Massage Therapy May be Safe and Reduce Pain in Critically Ill Patients with Acute Neurological Injury: a Case Control Study

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Purpose: Massage therapy is an important adjunctive treatment for physiologic and psychologic symptoms and has been shown to benefit patients among a wide variety of patient populations.

Setting: Few studies have investigated the utility of massage therapy in the general ICU setting, and even fewer have done so in the neurological ICU (NeuroICU).

Research Design: If massage therapy was determined to improve objective outcomes—or even subjective outcomes in the absence of harm—massage may be more readily employed as a complementary therapy, particularly in the ICU setting or in patients with acute neurological injury.

Intervention: This pilot study aimed to assess the safety of massage in the neurocritical care unit and its impact on patient vital signs, subjective pain assessment, and other clinical outcomes.

Participants: Twenty-one patients who received massage therapy during admission to the neurocritical care service were compared to matched controls in a retrospective case control study design.

Results: We found a statistically significant reduction in pain scores among patients with acute neurological injury who received massage therapy. There was no statistical difference in hospital length of stay, discharge destination, in-hospital mortality, adverse events, or incidence/duration of delirium between patients who received massage therapy and those who did not. No adverse events were ascribed to the massage therapy when evaluated by blinded neurocritical care specialists.

Conclusion: This study found that massage therapy may be safe for many patients in the NeuroICU and may offer additional subjective benefits.

KEYWORDS: Acute brain injury; integrative medicine; massage; neurocritical care; neurological injury

INTRODUCTION

Massage therapy is a commonly used technique in integrative medicine that promotes relaxation and reduces pain and anxiety.[1] Integrative medicine is defined as the practice of incorporating components of complementary and alternative medicine in parallel with conventional Western medicine to create comprehensive treatment plans. Studies have shown both subjective and objective benefits from integrative medicine in medically diverse patient populations including fibromyalgia,[2] HIV,[3] and cancer.[4] In surgical settings, massage has been shown to reduce pain and anxiety postoperatively,[5-9] and has been associated with improvements in objective measures such as decreased use of sedating medications.[10] Other studies have demonstrated the effectiveness of massage in managing pain and anxiety in the inpatient hospital setting.[11-12] In addition to diminishing pain, massage therapy has generated interest as a potential method to reduce delirium.[13]

Despite increasing literature to support the role of massage in the inpatient setting, its utility has been understudied in the intensive care unit (ICU) setting. Available

literature in the ICU population reports that massage therapy has positive effects on some outcomes such as improved sleep quality, but concludes that further investigation is needed to address gaps in the limited literature.[14] Within critical care, even fewer studies have investigated the safety of massage in the neurological ICU (NeuroICU).

The NeuroICU population includes patients with spontaneous or traumatic structural neurological injury including diagnoses such as acute ischemic stroke, intracerebral hemorrhage, spinal cord injury, and subarachnoid hemorrhage, among others. Massage therapy in this population has challenges, such as difficulty collecting subjective information from comatose or aphasic patients. There are currently no published data on the safety of massage therapy in patients with intracranial injury and possible intracranial hypertension. Therefore, this study aimed to provide preliminary data regarding the safety of massage therapy in patients with acute neurological injury.

METHODS

This was a case control study; "cases" included patients with acute neurological injury who received massage therapy at least once during their admission to the NeuroICU service. Massage therapy was offered to patients weekly during a two-month period in the summer of 2017 via a partnership between the UCSD Center for Integrative Medicine and UCSD Health Neurocritical Care services. Any adult patient (age > 18 years) with acute brain or neurological injury including ischemic stroke, intracerebral hemorrhage, spinal cord injury, subarachnoid hemorrhage, traumatic brain injury, brain abscess, and status epilepticus who did not meet exclusion criteria were offered massage therapy at no cost to the patient or family. Specific exclusion criteria included: 1) clinically suspected intracranial hypertension without intracranial pressure monitor in place, 2) cervical instability, 3) pregnancy, 4) hemodynamic instability requiring active titration of pressors, 5) patient agitation where safety of therapists could not be assured, 6) incarceration with inability to remove shackles, and 7) clinical or radiographic instability of the primary neurological process.

Study Setting

University of California—San Diego (UCSD) Health Medical Center is an academic and tertiary care center that includes a dedicated NeuroICU service that cares for more than 800 patients with acute neurological injury annually. Patients in the NeuroICU are cared for by a specialized team including Board-certified neurointensivists, nurse practitioners, and neuro-trained bedside nurses.

Ethical Consideration

This project was reviewed and approved by the local institutional review board (IRB # 171093), and a waiver of consent and HIPAA were obtained.

Interventions

Massage therapy services were delivered by intern therapists, who also applied practices of passive and active joint mobilization, acupressure point activation, reflexology, and Tui Na. Massage therapy was variable in its application and included palm circles, gentle rubbing, and Swedish Massage to the back, shoulders, arms, thighs, legs, and feet. Lotion was often utilized. Passive and active joint mobilization was used on the wrists, hands, fingers, ankles, feet, and toes. Acupuncture point activation included GB21, GB41-44, SI11, LI 4-5, LI9-11, H7, PC6, KID1-6, LIV2-3, LIV41, ST6, ST36, UB60, LU1-2, LU5, HT7, K1, SP1-6, and Ting Well points of the hands and feet. Reflexology included thumb walk on the spine and head reflexes of the big toes. Tui Na kneading was used over the upper and lower extremities. Previous studies helped shape our intervention protocol, in particular the decision whether to design a structured massage intervention or not. Modalities were ultimately selected at the discretion of the massage therapists, which fit better with the usual experience of the practitioners.[15] Sessions lasted between 10 and 30 minutes and were tailored to the patient's level of comfort and mobilization ability. The massage therapists recorded the practices they performed on each patient, including the patient's response, and reported this data back to the research team. The sessions were monitored by a member of the patient's ICU care team.

Evaluation

For "cases", data was prospectively collected by members of the research team. Objective demographic extracted from the electronic health record (EHR) including patient sex, age, race, comorbidities, primary diagnosis, and admission disease severity as measured by disease-specific tools (e.g., ICH score for intracerebral hemorrhage, Hunt-Hess score for subarachnoid hemorrhage). Clinical outcomes extracted included pre- and post-massage vital signs (e.g., heart rate, mean arterial pressure; MAP) with pain score. These values were measured immediately prior to and immediately following massage therapy. Additional clinical information extracted included delirium incidence (and if delirious, longest continuous duration of delirium during hospitalization), ICU length of stay (LOS), hospital LOS, in-hospital adverse (e.g., pneumonia) and serious adverse events (e.g., cardiac arrest, death), and discharge destination (i.e., home, long-term acute care, rehabilitation, skilled nursing facility, or death/hospice). Of note, a delirium evaluation was performed by standard CAM-ICU nursing assessment at the beginning of a shift in a private, quiet room with lights on for at least 15 minutes; the CAM-ICU tool is the most well-known tool utilized to assess delirium.

In patients with intracranial pressure monitors, pre-and post- massage measurements of intracranial pressure (ICP) were noted. Intracranial pressure was monitored during massage, and if ICP exceeded 20 mmHg for greater than 2 minutes, massage was to be aborted for emergent management of elevated ICP per institution protocol.

"Control" patients (patients admitted to the neurocritical care service who did not receive massage therapy) were retrospectively identified by the research team using the EPIC Slicer Dicer capability of the EHR. Care was paid to match the controls in a 1:1 ratio to previously identified cases based on age, sex, primary diagnosis, and disease severity when applicable (for example, patients with subarachnoid hemorrhage were matched based on Hunt-Hess and Fisher score; patients with ischemic stroke were matched based on NIHSS, and those with intracerebral hemorrhage matched on ICH score). It was not possible to match cases and controls on additional characteristics given the low incidence of some disease-specific states. Once matched, data were extracted to include incidence of delirium (and if ever delirious, longest continuous duration), hospital and ICU LOS, in-hospital adverse and serious adverse events, and discharge destination. Pre- and post-massage vital signs, including pain scores, were not available since these patients did not undergo massage therapy.

Outcome Measures

Our primary outcome measurements evaluated whether there was a difference between the two groups in rates of delirium incidence and duration, hospital and ICU LOS, in-hospital adverse and serious adverse events, and discharge destination. Our secondary outcomes evaluated whether patients in the massage group had changes in vitals and pain scores pre- and post-massage.

Statistical Analysis

Statistical software (SPSS version 26; IBM SPSS Statistics, Armonk, NY) was utilized to assess statistical differences in demographic and outcome variables between cases and controls. All adverse events were reviewed by a blinded group of neurocritical care physicians who assessed for potential clinical causality related to massage therapy. In consultation with a biostatistician, cases' pre- and post-massage data were evaluated for any statistical changes. Student's *t*-test was used to compare normally distributed continuous variables, and a rank sum analysis was performed for non-parametric continuous variables. Pearson's chi-squared test was used to compare categorical variables (e.g., delirium incidence, discharge destination) between cases and controls. Statistical significance was set at $p<.05$.

RESULTS

Our case control study matched pairs of patients with and without massage totaling 21 pairs of patients. The mean age of the cohort was 57 years (range 28 to 85 years). Females represented 52.4% of the cohort. Demographics are summarized in Table 1.

Our primary outcomes of interest were related to patient safety. As might be expected in a critically ill population, adverse events were common. There were 20

TABLE 1. Demographic and Clinical Information for Massage and Control Patients

	Massage Group	*Control Group*	*P Value*[a]
	(N=21)	*(N=21)*	
Age in years (mean, SD)	57.6 (14.3)	55 (13.4)	
Male (N, %)	10 (47.6%)	10 (47.6%)	
Female (N, %)	11 (52.4%)	11 (52.4%)	
Race (N,%)			
White	8 (38.1%)	6 (28.6%)	
Hispanic/Latino	9 (42.9%)	11 (52.4%)	
African American/Black	2 (9.5%)	3 (14.3%)	
Asian	2 (9.5%)	1 (4.8%)	
Primary Diagnosis (N)			
Intracranial hemorrhage	9	9	
Ischemic stroke	3	3	
Aneurysm s/p intervention	2	2	
Status epilepticus	2	2	
Vertebral artery dissection	2	2	
Brain abscess	1	1	
Cervical stenosis	1	1	
Guillain-Barre Syndrome	1	1	
ICU LOS (median, IQR)	10 (3.5, 28)	4 (2, 8.5)	.023*
Hospital LOS (median, IQR)	10 (3.5, 36.5)	7 (3.5, 22.5)	.12
Delirium Incidence (N, %)	8 (38.1%)	10 (47.6%)	.53
Delirium Duration (median, IQR)	3 (1, 7)	1 (1, 2)	.18
Discharge Destination (N, %)			.39
Death/Hospice	4 (19%)	2 (9.5%)	
Home	9 (42.8%)	8 (38.1%)	
Long-term Acute Care	1 (4.8%)	1 (4.8%)	
Rehab	1 (4.8%)	6 (28.6%)	
Skilled Nursing Facility	6 (28.6%)	4 (19.%)	
Adverse Events (N, %)[b]	20	18	.61
Neurologic	4 (20%)	4 (22.2%)	
Cardiovascular	2 (10%)	5 (27.8%)	
Respiratory	2 (10%)	2 (11.1%)	
Renal	4 (20%)	0 (0%)	
Gastrointestinal	1 (5%)	1 (5.6%)	
Hematologic	1 (5%)	0 (0%)	
Infection	3 (15%)	4 (22.2%)	
Death	3 (15%)	2 (11.1%)	.63
Vital Signs (mean, SD)[c]	Pre-massage	Post-massage	
Heart rate (bpm)	81.7 (15.1)	80.6 (14.7)	.56
MAP (mm Hg)	94.5 (12.3)	92.3 (11.7)	.33

Respiratory Rate	16.9 (4.1)	17.4 (4.4)	.59
Pain Score[d]	4.5 (4)	2.8 (3.2)	.047*

[a]Statistically significant p-values (p<0.05) denoted with *.
[b]Neurologic = ischemic stroke, intracranial pressure crisis, seizure, intracerebral hemorrhage, cerebral edema, subdural hematoma, epidural hematoma; Cardiovascular = atrial fibrillation, congestive heart failure exacerbation, sympathetic storm, hyper/hypotension; Respiratory = respiratory failure, pulmonary embolism; Renal = acute kidney injury, metabolic acidosis; Gastrointestinal = oropharyngeal dysphagia; Infection = sepsis, pneumonia, meningoventriculitis; Hematologic = heparin-induced thrombocytopenia.
[c]Vital sign snapshot (including pain) was measured immediately prior to initiation of massage therapy and immediately after massage therapy was completed.
[d]Pre- and post-massage pain score data only available for the patients who were able to provide it (i.e.. not comatose) (N=8).
SD= standard deviation; s/p = status post; LOS = length of stay; bpm = beats per minute; MAP = mean arterial pressure.

in-hospital adverse events reported in the massage group, which were categorized according to the organ system involved (e.g., neurologic, cardiovascular; Table 1); similarly, in the control group there were 18 adverse events. None of these adverse events were ascribed to massage therapy when evaluated by blinded neurocritical care specialists. There was no statistically significant difference in the incidence of adverse events between the two groups. ICP monitors were present in only four patients during the massage treatment. Data were manually inspected for clinically significant elevations in ICP (ICP sustained > 20), and no clinically significant elevation occurred during or after massage in any of the patients who had intracranial monitors in place.

In calculating mortality, we categorized patients by discharge destination. There was no significant difference in discharge destinations. Specifically for mortality, three patients died in the massage group compared with two in the control group (Table 1).

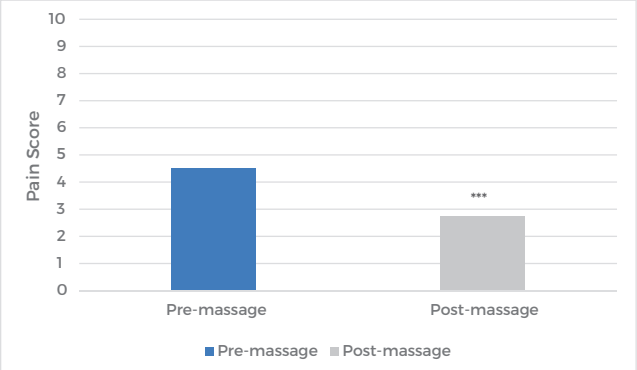
ICU LOS ranged one to 64 days for massage patients and one to 31 days for control patients. Median LOS (IQR) for massage patients was 10 days (IQR: 3.5, 28) and four days for the control group (IQR: 2, 8.5), which represented a significant difference (p=.02). However, hospital LOS did not ultimately differ between massage patients (10 days; IQR: 3.5, 36.5) and control patients (7 days; IQR: 3.5, 22.5) (Table 1).

Eight massage patients and ten control patients developed delirium during their hospitalization, which did not represent a statistically different incidence of delirium. For duration of delirium, the massage group had a median duration of three days (IQR: 1, 7) and the control group had a median duration of one day (IQR: 1, 2), which was also not significantly different (Table 1).

There were no statistically significant changes to vital signs including heart rate, mean arterial pressure, or respiratory rate (all p > .06). Among the eight subjects who were able to report a subjective pain score, pain scores decreased by 1.75 points (p = .047) post-massage with 95% confidence interval -3.47 to -0.03 (Figure 1).

DISCUSSION

In this pilot study, we evaluated the impact of massage therapy on patients with acute and critical neurological injury. In terms of our primary outcomes, in-hospital mortality and the number of adverse events were not different between case and control patients, and no adverse events were attributed to massage when evaluated by blinded specialists. Taken together, similar rates of adverse events and the stability of vital signs pre/post massage



Statistical significance denoted by *** for pain scores pre- and post-massage (p = .047).

FIGURE 1. Pain score.

support the idea that massage therapy may be safe in a population of critically ill patients with acute neurological injury, though further study is needed.

This study did not identify a statistical difference between massage/case and control patients with regards to discharge destination, overall length of stay, or incidence/duration of delirium. Of interest, even though hospital LOS was similar between massage patients and those without massage therapy, ICU LOS was significantly longer in the patients who received massage. Patients were not kept in the ICU specifically to continue massage therapy and we did not see evidence for any delay of care in these patients due to the massage therapy. We do not postulate that this lengthened stay was a direct result of the massage therapy, and despite efforts to match patients based on primary injury and score severity, it is possible that other unextracted confounders or the specific types of complications that the massage patients experienced contributed to this lengthened ICU stay.

In this study, pre- and post-massage vital signs remained stable and without significant change. In contrast, we did see a significant reduction in pain scores for the patients who received massage, though this study was not powered to draw causal conclusions. This improvement in pain, however, is consistent with findings from previous studies on massage therapy that have shown a meaningful reduction in various types of pain.[1,4,5-12] In the absence of worsened objective outcomes in patients with massage therapy, these subjective changes are encouraging, especially given the increasing focus on patient-reported outcomes[16] and in the context of the ongoing opioid epidemic.[17]

Despite the promising aspects of our study, there are several limitations to acknowledge. The massage therapy initiative was relatively new at the time of our data gathering which only allowed a small sample size for this study. Unfortunately, this means that any major conclusions will be under-powered, though the pilot data from this study may serve to promote future study into massage therapy, and we support future randomized control study of the impact of massage therapy in the neurocritically ill population. Furthermore, pain scores were only ascertained from non-comatose patients, which excluded all but eight participants in the massage group. In future studies, a pain score tool for comatose patients—such as the Nociception Coma Scale (NCS)[18]—could be utilized. Another inherent limitation was that this pilot study was conducted at a single center and included retrospective data. This limits the causal inferences that we can draw from this study. In an ideal design, we would have randomized patients to a massage therapy or control group in a prospective manner to obtain the same data that we collected retrospectively through the EMR. Despite this short-coming, we went to great lengths to find appropriate case-matched controls to minimize potential confounders that are usually balanced by randomization. Finally, the generalizability of the data is limited since there were multiple exclusion factors for massage therapy. Given that massage was a new therapy for this critically ill population, the neurointensivist team determined *a priori* the patients for whom they would not condone massage therapy; this approach was likely conservative in its tolerance of applying a new therapy. Of particular interest would be a study of massage therapy specifically in a subset of patients with intracranial monitors to gauge effects on ICP. Ultimately, a randomized control trial would be better suited to enroll participants following thorough discussion of risks and benefits, and the current study might offer relevant safety information in determining the risks of massage therapy in this patient population with acute neurological injury.

Our study took shape as a safety pilot investigation. However, this study also provides preliminary data that massage therapy might provide tangible benefits for our patients. In the future, we would aim to study a larger neurocritical care population via a multicenter randomized trial to re-examine the outcomes we have previously described, in addition to patient reported outcomes. Additionally, it would be interesting to evaluate the impact of serial sessions of massage therapy.

CONCLUSION

Massage therapy remains an important adjunctive treatment for patients in a wide variety of disciplines. We conclude from this study that massage therapy may be safe and offer subjective benefit for patients in the NeuroICU environment.

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CONFLICT OF INTEREST NOTIFICATION

The authors declare there are no conflicts of interest.

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