

# Anterior and posterior diaphragm kinesio taping for intractable hiccups after ischemic stroke

## A case report

Julie Gallagher, PT, DPT, CKTP\*

### Abstract

**Rationale:** Pathophysiologic mechanisms of the central nervous system, such as stroke, can be associated with intractable hiccups. Intractable hiccups can be associated with potentially fatal consequences, thus requiring safe management in an inpatient rehabilitation facility (IRF) setting with a multidisciplinary team approach to optimize mobility and feeding.

**Patient Concerns:** A 49-year-old male presented to the emergency department with complaints of vomiting and dizziness.

**Diagnoses:** Head computed tomography revealed moderate acute inferior cerebellar infarct in the territory of the posterior inferior cerebellar artery. He required a percutaneous endoscopic gastrostomy tube for feeding and developed severe intractable hiccups which he rated 7/10 on the hiccup assessment instrument (HAI) on IRF admission. Functional independence measure (FIM) score for transfers was 2 (maximum assist), walking was 1 (total assist), stairs were not attempted on IRF admit due to safety concerns, and feeding (eating) was 1 (total assist).

**Interventions:** Anterior and posterior diaphragm kinesio taping was applied on day 6 of IRF physical therapy in an attempt to inhibit diaphragm spasm and intractable hiccups given that pharmacologic interventions had not been effective up to that point (Table 3).

**Outcomes:** The HAI decreased from 7/10 on day 6 of IRF physical therapy to 0/10 on day 8. The taping was reapplied every 3 to 5 days. On IRF day 9, his diet was advanced to a regular consistency with extra moisture and thin liquids. On day 21, hiccup severity remained 0/10 on the HAI, while FIM score for transfers was 4 (minimal assist), walking was 4 (minimal assist), stairs was 4 (minimal assist), and feeding (eating) was 7 (independent).

**Lessons:** Diaphragm kinesio taping is a very effective treatment at reducing hiccup severity in a patient after ischemic stroke, while at the same time reducing burden of care for caregivers per FIM score improvement and improving diet to that of regular consistency with extra moisture and thin liquids.

**Abbreviations:** ADL = activity of daily living, FIM = functional independence measure, HAI = hiccup assessment instrument, IRF = inpatient rehabilitation facility.

**Keywords:** diaphragm taping, intractable hiccups, ischemic stroke, kinesio taping

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United Health Services, Physical Therapy and Rehabilitation, Inpatient Rehabilitation Facility, Binghamton General Hospital, Binghamton, NY.

\* Correspondence: Julie Gallagher, United Health Services, Physical Therapy and Rehabilitation, Inpatient Rehabilitation Facility, Binghamton General Hospital, 10-42 Mitchell Avenue, Binghamton, NY 13903 (e-mail: julie\_gallagher@uhs.org).

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## 1. Introduction

Hiccups manifest as an abnormal pattern of breathing rate and rhythm caused by multiple spastic contractions of the diaphragm and intercostal muscles. This spastic muscle action is accompanied by reciprocal inhibition of the expiratory intercostal muscles, causing the “hic” sound due to uncontrolled inhalation and sudden closure of the respiratory tract by the epiglottis.<sup>[1]</sup> The hiccup reflex arc consists of an afferent limb (vagus and phrenic nerves), the hiccup center (in the spine, at the level C3–C5; connects to the central nervous system, respiratory center, phrenic nerve nuclei, medullary reticular formation, and the hypothalamus), and an efferent limb (phrenic nerve, intercostal muscles, and anterior scalene muscles).<sup>[2]</sup>

Pathophysiologic mechanisms of the central nervous system, such as stroke, can be associated with persistent or intractable hiccups due to disruption of one or more components of the reflex arc.<sup>[2]</sup> According to Zhang et al,<sup>[1]</sup> hiccups can be classified into 3 categories depending on their duration: acute (lasting minutes to hours), persistent (lasting more than 48 hours), and intractable (lasting 1 month or more). However, there is no consensus in support of these definitions. Intractable hiccups may occur as a result of structural or functional disturbances of the medulla and

its afferent or efferent connections with the respiratory muscles, including structural lesions of the medulla due to infarct in the territory of the posterior inferior cerebellar artery.<sup>[3]</sup>

Pharmacologic interventions used to treat intractable hiccups vary widely, and there is no clear consensus in the literature regarding the optimal primary drug therapy for intractable hiccups. To date, there does not appear to be any evidence supporting the use of Kinesio Taping of the anterior and posterior diaphragm as a nonpharmacologic, muscle inhibitory intervention to treat intractable hiccups after ischemic stroke. The present case report shows, while pharmacologic intervention with multiple drugs failed, addition of Kinesio Taping was successful in eliminating intractable hiccups after ischemic stroke.

## 2. Case Presentation

The patient, a 49-year-old male, presented to the emergency department on December 2 with complaints of dizziness and vomiting. Comorbid conditions included hypertension, non-insulin-dependent diabetes mellitus, sleep apnea, and obesity with a body mass index  $>30\text{ kg/m}^2$ . Emergent computed tomography angiography revealed complete occlusion of the right vertebral artery and partial occlusion of the left vertebral artery. Tissue plasminogen activator was administered and angioplasty was attempted but was unsuccessful, so dual antiplatelet therapy was started. Repeat head computed tomography within the first week revealed a moderate acute inferior cerebellar infarct likely in the territory of the posterior inferior cerebellar artery. A percutaneous endoscopic gastrostomy tube was placed on day 11 in the acute care hospital and the patient required cardiopulmonary resuscitation following the procedure due to a reaction to midazolam (Versed). Prestroke, the patient had full cognitive and functional independence in terms of mobility, ADLs, instrumental ADLs. The patient was employed full time in a factory setting, married, and a father of 3 children. The patient was medically stabilized and transferred to an inpatient rehabilitation facility (IRF) after 17 days in the acute care hospital.

On IRF admission, the patient presented with severe intractable hiccups (rated 7/10 on the hiccup assessment instrument [HAI]) and had severe motor apraxia, ataxia, and limited endurance, requiring assistance to stand or sit (Table 1). The patient was only able to walk 2.5 m and required physical assistance, as well as a helper following behind with a wheelchair for safety. Climbing up or down stairs was not attempted due to safety risks involved. The physical therapy goals were to achieve independent transfer and walking, and the patient was willing to try any intervention to relieve his hiccups, which were impacting his ability to eat (Table 2).

**Table 1**

**FIM scores in a patient with intractable hiccups treated with medication and diaphragm taping.**

FIM item	Score on admission	Score on discharge
Transfers	2 (maximum assist)	4 (minimal assist)
Ambulation	1 (total assist)	4 (minimal assist)
Stairs	0 (unsafe to attempt)	4 (minimal assist)
Feeding	1 (total tube feeding)	7 (regular diet)
Total motor	24	55
Total cognitive	18	27

FIM = functional independence measure.

**Table 2**

**Diet prescribed for intractable hiccups in a patient treated with medication and diaphragm taping.**

Diet	Start day	End day
NPO except ice chips	IRF day 1	IRF day 1
Continuous tube feeds	IRF day 2	IRF day 2
Contingency tube feeds	IRF day 2	IRF day 4
Dysphagia pureed diet with thin liquids	IRF day 2	IRF day 4
Dysphagia mechanical diet with thin liquids	IRF day 4	IRF day 9
Regular diet with extra moisture	IRF day 9	Not applicable

IRF = inpatient rehabilitation facility, NPO = no food or fluids consumed orally.

On day 6 of physical therapy in the IRF, the patient was indicated for Kinesio Taping of the anterior and posterior diaphragm in an attempt to relieve his intractable hiccups, since the pharmacologic interventions (Table 3) had not been effective at reducing the severity of hiccups up to that point. The patient denied any allergies to tape application and was free from comorbid conditions that would contraindicate the use of Kinesio Tape. After taping, the HAI was used to rate any reduction in the severity of intractable hiccups, and functional independence measure (FIM) scores were utilized to assess functional mobility and feeding improvement. Any medication changes were recorded in the patient's medication administration chart. The need for reapplication of Kinesio Tape was reassessed every 3 to 5 days, based on the recommendations of Miralles et al,<sup>[4]</sup> who found that Kinesio Tape can remain on the skin for 3 to 5 days before the quality of the elastic polymer diminishes.

Kinesio Taping was performed by a physical therapist who is also a certified Kinesio Taping practitioner. For taping the posterior diaphragm, one 15-cm strip of lightly stretched (15%) Kinesio Tape was applied over the T10 spinous process while the patient was standing with assistance for balance and the use of a rolling walker for stabilization; the patient was then assisted to bend forward at the trunk and light tension (15%–25%) was applied to the ends of the tape. For taping the anterior diaphragm, a second 15-cm strip of Kinesio Tape was applied, with no tension, over the xiphoid process while the patient was standing; then, as the patient rotated to the right, the right end of the tape was slightly pulled (without stretching) toward the bottom of the rib cage; similarly, as the patient rotated to the left, the left end of the tape was slightly pulled toward the bottom of the rib cage. The Kinesio Taping protocol is illustrated in Fig. 1. Tape was reapplied every 3 to 5 days depending on patient's response to intervention. The only cointervention that changed after the initiation of Kinesio Taping was gabapentin dosage (on IRF day 9).

The patient's response to Kinesio Taping of the anterior and posterior diaphragm was monitored in terms of hiccup severity

**Table 3**

**Dosage of medication for intractable hiccups.**

Medication	Upon admission	Upon discharge
Gabapentin (Neurontin)	400 mg = 8 mL every 6 h, by PEG tube	250 mg/5 mL = 2 mL, orally, once daily
Metoclopramide (Reglan)	10 mg = 1 mL every 6 h, by PEG tube	None prescribed
Baclofen (Lioresal)	5 mg = 0.5 tablet by PEG tube, 3 times daily as needed	None prescribed

mg = milligrams, mL = milliliters, PEG = percutaneous endoscopic gastrostomy.



**Figure 1.** Application of the Kinesio Tape for intractable hiccups after ischemic stroke. Taping of the posterior diaphragm is performed in 2 steps. Step 1: A strip of Kinesio Tape (5 blocks in length; about 25 cm) is applied over T10 with light stretching (10%–15%). Step 2: As the patient bends forward slightly, the tape strip is stretched to 15% to 25% and its ends are placed gently on the skin, followed by rubbing the tape to activate the adhesive. Taping of the anterior diaphragm is performed in 4 steps. Step 1: While the patient is standing, a strip of tape (6 blocks in length; about 30 cm) is applied without stretching over the xiphoid process (bottom of the sternum). Step 2: As the patient rotates (turns the shoulders) to the right, the left end of the tape is pulled very lightly to angle the tape toward the bottom of the rib cage (on the left side). Step 3: As the patient rotates (turns the shoulders) to the left, the right end of the tape is pulled very lightly to angle the tape toward the bottom of the rib cage (on the right side). Step 4: Rubbing the tape activates the glue.

on the HAI, by FIM scores (Table 1), and changes in hiccup medication (Table 3). FIM scores at admission and at discharge were collected by a multidisciplinary team trained to use Uniform Data System standards.<sup>[5]</sup>

On day 8 of IRF physical therapy, the patient rated hiccup severity as 0/10 on HAI (no hiccups). Although the HAI has only been preliminarily validated by Ge et al,<sup>[6]</sup> its use in the present case was successful in reflecting positive changes in symptoms in response to Kinesio Taping. On day 9, the patient was switched to a regular-consistency diet with extra moisture and thin liquids by mouth (Table 2). On IRF day 21, hiccup severity had remained 0/10 on the HAI (no hiccups). Upon discharge, FIM scores were very good, as the patient required only steady assistance (contact guard) for transfers, could walk 114m with a rolling walker and steady assistance (contact guard), and was able to ascend/descend 18 steps with the use of railings and minimal assistance (Table 1).

### 3. Discussion

The present case report described the successful use of Kinesio Taping of the anterior and posterior diaphragm to inhibit the spasmodic action of the diaphragm and thus support previously unsuccessful pharmacological therapy in treating hiccups. This novel approach was judged as successful based on the improvement in the patient's HAI ratings and FIM score, most notably feeding.

Stroke patients experience an array of symptoms and complications that often impair their quality of life significantly, especially motor disability, insomnia, depression, and hiccups.<sup>[1]</sup> Because intractable hiccups can be associated with potentially fatal consequences, safe management of stroke patients with intractable hiccups may require an IRF setting with a multidisciplinary team approach to optimize the mobility and feeding impairments of this challenging population.<sup>[7]</sup> Recently, Ge et al<sup>[6]</sup> developed a HAI for evaluating hiccup severity on a numerical scale from 0 (no hiccups) to 10 (most severe hiccups). HAI ratings of 1 to 3 indicate mild hiccups, nagging/annoying and interfering slightly with ADL; HAI ratings of 4 to 6 indicate moderate hiccups, interfering significantly with ADL; finally, HAI ratings of 7 to 10 indicate severe hiccups, disabling, and rendering the patient unable to perform ADLs. To date, the HAI has only been preliminarily validated, but was demonstrated to reflect positive changes in symptoms (hiccups) in response to acupuncture.<sup>[6]</sup>

Evidence regarding the effect of pharmacologic interventions aimed at treating intractable hiccups date back to the 1950s, when intravenous chlorpromazine was the drug of choice, while commonly used therapies include baclofen, gabapentin, chlorpromazine, haloperidol, and metoclopramide.<sup>[8]</sup> A more recent Cochrane systematic review by Moretto et al<sup>[9]</sup> found no sufficient evidence to support the treatment of persistent or intractable hiccups with either pharmacologic or nonpharmacologic interventions.

Kinesio Tape, an alternative taping technique introduced in the United States in 1995 by Dr KenzoKase, is currently used by rehabilitation professionals to treat an array of musculoskeletal conditions. Kinesio Tape is made from soft, hypoallergenic material (100% cotton and elastic fiber; 100% latex free) and has 100% medical grade, heat-activated acrylic adhesive. Kinesio Tape is designed to imitate the thickness and weight of human skin, and stretches only along the longitudinal axis.<sup>[10]</sup> Although the exact mechanisms of Kinesio Taping are still under investigation, this technique has been proposed to inhibit overactive muscles by means of neurofacilitation and mechanical restraint.<sup>[11]</sup> The muscle inhibitory effects of Kinesio Tape are anecdotal and only clinically relevant, as inhibition of muscles can be achieved by stretching the Golgi tendon organ at the distal end of the muscle.<sup>[12]</sup> Pharmacologic treatment of hiccups reported, as in the literature, is largely uncontrolled and, according to Moretto et al,<sup>[9]</sup> there is no clear evidence to guide the pharmacologic or nonpharmacologic treatment of persistent or intractable hiccups. This case report demonstrated that Kinesio Taping of the anterior and posterior diaphragm over the course of 17 days with reapplication of the tape every 3 to 5 days can achieve substantial reduction in reliance on pharmacologic measures to control intractable hiccups (Table 2).

This case supports the use of Kinesio Taping of the anterior and posterior diaphragm as a highly effective complementary physical therapy intervention to be employed in addition to common pharmacologic interventions for the treatment of intractable hiccups after ischemic stroke. These observations also further the validity of the HAI, which was only recently introduced by Ge et al.<sup>[6]</sup> One limitation of this study is that it is a single case study involving only a single patient. Further studies are warranted to investigate the effects of this particular Kinesio Taping application at reducing hiccup intensity in controlled settings and in larger and more various populations of patients with intractable hiccups, as well as to further validate the HAI for this purpose.

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## Author contributions

**Conceptualization:** Julie Gallagher.

**Data curation:** Julie Gallagher.

**Investigation:** Julie Gallagher.

**Validation:** Julie Gallagher.

**Writing – original draft:** Julie Gallagher.

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