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Rehabilitation Outcomes Among Patients Experiencing Cerebral Vasospasm: A Descriptive Retrospective Exploratory Study

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Abstract

Background

Practice guidelines regarding intervention thresholds or considerations when treating patients with aneurysmal subarachnoid hemorrhage experiencing vasospasm are absent for occupational and physical therapy. This patient population has limited literature addressing rehabilitative intervention in the acute care setting. The study aimed to explore and describe patient demographics, therapy outcomes, and adverse events for aneurysmal subarachnoid hemorrhage patients who participated in therapy with vasospasm during their admission

Methodology

This descriptive retrospective exploratory study reviewed 32 patients admitted for aneurysmal subarachnoid hemorrhage in a neurosurgical intensive care unit at a quaternary hospital. Participants subsequently underwent rehabilitation from July 2019 to June 2022. A total of 21 patients were eligible for inclusion in this retrospective review.

Results

Minimal adverse events were documented, and no serious adverse events were reported with early rehabilitation. The daily mobility AM-PAC "6-Clicks" scores improved in 67%of the patients, and the daily activity AM-PAC "6-Clicks" scores improved in 48% of the patients, with 57% discharged to home. Interventions related to mobility and self-care are shared.

Discussion

Guidelines were created from this exploratory study that supports occupational and physical therapy intervention through collaboration with the interdisciplinary rehabilitation team. This study aligns with other research supporting intervention once the aneurysm is secure, the neurological exam is stable, and the patient's vasospasm is stable or improving.

Keywords: aneurysmal subarachnoid hemorrhage, intensive care unit, occupational therapy, physical therapy, practice guideline

Background

Aneurysmal subarachnoid hemorrhage (aSAH) is uncommon and accounts for only 5% of all strokes (Burns et al., 2018; Dority & Oldham, 2016; Muhammad & Hänggi, 2021). Worldwide, the incidence of aSAH is around 7.9 per 100,000 persons (Etmnian et al., 2019). This type of stroke affects people at a younger age (Grasso et al., 2017). The mean age is between 50 and 55; the incidence increases with age and occurs in a higher percentage of women between 55 and 85 and younger men 25-45 years of age (Burns et al., 2018; Connolly et al., 2012; Thompson et al., 2022; Wahood et al., 2022). The mortality rate of aSAH has been reported to range between 25% and 50% (Burns et al., 2018; Connolly et al., 2012; Muhammad & Hänggi, 2021; Neifert et al., 2021; Samuels et al., 2021).

Early medical intervention and management of complications such as hydrocephalus have improved functional outcomes, decreasing case fatality rates (Connolly et al., 2012). High blood pressure, smoking, and alcohol consumption are considered modifiable risk factors and are associated with higher odds of admission for aSAH (Neifert et al., 2021; Rehman et al., 2019; Wahood et al., 2022). Family history is also considered a risk factor for aSAH (Rehman et al., 2019; Zuurbier et al., 2022).

Signs of aSAH often include a severe headache, nausea, vomiting, photophobia, neck stiffness, altered level of consciousness, seizures, and profound encephalopathy (Burns et al., 2018; Neifert et al., 2021). Diagnosis of aSAH is through a non-contrast computed tomography (CT) scan of the head and computed tomography scans (CTA) (Burn et al., 2018). A lumbar puncture is performed if aSAH is suspected and not shown on the CT (Connelly et al., 2012). Patients are admitted to the neurosurgical intensive care unit (NSICU) or invasive monitoring and mechanical ventilation (Sottile et al., 2015). Patients require close monitoring and management of vasospasm, delayed cerebral ischemia (DCI), hydrocephalus, and seizures (Connolly et al., 2012).

Medical Interventions

Emergency intervention is required with a ruptured spontaneous aSAH, which occurs in 85% of the events (Thompson et al., 2022). It is best practice to transfer a patient to a facility that manages a high volume of aSAH patients with an experienced neurocritical care team for optimal outcomes (Connolly et al., 2012; Shukla, 2017; Souter, 2017). Mayo Clinic in Jacksonville, Florida, is a comprehensive stroke center and follows the guidelines from the American Heart Association (Connolly et al., 2012).

The two most common interventions are surgical clipping and endovascular coiling to secure the aneurysm and prevent rebleeding (Burns et al., 2018; Thompson et al., 2022). Endovascular coiling is considered superior and associated with positive outcomes, along with being used to repair most ruptured aneurysms in the United States (Connolly et al., 2012; Golnari et al., 2020; Samuels et al., 2021). Surgical interventions also include an external ventricular drain (EVD) for intracranial hypertension, intraventricular hemorrhage (IVH), and hydrocephalus (Burns et al., 2018; Konovalov et al., 2021; Neifert et al., 2021). It is essential to perform an initial clinical severity of aSAH with a validated scale (Connolly et al., 2012). Examples include the Hunt and Hess and or the World Federation of Neurological Surgeons; both are valid indicators of outcomes following aSAH (Connolly et al., 2012). Oral nimodipine therapy remains the mainstay of neuroprotective therapy and should be given to all patients with aSAH, as it has been shown to improve outcomes (Connolly et al., 2012; Muhammad & Hänggi, 2021).

Cerebral Vasospasm

Cerebral vasospasm is the disruption of chemical hemostasis and endothelium integrity resulting from brain injury caused by aSAH (Viderman et al., 2023). It is the leading risk factor for neurological deterioration (Tawk et al., 2021; Thompson et al., 2022). 70-90% of patients experience vasospasm, which occurs on days four through 14 and typically resolves after 21 days (Burns et al., 2018; Connolly et al., 2012; Dority & Oldham, 2016). Frequent monitoring, early detection, and management are essential, as some patients experience symptomatic ischemia and others develop infarction (Connolly et al., 2012). Cerebral angiography provides the ability to evaluate the vasculature and diagnose vasospasm, a post-central nervous system aSAH complication (Burns et al., 2018; Muhammad & Hänggi. 2021). Vasospasm is diagnosed with CTA, CT, and transcranial doppler (TCD), which determines reduced cerebral blood flow, and intervention is indicated (Neifert et al., 2021; Venkatraman et al., 2018). Interventions, including balloon angioplasty and intra-arterial vasodilators, are used to manage vasospasm but have not improved overall clinical outcomes (Venkatraman et al., 2018).

Rehabilitation and Early Mobilization

Early mobilization, defined by The Society of Critical Care Medicine as active functional participation, which includes “sitting edge of bed, standing to transfer from bed to chair, standing, marching in place, and walking” assists in regaining function, detecting vasospasm for intervention, and reducing the incidence of severe vasospasm (Balas, 2019, p.53; Karic et al., 2017; Shukla, 2017). Early mobilization of patients in the neurological intensive care unit requires additional consideration of their hemodynamic stability and a safety checklist (Hernandez, 2021; Olkowski & Shah, 2017). Rehabilitation services follow expert consensus and recommendations for hemodynamic stability and recommended lab values from the Academy of Acute Care Physical Therapy Laboratory Values Interpretation Resource prior to initiating early intervention of critical care patients (Hodgson et al., 2014; Tompkins et al., 2017).

Interdisciplinary collaboration for rehabilitation of patients with aSAH and EVD follows a safety guideline that ensures the EVD is secure, intracranial pressures (ICP) >18 to 20 mmHg, stable blood pressure (BP), and hemodynamic stability (R. Hanel, R. Reimer, R. Warren, personal communication, April 2014). Yataco et al. (2019) established the guideline for early mobility of patients with an EVD in the NSICU at Mayo Clinic Jacksonville recommending that the nurse must clamp the EVD before mobilization to avoid the potential adverse event (AE) of cerebral spinal fluid siphoning and monitor for AEs.

Evidence exists for the safe early mobilization of patients with EVD (Moyer et al., 2021; Olkowski & Shah, 2017; Yataco et al., 2019; Young et al., 2019). However, there is limited literature and evidence for early rehabilitation for aSAH patients with vasospasm as patients are often excluded from research and early mobility if they have symptomatic or severe vasospasm (Olkowski & Shah, 2017; Young et al., 2019). Moyer et al. (2021) reported vasospasm precluded therapy intervention in seven studies. In contrast, Karic et al. (2017) found mobilization safe and feasible with aSAH patients with decreased frequency and severity of cerebral vasospasm for those participating in early rehabilitation. Olkowski and Shah (2017) reported that vasospasm should not limit mobility if the patient's neurological exam is stable, and mobilization is recommended within 48 hours of aneurysm securement and following a safety guideline. Shukla (2017) recommended the prevention of overstimulation while initiating early mobilization when the patient is medically and neurologically stable. Hernandez et al. (2018) reported most physical therapists preferred their patients to remain in bed if they were experiencing vasospasm but mobilized patients the first day after the ruptured aneurysm had been secured if medically and neurologically stable (Hernandez et al., 2018). Finally, Okamura et al. (2021) found that early mobility was associated with discharge home and positive functional outcomes compared to the delayed mobility group**.**

Rehabilitation Disciplines and Involvement

Typically, aSAH follows a similar rehabilitation process as traumatic brain injury and ischemic stroke (Shukla, 2017). There are published guidelines for managing aSAH, but acute inpatient rehabilitation is not mentioned (Shukla, 2017). Studies focus more on physical rather than cognitive and emotional impairments, and all three require attention as they impact functional outcomes (Malcolm et al., 2021; Okazaki & Kuroda, 2018; Shukla, 2017; Weinreich et al., 2017).

The rehabilitation role for patients with aSAH falls under the neurological rehabilitation umbrella, including occupational therapy (OT), physical therapy (PT), and speech-language pathology (SLP). The current process at Mayo Clinic-Jacksonville includes an order set for OT, PT, and SLP services for patients admitted with aSAH. The neurocritical care team collaborates with the rehabilitation team during interdisciplinary neurology rounds and provides updates when a patient is neurologically stable for intervention.

OT provides a patient-centered, holistic approach to address activities of daily living (ADL) and cognition to promote meaningful engagement in activities to facilitate a patients recovery starting in the ICU (Bittencourt et al., 2021; Malcolm et al., 2021; Weinreich et al., 2017). Other common OT interventions include early mobility and cognitive interventions (Weinreich et al., 2017). It is vital to address cognition early, as 69% of ICU survivors experience new or worsening instrumental activities of daily living (IADL) impairments associated with cognitive and psychological deficits (Hopkins et al., 2017; Shukla, 2017; Weinreich et al., 2017).

PT optimizes movement and improve the human experience (American Physical Therapy Association, 2022). PT interventions in the NSICU include breathing exercises, mobility, transfers, ROM, use of a tilt table, and cycling in bed (Koukourikos et al., 2020; Sottile et al., 2015). It is essential to carefully monitor the cerebral hemodynamics of brain-injured patients when participating in therapy intervention dealing with changing head position and exertion (Hernandez et al., 2021).

Current Practice and Precautions

Several studies demonstrate the safety and feasibility of early rehabilitation for patients requiring an EVD (Moyer et al., 2021; Olkowski & Shah, 2017; Yataco et al., 2019; Young et al., 2019). Limited evidence or guidelines exist for early rehabilitation of aSAH patients experiencing vasospasm. Okazaki and Kuroda (2018) reported a need for more attention and research for patients with aSAH to improve neurological outcomes directly related to overall function.

The standard of practice in the NSICU at Mayo Clinic- Jacksonville is to closely monitor patients for early detection of neurological deterioration and management of medication and invasive lines such as EVD or mechanical ventilation. Early detection of low BP and blood sugar is critical as they are associated with poor outcomes in aSAH patients (Connolly et al., 2012; Dority & Oldham, 2016). Higher BP ranging from 140 to 160 is permitted post-aneurysm securement and if there is a concern for vasospasm or DCI to manage the symptoms (Burn et al., 2018; Dority & Oldham, 2016; Connolly et al., 2012). It is also essential to monitor hypotensive effects of nimodipine, which is the mainstay of neuroprotective therapy for aSAH patients (Connolly et al., 2012; Hernandez, 2021; Muhammad & Hänggi, 2021). Balas (2019) recommended monitoring for signs of delirium in neurocritical patients due to negative outcomes. It is essential to determine if it is related to the primary or secondary complications of the neurologic injury (Balas, 2019). Patients requiring mechanical ventilation can participate in early rehabilitation following guidelines based on expert consensus and recommendations (Hodgson et al., 2014). Rehabilitation can be initiated if the fraction of inspired oxygen is less than 0.6, oxygen saturation is 90 percent or greater, and the respiratory rate is 30 breaths/minute or less (Hodgson et al., 2014). Review lab values to ensure they are within the normal range following the Academy of Acute Care Physical Therapy Laboratory Values Interpretation Resource (Tompkins et al., 2017). Patients are monitored continuously during therapy interventions for adverse events and activity intolerance. The goal is to establish the patient's current baseline of function and work toward their prior level of function.

The current rehabilitation guideline at Mayo Clinic prohibits therapy intervention for patients experiencing vasospasm (R. Hanel, R. Reimer, R. Warren, personal communication, April 2014). The reasoning is fear of worsening vasospasm or delayed cerebral ischemia (Karic et al., 2017; Olkowski & Shah, 2017). However, evidence indicates this guideline could be updated, with several studies suggesting that early mobilization of neurocritical care patients with an EVD is safe, feasible, and should not preclude mobilization (Moyer et al., 2021; Olkowski & Shah, 2017; Yataco et al., 2019; Young et al., 2019).

Methods

The purpose of this study was to describe patient demographics, therapy outcomes, and rehabilitation course of aSAH patients with vasospasm who participated in therapy during their admission. This study also aimed to explore and characterize documented adverse events of this patient population during their hospital stay. Finally, a secondary aim was to develop guidelines for OT and PT to perform safe early mobilization and activity engagement to avoid the detrimental side effects of immobility.

After obtaining Institutional Review Board (IRB # 22-006342) at Mayo Clinic - Jacksonville the researchers retrospectively reviewed the medical records of 32 patients admitted for aneurysmal subarachnoid hemorrhage at Mayo Clinic - Jacksonville's NSICU, a quaternary hospital, who underwent rehabilitation from July 2019 to June 2022. There was a total of 21 patients who met the inclusion criteria, while 12 were excluded. Patients included were diagnosed with aSAH, experienced vasospasm during admission, and received OT and or PT intervention. Patients were excluded if they were not diagnosed with aSAH, were never mobilized due to medical acuity, and did not experience vasospasm during admission. Two patients were excluded from the study as they were diagnosed with perimesencephalic SAH, a non-aneurysmal subarachnoid hemorrhage, functionally independent and did not require therapy intervention following evaluation.

Data Collection

Data was extracted over four weeks with a student researcher, and the first author completed a second review to compare and ensure data accuracy. The data was stored on a password protected computer with individual patient numbers assigned to ensure privacy. The following demographic and medical information was extracted from the medical records and inputted into an Excel document: age, sex, ethnicity, comorbidities, date of hospital admission, aSAH severity at hospitalization admission with the grading scales Hunt and Hess grade and Fisher grade, location of aneurysm, treatment (surgical clip ligation/endovascular coil embolization/preservation, vasospasm present and severity based on TCD vasospasm criteria cerebral vasospasm mild (TCD mean flow velocity or MFV >120cm/s), moderate (>150cm/s), and severe (>200cm/s), complications (rebleeding/hydrocephalus, deep vein thrombosis, pulmonary embolism, mechanical ventilation), EVD present and date, EVD removal date, number of EVD days,

The following rehabilitation information was extracted from the medical record: 1) hospital day first mobilized with OT and or PT, 2) adverse events during or following first mobilization session, 3) any adverse events during or following any OT or PT session, 4) barriers or reason not mobilized, 5) total number of OT and PT sessions, 6) highest level of function with OT and PT, 7) discharge date, 8) length of hospitalization, 9) first and last OT and PT note reviewed for highest level of function. Using electronic medical record data (i.e., Epic) integration support, OT and PT procedure codes were gathered for each patient throughout their hospitalization. The data extraction focus for this study was adverse events with early mobility facilitated by OT and PT disciplines. Speech language pathology discipline data was not analyzed.

The Activity Measure for Post-Acute Care (AM-PAC) “6-Clicks” inpatient daily activity and basic mobility are short forms were developed by researchers at Boston University (Haley et al., 2004). The AM-PAC “6-Clicks” is a valid measure of a patient’s current level of function in daily activity and mobility, their need for therapy in the acute care setting and post discharge setting needs (Jette et al., 2014). Each item in the daily activity and mobility AM-PAC “6-Clicks” is scored from one to four based on how difficult the task or the amount of assistance the patient requires to complete the task (Jette et al., 2014). The lower the score indicates lower level of function, and the higher score indicates a higher functional level of independence (Jette et al., 2014). The AM-PAC “6-Clicks” daily activity and mobility scores are entered into every OT and PT evaluation and visit note in the electronic medical record at Mayo Clinic Jacksonville.

Therapy Orders

Patients are automatically referred for rehabilitation services (OT, PT, and SLP) when admitted to the hospital. Rehabilitation was initiated through collaboration with the neurocritical interdisciplinary team, including nurses, neurologists, neurosurgeons, physician assistants, nurse practitioners, physical medicine and rehabilitation physicians, OTs, PTs, and SLPs. A patient’s aneurysm must be secured and deemed medically stable through interdisciplinary collaboration, following guidelines from expert consensus and the Academy of Acute Care Physical Therapy Laboratory Values Interpretation Resource (Hodgson et al., 2014; Tompkins et al., 2017).

Variables

Functional Mobility

Mobility for this exploratory, descriptive study was defined as activity events that included transfer from a supine position to sitting on the side of the bed, sit to standing by the side of the bed, transfer from the bed to chair, and ambulating any distance away from the bed. Additional activity events included bed-level ADL and cognitive screening.

Adverse Events Construct

Potential minimal adverse effects with mobility and daily activity were defined for this study, including unstable ICP (defined as an ICP of 20 mm Hg or sustained 2 min or longer) for patients with an EVD, cerebral perfusion pressure lower than 50 mm Hg, systolic BP lower than 90 mm Hg or higher than 180 mm Hg, diastolic BP higher than 105 mm Hg, orthostatic systolic BP drop of 20 mm Hg following any positional change, persistent saturation of peripheral oxygen less than 90 percent, increased headache, nausea, and emesis. Additional minimal adverse events in response to therapy included atrial fibrillation, bradycardia, and tachycardia. Serious adverse effects included EVD dislodgement from the head and the decline in medical or neurological condition requiring NSICU team intervention following therapy intervention.

Results

Patient Demographics and Past Medical History

The 21 patients in this study comprised 12 females and nine males with an average age of 56. The age range of females and males was 21 to 81, with the female average of 59 and the male average of 50. Patient ethnicities included 10 Caucasian,

five African American, two Asian Filipino, one Asian Chinese, one Pacific Islander Puerto Rican, one White Puerto Rican and one White Hispanic or Latino.
One patient had a family history of a brain aneurysm, and one patient had a sibling with a hemorrhagic stroke. One of the patients had a previous aneurysm with clipping and ventriculoperitoneal shunt. Hypertension (HTN) was a common comorbidity among 12 (57%) of the patients.

Rehabilitation Duration and Frequency

The average first day of OT intervention was day four, and the average first day for PT was day three. Overall, 67% of patients were seen by therapy on day one or two. Due to medical acuity, therapy began on day 13 for one patient, and for two patients therapy began on day six or seven. Average length of hospitalization was 20 days, with a range from seven to 45 days. Patients received an average of six OT and eight PT sessions while hospitalized, with a range from two to 40. On average, patients were seen by therapy on 45% of their hospital days and received therapy with an average of 10 days of therapy during their hospitalization.

Prior Level of Function

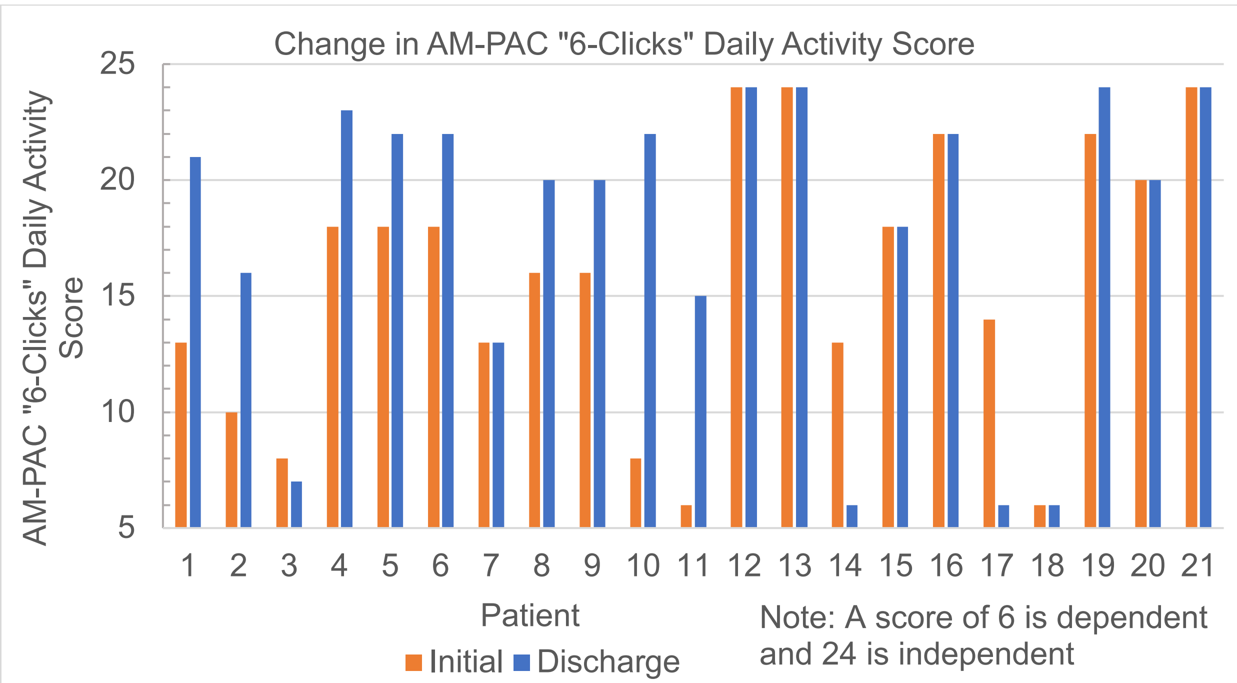
The patient's prior level of function was documented on the initial evaluation by OT and PT. Prior to hospitalization, thirteen of the patients were independent, seven patients were independent and employed, and one was independent except for requiring assistance with lower body dressing.

Change in Function During Hospitalization

The level of function at evaluation ranged from dependent to independent based on the daily activity and mobility AM-PAC “6-Clicks” scores. Scores ranged from 6 (dependent) to 24 (independent). The daily activity scores improved in 48% of the patients and stayed the same in 38% of the patients (Figure 1). There was a decrease in 14% of the patient's daily activity AM-PAC "6-Clicks" scores. The daily activity AM-PAC "6-Clicks" scores remained the same in independent patients who were seen for an evaluation only.

Figure 1

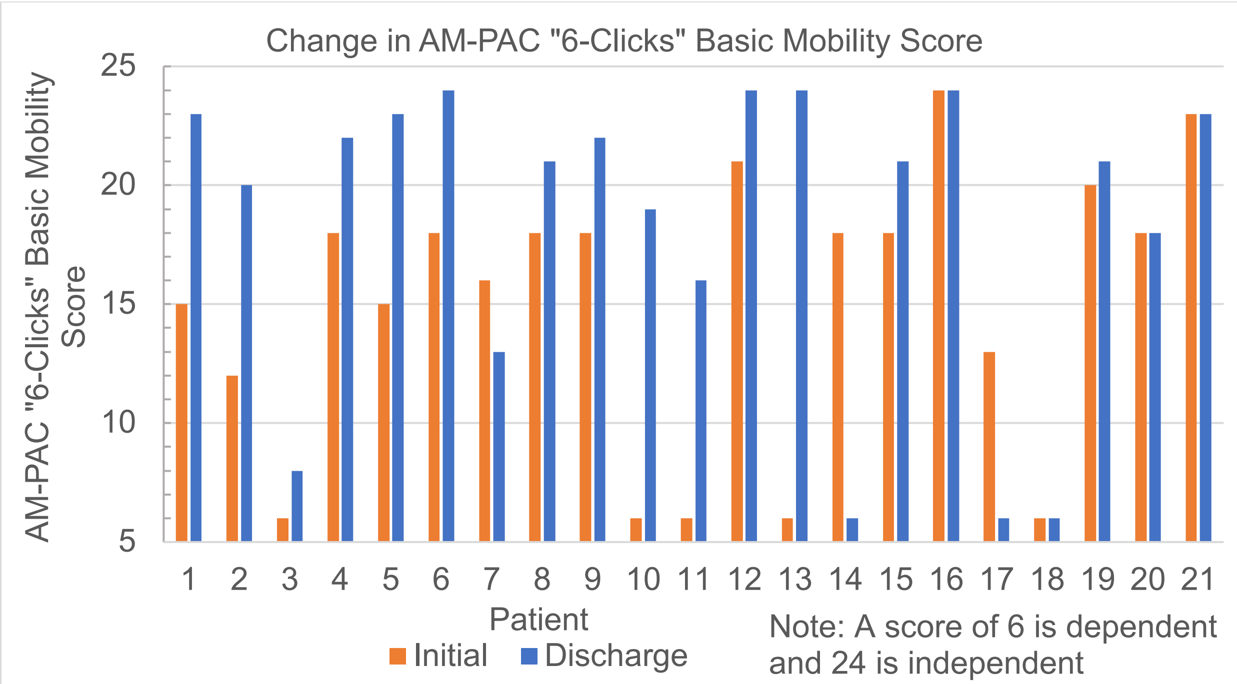
Initial and Discharge Daily Activity Measure for Post-Acute Care (AM-PAC) "6-Clicks"



The mobility AM-PAC "6-Clicks" scores improved in 67% of the patients, stayed the same in 19%, and decreased in 10% of the patients (see Figure 2). One patient's mobility AM-PAC "6-Clicks" score remained the same and discharge destination was IRF. Medically, two patients declined, and they transitioned to hospice care. One patient remained dependent, while another improved by two points in their mobility score and declined by one point in their ADL score.

Figure 2

Initial and Discharge Mobility Activity Measure for Acute Care (AM-PAC) "6-Clicks"



Level of Function at Discharge and Discharge Location

Information on discharge disposition and level of function at discharge was collected (Table 1). At discharge, 17 patients were ambulating independently without an assistive device to moderate assistance of two using a podium walker at discharge. ADL performance varied from independence to moderate assistance. Three patients were dependent; one required maximum assistance of two people to stand and maximum hand-over-hand assistance to perform grooming.

Table 1

Discharge Level of Function with Occupational and Physical Therapy

Pt No.	Age	Sex	Days Hospitalized	Discharge Level of Function with Occupational and Physical Therapy	Discharge Destination
1	47	F	21	Ambulation Supervision, ADL Supervision	Home
2	56	F	24	Ambulation 150' with RW, ADL CGA to Min Assist	IRF
3	65	M	31	Stood with Max x 2, Max hand over hand assist grooming	LTAC
4	60	F	17	Ambulated 360 ft Supervision, ADL Supervision,	Home
5	41	M	21	Ambulation Supervision 1200 ft, Independent ADL	Home
6	52	M	15	Ambulation independent, Supervision ADL	Home
7	33	M	38	Ambulation with Podium Walker Mod x 2 12 ft x 4, ADL Min to Mod Assist	IRF
8	44	M	13	Ambulation Independent, ADL Supervision	Home
9	43	M	13	Ambulation Supervision 360 ft, ADL Supervision	Home
10	72	F	45	Ambulation without AD unsteady gait belt 30 ft x 2 Min Assist, ADL Min Assist	IRF
11	50	M	27	Ambulation with RW Mod Assist, ADL Mod Assist	TCU
12	62	F	13	Ambulation/ADL Independent	Home
13	21	F	15	Ambulation/ADL Independent	Home
14	58	F	12	Dependent	Hospice
15	75	F	13	Ambulation with Supervision RW, ADL Min Assist	Home with HH
16	65	M	12	Ambulation/ADL Supervision	Home
17	81	F	22	Dependent	Hospice
18	70	F	25	Dependent Sitting EOB/ADL	LTAC
19	45	F	13	Ambulation Supervision, ADL Independent	Home with OP PT
20	63	F	17	Ambulation Min Assist, ADL Supervision	IRF
21	63	M	7	Ambulation/ADL Independent	Home

Note. AD= Assistive Device; ADL=Activities of Daily Living; HH=Home Health; IRF=Inpatient Rehab Facility; RW=Rolling Walker; CGA=Contact Guard Assist; LTAC=Long Term Care; Min.= Minimal; Mod=Moderate; Ft.=Feet; OP= Outpatient; PT=Physical Therapy; TCU=Transitional Care Facility

Identified Adverse Events

No serious adverse events were documented during or after therapy intervention, however minimal adverse responses were documented. The minimal adverse responses identified with therapy intervention included: atrial fibrillation, bradycardia, decreased level of arousal, decreased SpO2, dizziness, emesis, head pain when EVD clamped, HTN, hypotension, and tachycardia. All the patients in this study experienced vasospasm during their admission.

An adverse event was document in 13% (35) of the total 285 therapy sessions. 13 (62%) patients experienced an adverse event during therapy. Eight patients (38%) did not experience an adverse event during therapy. Therapy was deferred once due to hypertension and intolerance to having EVD clamped, and two therapy sessions ended due to hypertension, and one patient was also dizzy. Gait was deferred one session due to hypotension and another due to HTN and atrial fibrillation.

Patients experienced adverse events with therapy on days with and without vasospasm. Eight patients with vasospasm did not have an adverse event. In contrast, 11 patients without vasospasm experienced a total of 25 adverse events while participating in therapy. On the day of vasospasm, four out of the 16 patients had a total of eight adverse events while participating in therapy. One patient accounted for four of the eight adverse events and had a diagnosis of traumatic bilateral subdural hematomas. The adverse events for this patient included: 1) HTN and atrial fibrillation, 2) HTN, 3) tachycardia, and 4) decreased level of arousal. Nursing monitored the patient closely and did not require NSICU intervention post-therapy.

Notably, 80% of patients experienced a headache during their admission, and improved over their hospitalization. Patients with no headache documented were functionally low-level and discharged to hospice or a LTAC facility. Hypertension was the most common AE and combined with dizziness, atrial fibrillation, bradycardia, along with tachycardia when EVD clamped and decreased SpO2. 15 patients had an EVD while six did not. 14 patients had hydrocephalus, two patients without hydrocephalus had an EVD, and one with no EVD. Two patients were diagnosed with a DVT, whereas none were diagnosed with pulmonary embolism or rebleeding.

Discussion

Results from this study suggest a documented minimal adverse event occurred in 13% of therapy sessions and there were no documented serious adverse events. These results align with Karic et al. (2017) who reported mobilization is safe and feasible with aSAH patient. Result also support recommendations by Olkowski and Shah (2017) who concluded that vasospasm should not limit mobility if a patient's neurological exam is stable.

This patient population is at significant risk for impairment due to the severity of this stroke and their prolonged hospital length of stay (Connolly et al., 2012; Dority et al., 2016; Karic et al., 2017; Neifert et al., 2021; Olkowski & Shah, 2017; Shukla, 2017). Okamura et al. (2021) reported risk for impairment could be mitigated with early mobility, suggesting that early mobilization of patients with aSAH was associated with discharge home and positive functional outcomes. The findings of the current study support Okamura et al. (2019) as 57% of the patients were discharged to home or inpatient rehab and improvements in daily activity and mobility AM-PAC “6-Clicks” scores were observed with early mobility and activity in this patient population.

Currently, limited evidence exists describing or outlining the rehabilitation course, duration, or frequency of patients with aSAH experiencing vasospasms. The current study fills a gap in knowledge of the rehabilitation course and suggests variable lengths of hospitalization and duration of therapy. Results indicate average for PT sessions were slightly higher than OT sessions and patients received therapy on nearly half (45%) of their hospital days.

Hernandez (2018) reported that many PTs prefer their patients to remain in bed if they are experiencing vasospasm. Further, Moyer et al. (2021) suggested vasospasm precluded therapy intervention in seven studies. Given this historical hesitancy, the current study helped to shape current guidelines for OT and PT intervention with aSAH patients experiencing vasospasm at Mayo Clinic Jacksonville and may provide foundation data for future studies. Results from the current study and others, support collaboration with the interdisciplinary team and initiation of intervention once the aneurysm is secure, the neurological exam is stable, and the patient’s vasospasm is stable or improving (Karic et al., 2017; Okamura et al. 2021; Olkowski & Shah, 2017). OT and PT should also follow expert consensus and the Academy of Acute Care Physical Therapy Laboratory Values Interpretation Resource (Hodgson et al., 2014; Tompkins et al., 2017).

Limitations

This exploratory retrospective descriptive study had several limitations. The study featured a sample size from a single site and only included patients who experienced vasospasm and participated in rehabilitation during their hospital admission. These limitations affect the ability to generalize study findings. Preexisting data was used to perform chart reviews by a student researcher followed by a second review by the first author. Errors can occur in the chart review process, and there is the possibility of incomplete and missing data. Transferring data into an Excel spreadsheet poses a risk for errors and the data was dependent upon the documentation of up to multiple therapists seeing each patient during their hospitalization which could have influenced the accuracy of the data and results.

Implications and Suggestions for Acute Care Practice

OT and PT intervention for patients admitted to the NSICU with aSAH should begin once the aneurysm is secure, and the neurological exam is stable, including patients experiencing vasospasm if they are asymptomatic, stable, or improving. Collaboration with the neurocritical care team is essential to ensure safe early rehabilitation when the patient is hemodynamically stable, along with following current intervention guidelines for patient safety. Rehabilitation services should continuously monitor the patient during intervention for any adverse events and avoid overstimulation while progressing with activity based on the patient’s tolerance (Shukla, 2017). Standard of practice should include OT performing task analysis, ADL, and cognition through assessment and treatment to identify deficits to make discharge recommendations. Cognitive and emotional impairments require more attention as they impact a patient's functional outcome (Malcolm et al., 2021; Okazaki & Kuroda, 2018; Shukla, 2017; Weinreich et al., 2017). The timing of a cognitive assessment needs consideration since most patients with aSAH experience a headache. Therefore, optimal timing is once a patient’s headache is minimal.

Future research should consider further evaluation of cognition and psychosocial factors. OT’s may have a role in addressing cognition with this patient population. Additionally, this type of stroke frequently occurs in younger men and women still employed resulting in lost productive years (Macdonald & Schweizer, 2017; Tawk et al., 2021). Future research could focus on longitudinal outcomes and assess for ongoing impairment as well as return to work and other meaningful occupations.

Conclusion

This descriptive exploratory retrospective study aimed to describe adverse events of aSAH patients experiencing vasospasm who participated in OT and or PT. The secondary outcome was to develop guidelines for OT and PT to follow to initiate safe early mobilization and activity engagement to avoid the detrimental side effects of immobility. This also includes addressing a patient’s cognition and emotional status, which impacts overall function (Malcolm et al., 2021; Okazaki & Kuroda, 2018; Shukla, 2017; Weinreich et al., 2017).

The results of this study demonstrate minimal adverse effects with early rehabilitation for aSAH patients experiencing vasospasm. This patient population is at high risk of functional and cognitive impairment due to the severity of this stroke and their prolonged hospital length of stay. Initiation of rehabilitation services for aSAH patients admitted to the NSICU should begin once the aneurysm is secure, interdisciplinary collaboration, the vasospasm, and the neurological exam are stable or improving. Therapists should continuously monitor their patients during each session for adverse effects and progress to their activity tolerance. Early rehabilitation services for aSAH patients experiencing vasospasm can promote a positive functional outcome. Twelve of the patients in this study were able to discharge home, and four went to an IRF. Therapists can follow the established guidelines, collaborate with the interdisciplinary team, and progress aSAH patients to their prior level of function and roles starting in the NSICU.

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