extremity changed the pelvic and abdominal diaphragms and decreased their restriction.

The cranial region played an important role in the development of his somatic dysfunctions, in light of his trauma history. Regarding his sphenobasilar compression, the temporal bones may have been restricting the vagus nerve and, therefore, decreasing its functioning capacity. Balancing the temporal bones and performing suboccipital decompression addressed these structures and removed the restrictions that impaired the vagus nerve's ability to function optimally. Lymphatic drainage from the head was further impaired, owing to the OA joint and cranial dysfunctions, therefore contributing to the increased pressure on structures within that area, which may have contributed to his nausea, vomiting, and headaches. Furthermore, the sphenobasilar compression may have impaired fluid drainage from the deep cerebral structures, including the great cerebral vein of Galen to the straight sinus at the junction of the tentorium cerebelli and falx cerebri. When the temporal and occipital bones are restricted, they can cause strain in the tentorium cerebelli and falx cerebri sinuses, therefore impeding optimal venous drainage from the cerebral circulation. When the temporal and occipital bones are released, the tentorium cerebelli and falx cerebri can allow the venous drainage to flow freely through their sinuses.

The patient described in the case report experienced symptom relief after 1 OMT session, and his symptoms continued to improve after each consecutive treatment. After the first OMT session, in which OMT techniques were applied to the cervical, thoracic, abdominal, and pelvic diaphragms, the patient was free from nausea and vomiting for 2 weeks. Two weeks after his third session, he had 2 days of nausea and then was nausea-free for the duration of the study (>6 weeks). Furthermore, the patient had been hospitalized approximately every 6 to 8 weeks before the study; but throughout the duration of the 6-month

study, he was hospitalized once and has not been hospitalized to date.

On the GCSI,⁷ his nausea went from 4 to 2, and his retching went from 4 to 0 (*Table*). His vomiting remained at 1 throughout the duration of the study. His stomach fullness and bloating went from 0 to 1, and his loss of appetite went from 2 to 1. Furthermore, he did not notice a change in feeling excessively full after a meal, not able to finish a normal size meal, or notice that his stomach was visibly larger.

Conclusion

Osteopathic manipulative treatment may be a cost-effective and safe treatment option for patients with diabetic gastroparesis as an adjunct to standard medical treatment or possibly as the sole treatment. Further research needs to be conducted to build an evidence base for OMT in patients with diabetic gastroparesis and other chronic diseases.

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Author Contributions

Ms Van Ravenswaay and Drs Hain and Shubrook provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; all authors drafted the article or revised it critically for important intellectual content; all authors gave final approval of the version of the article to be published; and all authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Authors' Note: For information regarding the GCSI Questionnaire and permission to use it, contact Mapi Research Trust, Lyon, France (e-mail: proinformation@mapi-trust.org; www.proqolid.org).