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A Randomized Sham-controlled Trial of Sciatic Nerve Neurodynamic Mobilization in Painful Diabetic Peripheral Neuropathy

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Abstract

Objective: To study the efficacy of sciatic nerve neurodynamic mobilization as compared to control intervention on vibration thresholds, neuropathic pain severity, sciatic nerve neurodynamic test range of motion and neuropathy specific quality of life (NeuroQoL) in painful diabetic peripheral neuropathy patients.

Design: Observer-blinded randomized sham-controlled trial.

Methods: The study conduct was approved by Institutional Ethics Committee and was registered at Clinical Trials Registry- India. Thirty two patients of age (60.12 ± 11.41years), both gender (13 male, 19 female) were selected on convenient sampling. Subjects were selected based on following: Physician diagnosed type-II DM of atleast eight years duration; complaint of neuropathic pain (screened using neuropathic pain questionnaire NPQ) in the legs and feet; mechanical behavior of neuropathic pain (aggravated and/or relieved by movements); ability to understand and co-operate for instructions of tester. The twenty one excluded subjects had either of the following: progressive worsening neurological deficit, irritable pain, allodynia/ hyperalgesia, musculoskeletal problems, cognitive maladaptation syndrome. The independent blinded observer then recorded neuropathic pain intensity on NPQ, sciatic nerve neurodynamic test range of motion at initial resistance R1, vibration thresholds by Biothesiometry and NeuroQoL. The subjects then were randomized to receive either of two interventions-control and experimental. The control group received sham treatment, drugs for glycemic control, Gabapentin for neuropathic pain, diet-lifestyle modification and walking exercise prescription. The experimental group received in addition, sciatic nerve neurodynamic mobilization consisting of nerve massage and nerve sliders. The treatment session was of 45 min duration on five sessions (one session per week) for total study duration of five weeks. Patients were instructed to perform self-mobilization once daily and were given patient log to ensure compliance. Data was collected twice- pre and post intervention.

Results: The groups were comparable in age, gender, chronicity and severity of neuropathic pain. Both groups showed significant improvements. The experimental group showed significant improvements post treatment in all the four study outcomes. The between-group mean differences were NPQ (18.89 ± 2.46), neurodynamic range of motion (4.00 ± 3.85 degrees), vibration threshold (5.94 ± 1.12 volts) and NeuroQoL (15.93 ± 2.85) in favour of experimental group. All differences were statistically significant at $p<.05$ when analyzed using students' t-test at 95% confidence interval using SPSS 12.0.1 for Windows.

Conclusion: Sciatic nerve neurodynamic mobilization comprising of nerve massage and nerve sliders was shown to be an effective treatment adjunct for painful diabetic peripheral neuropathy.

Implications for practice: Neurodynamic assessment and intervention should be considered as an effective therapeutic option for painful diabetic peripheral neuropathy patients who complain of pain in the sciatic nerve distribution.

Implications for research: Studies on other nerves, other neuropathic pain syndromes, other outcomes (electrophysiologic studies) are warranted.

Keywords: Neuropathic pain; Neurodynamics; Diabetes mellitus.

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Introduction

The term diabetes mellitus describes a metabolic disorder of multiple aetiology characterized by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both.[1] The prevalence of diabetes for all age-groups worldwide was estimated to be 2.8% in 2000 and 4.4% in 2030. The total number of people with diabetes is projected to rise from 171 million in 2000 to 366 million in 2030. The prevalence of diabetes is higher in men than women, but there are more women with diabetes than men. The urban population in developing countries is projected to double between 2000 and 2030.[2] The microvascular complications of diabetes are termed collectively as "triopathy" which includes retinopathy, neuropathy and nephropathy and the macrovascular complications include peripheral vascular disease, cerebrovascular disease and cardiovascular disease.[3,4]

Diabetic peripheral neuropathy (DPN) is a common complication estimated to affect 30% to 50% of individuals with diabetes. Chronic sensorimotor distal symmetric polyneuropathy is the most common form of DPN. The prevalence of neuropathy in type 2 diabetes ranges from 27% to 63% and from 14% to 70% in diabetes mellitus in general.[4] The higher prevalence of neuropathy in type 2 diabetes patients is related to greater age, male gender, longer diabetes duration, higher levels of glycosylated hemoglobin, lower HDL cholesterol, smoking; peripheral vascular disease and insulin use.[5]

Diabetic neuropathy has been defined as Peripheral somatic or autonomic nerve damage attributable solely to diabetes mellitus. It may be of two types symmetrical and asymmetrical. The symmetrical type was the commonest and it affects the sensory and autonomic functions of mostly peripheral nerves whereas the asymmetrical type affects the cranial nerves in their sensory and motor functions.[6] The first description of "diabetic neuropathy as a presence of pain and paresthesiae in lower limbs" was done by Rollo in 1798.[7] The consensus of opinion at the San Antonio conference on diabetic neuropathy was that diabetic neuropathy was "a descriptive term meaning a demonstrable disorder, either clinically evident or subclinical that occurs in a setting of diabetes mellitus without other causes of neuropathy. The neuropathic disorder includes manifestations in both somatic and/or autonomic parts of the nervous system."

Diabetic peripheral neuropathic pain (DPNP) or painful diabetic peripheral neuropathy (PDPN) affects approximately 11% of patients with diabetic peripheral neuropathy (DPN). The most common type of neuropathy in DM is DPN, with up to 50% of patients experiencing some degree of painful symptoms and 10% to 20% having symptoms severe enough to warrant treatment. A classic population-based study found some degree of neuropathy in 66% of patients with DM. Among those with type 1 and type 2 DM, 54% and 45%, respectively, had DPN and 15% and 13%, respectively, were symptomatic.[8]

The peripheral neuropathic pain can rise from musculoskeletal causes due to entrapment syndromes and also from movement induced mechanosensitivity.[6,9] Identification of musculoske letal peripheral neuropathic pain is made based on mechanical behavior of symptoms which alter with postures and/or movements.[7,10] Symptoms arising from peripheral nerves have been categorized into positive symptoms (dysesthetic pain such as hyperalgesia, allodynia, tingling, numbness, paresthesia and/or shooting pain) and negative symptoms (with neurological deficits such as sensory loss, motor loss and reflex loss)[8,11] and appropriate management was indicated to suit individual patient presentations with shrewd clinical reasoning.[9, 12]

Evaluation and treatment of this type of pain was proposed to be done utilizing neurodynamic testing that aims at checking neural mobility both intra and extraneural.[10,13] Intraneural mobility involves mobility between the nerve and its connective tissue sheaths, and extraneural mobility for between nerve and its surrounding structures.[11,14]

Neurodynamic mobilization involves nerve-specific movement testing (nerve slider and tensioner) and graded mobilization, nerve massage (longitudinal and transverse) applied to the affected nerve on thorough understanding of its neuroanatomy and neurophysiology.[7,12,13,14,10,15-17] Studies on neurodynamic treatment effects were done as nerve gliding exercises for carpal tunnel syndrome,[15,16,18,19] cubital tunnel syndrome,[17, 20] radial tunnel syndrome,[18,21] thoracic outlet syndrome,[19,22] and as neural mobilization for cervical cord compression,[20,23] cervical radiculopathy,[21,24] non radicular low back pain,[22,25] lower extremity symptoms[23, 26] and lumbar spine surgery.[24,27]

Two types of neurodynamic dysfunction were identified to be slider and tensioner dysfunction[28] (Shacklock, 2005a) based on the underlying biomechanical basis of convergence and divergence

in response to joint motion (Topp and Boyd, 2006).[29] Correspondingly two neurodynamic mobilization techniques were categorized to be sliders and tensioner techniques (Shacklock, 2005a).[28] Typically the nerve slider technique produces greater longitudinal excursion of the nerve along its bed compared to tensioner technique (Coppieters and Butler, 2008).[30]

Straight Leg Raising (SLR) test is a common neurodynamic test used for years to aid in the diagnosis of lumbar disc lesions and nerve root compression since its initial documented description by J. J. Frost in 1881 (cited in Urban, 1981).[31] The neuromechanical responses to SLR test were studied during structural differentiation manoeuvres like ankle dorsiflexion (Gajdosik et al, 1985; Hall et al, 1998; Boland and Adams, 2000; Herrington et al, 2008; Boyd et al, 2009),[32-36] cervical flexion (Hall et al, 1998),[33] pelvic rotation (Bohannon et al, 1985),[37] or hip movements (Cameron et al, 1994; Coppieters et al, 2005).[38, 39] SLR mobilization was also studied as a treatment technique in spinal surgery patients by authors earlier (Kitteringham, 1996; 27. Scrimshaw and Maher, 2001).[27, 40]

Neurophysiological effects of SLR test was studied by Ridehalgh et al[41] (2005) who examined the effects of superficial peroneal nerve tensioner technique a modified straight leg raise with plantar flexion and inversion on vibration perception thresholds (VPT) and the findings showed that the tensioner technique increased the VPT compared to sham technique but the effects were reversible within ten minutes among both runners and non-runners. Earlier study by Humphreys et al[42] (1998) on ten healthy subjects, demonstrated longer tibial nerve F-wave latencies when measured in straight leg raise position, proposedly indicating the neurophysiological effect of the SLR position and the author recommended neurophysiologic testing in nerve lengthened positions so as to elicit subtle neural involvement signs.

Earlier study by Coppieters and Butler[30] (2008) suggested that the nerve slider and tensioner techniques prove to be a valuable treatment tool in patients with neuropathies. Coppieters et al[43] (2009) also stressed the importance and safety of use of slider techniques in increasing nerve mobility and excursion without compromising neural circulation when in-vivo ultrasound imaging for median nerve was used to compare the slider and tensioner techniques. The evidence is continuously growing in favor of neurodynamic mobilization for patients with neural dysfunctions[44] (Ellis and Hing, 2008) and for patients with peripheral neuropathic pain (Nee and Butler, 2006).[45]

Bilateral leg symptoms in painful diabetic peripheral neuropathy patients are characteristically distributed in the sciatic nerve distribution. Involvement of sciatic nerve is common in PDPN which could be due to its large size and cross-sectional diameter; it is the autonomic supply for the lower limb; and it is the longest peripheral nerve in the body. Though straight leg raise tests evolved primarily as clinical diagnostic test for reproduction of patient symptoms from sciatic nerve, the SLR techniques was not studied as a treatment technique until straight leg raise mobilization has been shown to have influence on the vibration thresholds[25, 41] of the feet thus establishing evidence for neuromechanics and neurophysiology.

Studies on effects of sciatic nerve neurodynamic mobilization could not be retrieved from the existing literature. The purpose of our study was to observe the efficacy of sciatic nerve neurodynamic mobilization comprising of nerve massage and nerve sliders when added to control intervention of standard care on vibration perception thresholds, neuropathic pain severity, sciatic nerve neurodynamic test range of motion and neuropathy specific quality of life (NeuroQoL) in PDPN patients.

Materials and Methods

This Observer blinded Randomized Controlled Trial was approved by Institution Ethics committee and registered at Clinical Trials Registry- India and then conducted at Shri Rama Shakti Mission Charitable Trust and Hospital, Shakti Nagar, Mangalore in the period of four months, from January to April 2008. Thirty two patients were recruited on incidental sampling of either sex (15 male, 17 female), with mean age 60.12 ± 11. 41 years, who volunteered to participate after giving written informed consent. Subjects were deemed eligible if they were known physician diagnosed cases of Diabetes Mellitus for atleast six years; had neuropathic symptoms in both legs and feet (in sciatic nerve distribution- back of thigh and leg) for atleast 6 months; had mechanical behavior of neuropathic symptoms altered by positions and/or movements; had positive response to tibial nerve neurodynamic testing using SLR.[1] Excluded subjects (16 in number) consisted of inability of subjects to understand and/or co-operate during quantitative sensory testing and/or manual nerve mobility testing and/or treatment; Progressive worsening neurological deficit, irritable pain, allodynia/ hyperalgesia, musculoskeletal problems, cognitive maladaptation syndrome. Please refer to CONSORT

2010 flow diagram in figure-1.

Outcome measurement

Vibration thresholds VibrothermTM Biothesiometer (Diabetic Foot Kare India, Chennai): The transducer probe of the biothesiometer was placed at one of the three sites in the sole of the foot (in a randomly selected order) and then instructed to report when he/she started feeling the onset of sensation of vibration.[46] Biothesiometer assessment of quantitative sensory testing was validated highly and studied extensively for its high reliability and responsiveness.[47]

Tibial Nerve Neurodynamic Test Straight Leg Raise Test (SLR) 1: Originally proposed by Butler9, the test was done as follows; The patient lay supine on the plinth, the tester stands at the tested side lower extremity. With his distal hand performed dorsiflexion and eversion of the foot while the proximal hand performed the straight leg raise fixing the knee in extension simultaneously. The leg was lifted till the tester felt the onset of first initial resistance R1. Patient's symptom reproduction is considered to be a positive test which should again be confirmed for neural tissue involvement by structural differentiation.48 The tester once the symptom provocation was felt at the tibial nerve distribution, performed ankle plantarflexion or eversion and noted change in symptoms. Change in symptoms with structural differentiation is essential before considering neural tissue as the cause of the limitation of range of SLR. The range of SLR2 was then measured using a standard universal goniometer in degrees.

Neuropathic Pain Questionnaire: NPQ49: It was a 12-item self report questionnaire which has high sensitivity and specificity and test retest reliability for use in neuropathic pain trials. Each item has a visual analogue scale of 0 to 10 where 0 indicates no "pain" and 10 indicates "maximum or worst pain" possible for 10 different perceptions of neuropathic pain. Refer appendix-1 (reproduced with permission from authors). Score ranges from 0 to 100 where 0 denotes no neuropathic pain and 100 denotes worst neuropathic pain when scored.

Neuropathy-Specific Quality of Life Neuro QoL50: It was a 18 item self report questionnaire for measuring the quality of life in neuropathy subjects due to their foot problems. Each item had five responses ranging from "always" to "never". Another set of 3 responses which denote the importance of each item was also taken. Total score is thus obtained between 0 and 100 where 0 indicates poor quality of life and maximum score indicates good quality of life.

Interventions

After the outcome assessment by the blinded observer, the subjects were then randomized to receive either of the two interventions- control or experimental group by block randomization. The allocation was concealed from the primary investigator who administered the neurodynamic intervention.

Control group

Standard care was given by physician for patients in this group comprising of glycemic control, diet advice and palliative care for neuropathic pain. Another blinded physiotherapist prescribed group exercise of gentle active movements, 25 min walking exercise prescription to be done 5 times a week, The treatment lasted for 45 min duration.

Experimental group:

This group received in addition to standard care, neurodynamic intervention which consisted of, in the same order: Active movements of hip, knee, ankle and foot 5 reps, lasting 2 mins. Passive stretching for hip, knee, ankle and foot, each stretch held for 30 secs for plantar fascia, Gastrosoleus, hamstrings, piriformis and rectus femoris muscles, lasting 5 mins.

Sciatic nerve massage beginning with tibial nerve palpation along its course, transverse massage was given from proximal to distal. Longitudinal massage was then performed proximally and the progressing distally, lasting 3 mins. See fig 2.

Sciatic nerve Sliders: Sciatic nerve sliders were administered by simultaneous offloading of knee during hip loading and vice-versa. Subject was positioned in side lying and treating therapist performed straight leg raise upto onset of symptom. Combination of hip flexion with knee flexion and hip extension with knee extension was performed as two ended slider technique for 3 mins duration. The hip position is taken before the painful position and knee extension oscillations were performed as distal tensioner and hip flexion oscillations with knee in pre-loaded position as proximal tensioner for another 3 mins; and the session completed with active movements again for 2 mins.

Total treatment duration 45 mins. All patients were seen at same time of the day, 10 am to 12 noon, to avoid influence from any diurnal variations

on the outcome measures or on the responses to testing and interventions. The patients were then instructed to comply with home programme which was indicated by giving patient log. The independent observer collected the data twice- pre and post intervention for all the subjects.

Data analysis

All outcomes were analysed for their pre and post differences in within-subject comparisons using students' t-test at 95% confidence interval using SPSS 16.0 for Windows.

Results

Descriptive statistics

Comparison of patient characteristics between control and experimental groups.

	Control group	Experimental group	P- Value
Number of subjects	16	16	1.000
Age (years)	57.43 12.04	62.81 10.43	.187
Gender Male (female)	7 (9)	6 (10)	.723
Duration of Neuropathic pain (years)	3.75 ± 2.23	3.00 ± 1.75	.299
NPQ pre	61.53 ± 12.76	59.99 ± 12.06	.729
NeuroQoL pre	64.06 ± 13.79	61.50 ± 13.51	.599
Vibration Thresholds pre (volts)	34.75 ± 2.38	34.21 ± 2.38	.533
SLR1 ROM pre	17.5 ± 11.83	19.37 ± 10.14	.634

All comparisons between the two groups were not statistically significant at p <.05. The two groups were comparable before intervention.

Inferential statistics

Mean Differences	Control group	Experime-ntal group	Between group Difference	P- Value
NPQ (pre- post)	9.61 ± 4.69	28.5 ± 7.15	18.89 ± 2.46	.000*
NeuroQoL (pre- post)	12.7 ± 3.99	28.63 ± 6.84	15.93 ± 2.85	.000*
Vibration Thresholds (pre- post) volts	10.56 ± 2.22	16.5 ± 3.14	5.94 ± 1.12	.000*
SLR1 ROM (pre- post) degrees	-4.62 ± 2.94	-8.62 ± 5.79	4.00 ± 3.85	.020*

*- Statistically significant at p<.05

Neuropathic Pain Questionnaire

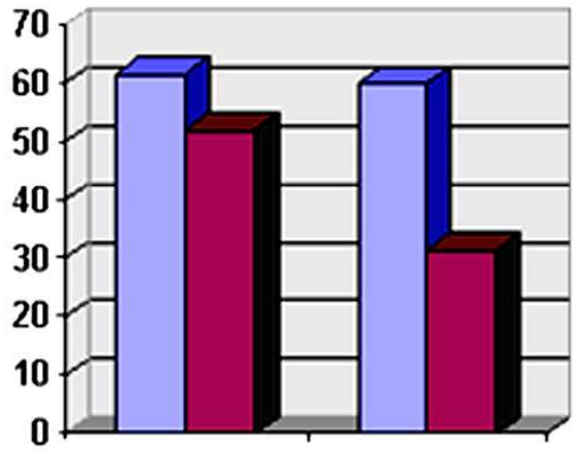

Fig. 1: Control Group Experimental Group.

Neuropathy Specific Quality of Life

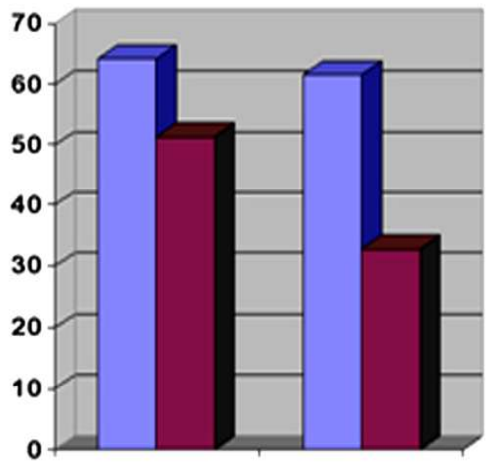

Fig. 2: Control Group Experimental Group.

Vibration Thresholds

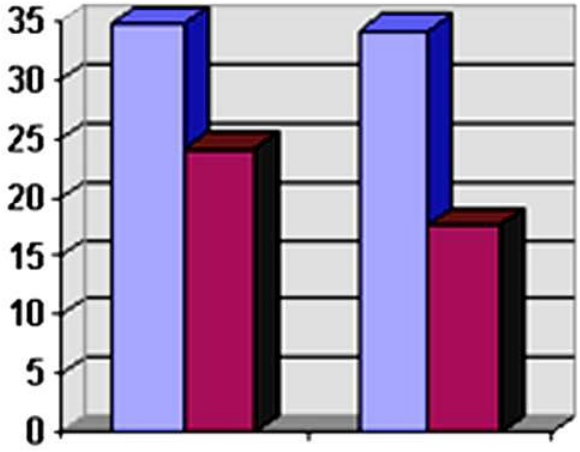

Fig. 3: Control Group Experimental Group.

Sciatic Nerve Neurodynamic Test Range of Motion

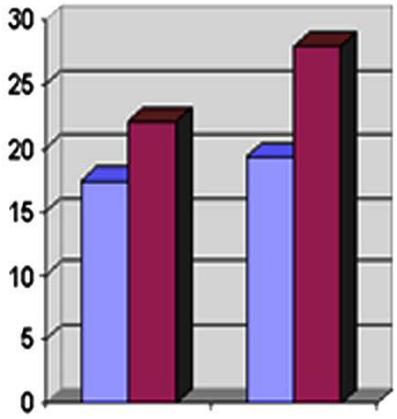

Fig. 4: Control Group Experimental Group.

Discussion

The study had important observations; Both the groups showed statistically significant improvements in all the four variables studied, which may be attributable to the standard care (glycemic control, palliative care, diet and exercise prescription) that subjects received might have influenced the recovery of the peripheral neuropathic pain in these subjects, as it was found in other studies.[51,52] The experimental group however had a statistically significant large treatment effect when compared the control group which can only be attributable to the neurodynamic mobilization the subjects received, thus rejecting the null hypothesis. TENS Transcutaneous Electrical Nerve Stimulation was another physical therapy modality of choices which had been studied earlier[53,54,55] was not given in this study due to community setting, and weekly follow-up which conflicted with the prescription dosage of TENS. The study had its own limitations; The confounding effect of placebo could not be ruled out in experimental group, due to the direct touch and its effects on patient perception as a manually applied technique of neurodynamic mobilization. However, use of placebo56 in neuropathic pain trials was more indicated for drug trials[57] than for others.

The following are the significance of this study; the first of its kind in neurodynamic mobilization and its clinical reasoning based application in so called presumably contra-indicated in regular settings. The neurophysiological effects were studied using vibration thresholds, and adoption of quality of life measure showed it had an impact on their way of life.

The combination of nerve massage, nerve sliders and nerve tensioners was never before been applied in clinical trials of neurodynamics. This opens up a new research scope for the effects of nerve sliders and tensioners in various other pathologies as well as claimed by other researchers58. Clinically, the sliders were well tolerated by the subjects and they showed within session improvements both qualitatively and quantitatively. The straight leg raise test 2 or tibial nerve neurodynamic test mobilization involved the component of SLR[59] added, which again might have mobilized the proximal trunks of sciatic nerve to exert an indirect influence on the tibial nerve. Future studies are warranted in other neuropathic pain syndromes, other peripheral nerves, measuring outcomes such as longitudinal nerve motion[60] using ultrasonography, nerve conduction studies.

Conclusion

Sciatic nerve neurodynamic mobilization in addition to standard care was better than standard care alone in type II diabetes mellitus subjects with peripheral neuropathic pain. Sciatic nerve neurodynamic mobilization should be considered as an effective treatment adjunct to standard care in treatment of neuropathic pain symptoms in type II diabetes mellitus patients.

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The Study Participants for their Consent, Co-operation and Compliance with the Treatment Regime during the study period.

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Effectiveness of Foam Roller on Plantar Fascia and Hamstring in Combination with Active Release Technique for Hamstring Tightness in College Students

Upasana Joshi[1], Tarang Srivastava[2], Anirban Patra[3], Niraj Kumar[4]

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Abstract

Introduction: In normal human function flexibility is an important aspect. Smooth, unrestricted, painfree ROM are done by a single joint or series of joints. The knee joint is stabilized by hamstring muscles, extension of knee decelerates by contracting eccentrically lead to flexi on of knee and hip extension. When there is lack of ability of muscle to change it slength from its state offull contraction to full stretchled to hamstring tightness.[1]

Needof Study: Hamstring tightness leads to high risk of recurrent injury, decreases the performance of daily living of students. It also lead to back pain and gait abnormality. So ART incombination with foam rollercan decrease hamstring tightness and decrease back painandstudent will do their activities without restriction.

Methodology: 30 subjects included in the study. At the mid of the treatment session mid tests done to see the improvement and post tests wasdone at the end of treatment session. Hamstring tightness were evaluated by finger to floor distance test Sit and reach test and Active knee extension test of subjects weredone to note the pretest score. Treatment of Foam roller and active release technique was given to patient for 6 days per week for a consecutive 4 weeks.

Result: Data was analyzed by using one samplet–test. Pre and Post score were taken via with SRT and AKET. Pvalue<0.05.

Conclusion: Foam roller treatment on plantar fascia and hamstring with Active release technique show its beneficial effect for hamstringtightnessin college students.

Improvement is easily seen by takings it and reach test and active extension test as an out come measure.

Keywords: Foam rolling; Active knee extension test; Active release technique; Sit and reach box.

Introduction

In normal human function flexibility is an important aspect. Smooth, unrestricted, pain free ROM are done by a single joint or series of joints. The knee joint is stabilized by hamstring muscles, extension of knee decelerates by contracting eccentrically lead to flexion of knee and hip extension. When there is lack of ability of muscle to change its length from its state of full contraction to full stretch led to hamstring tightness.[1]

Draw the pelvis in to post erior rotation during normal daily postures only because of reduced hamstringextens ibility. Ernations in the lumbarcurve and changes the bio mechanical line of pull of back and strains the back during usual day to day activity all are develops by it and cause thoracic kyphosis, spondylos is, discherniation changes in lumbopelvic rhythm and low back pain.[2]

Find the specific tissues that are restricted is target by ART. Physically work on soft tissue back

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to their normal texture and length with the help of various hand position and soft tissue manipulation method.[3]

Mechanical friction is caused between the foam roller and superficial and deep layers of soft tissue when form roller is applied. It helps in stimulation of primarily mast cells and produce histamine and lead to vasodilatation. Vasodilatation help to increase blood flow to the area treated and quicker as well as complete diffusion of waste products from the tissue to the blood and finally increase intramuscular tissue temperature and blood flow, both the seeffects cause increase in viscoelastic properties of muscle.[4]

In college going students of age group 18 to 25 the prevalence of hamstring tightness is very high. There is higher percentage of prevalence of hamstring tightness in right lowerextremity, between 30 to 45 degreese verity of hamstringtightness is high. Shanka Weerasekara et. al conducted study and found that hamstring tightness higher in those who are engaged in sports.[5]

The patients with nonspecific LBP have high prevalence of hamstring and iliotibial band tightness and concluded that hamstring tightness is large in number that is 85 % ascompared to iliotibial band tightness that is 21.66%.[6]

In modern society sedentary style of living also lead to pos turalabnormalities. The prolong sitting hours required is most of jobs and educational setup scan affects of ttissues flexibility especially two join tmuscles. Dysfunctional motorcontrol pattern leading to a sub maximal finning pattern of postural muscles due to hamstring tightness resulting in function of hamstring as stabilizers rather than their main function of primemovers. This primary function change led to present ation of ham string tightness. According to Gajdusek et. al 2011. In forward bending hamstring flexibility also affect the pelvic as well as thoracic angle and ROM. Hamstring tightness also associated with lumbar pelvic rhythm, development of plantar falsities as well as patellar tendinopathy and patellofemoral pain syndrome.[7]

Patients suffer from shortening of hamstring can detected by various test and Finger to floor distance test (FFDT) is one of the tests to detect hamstring tightness frequently. A plat form of 20cm in which subject stood after removed the shoes and feet to get her. Subject asked for forward bending as far as possible and maintains knees, arms, fingers in extended positioning than vertical distance from middle finger of subject to platform was measured in centimeters. The test was possible when subject did not touch the plat form and negative when subject touch the platform.[8]

Foam rolling exercise used for preventive as well as rehabilitative purpose. Endurance and strength enhanced by formrolling. It show sits beneficial effect in following ways-

- Stress relaxation improvement.
- Reduction in delayed on set of musclesoreness (DOMS) and pain.
- Anaerobic capacity improved.
- Increase Range of motion.
- Muscle and connectivet is suet one decrease.
- Sensmotoric function and coordination increased.
- Warming up and blood flow increased
- Improving strength.

Foam rolling treatment proceed towards Active release technique (ART). It is the method for treating tendon, nerve and My ofascial and also for strain injury, acute in jury and functional fixation damage due to abnormal posture. All the adhesions of scar tissue and soft tissue thar lead to pain, spasm, muscle weakness, tingling and other many more symptoms are resolved by ART.[9]

Objective of study

To find the effect of foam roll eronhamstring and plant a fascia for ham string tightness.

To find the effect of Active Release Technique on ham string for ham string tightness.

To find the combined effect offoamroller and Active Release Technique for hamstringtightness.

Need of Study

Hamstring tightness leads to high risk of recurrent injury, decreases the performance of daily living of students. It also lead to back pain and gait abnormality. So ART in combination with foam roller can decrease hamstring tightness and decrease back pain and student will do their activities without restriction.

Purpose of study

Now a days most of students require prolonged sitting on chair due to their studies and due to their work on computer Sedentary life style is associated with obesity as well as muscle tightness led to chronic problem. So, ART with foam roller help

us to release muscle tightness and student able to give full performance in every field and achieve the irgoal.

Hypothesis

Experimentallhy pothesis

There may besignificant effecto Foamrolleron plant arfascia and hamstring with Active release technique for Hamstring tightness in college students.

Nullhypothesis

There may not besign if icant effect of Foamrolleron plant arfascia and hamstring with Active release technique for Hamstring tightness in college students.

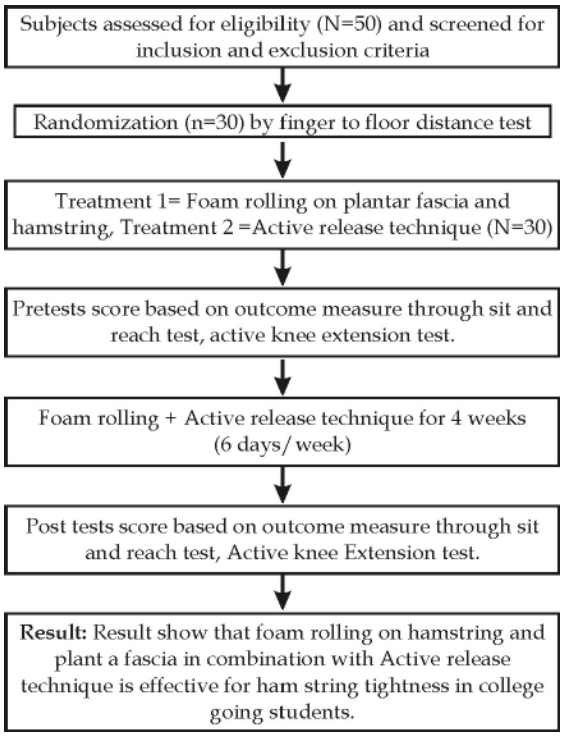

Fig. 2.1: Work plan with flowchart.

Review of literature

Oliva Stovern et. al 2019 conducted study One ffectoftraining with a foamroller on Ankle and Knee ROM, Hamstring flexibility, Agility and vertical jump height.20 subjects completed 6 weeks of form rolling which was held three days per week. Fourteen volunteers with similar characteristics served as a control group. Pre and post testing evaluation included measurement of ankle dorsiflexion and knee flexion ROM, hamstring flexibility, agility and vertical jump height. Concluded that six weeks of formrolling had a positive effect on hamstring flexibility and did not negatively affect agility of vertical jump height.[10]

Shradha Kothawale* et. al *2018 conducted study oneffectiveness of position alreleasetechniqueverses Active release technique on hamstringstightness. Sixty participants with hamstrings tightness meeting the inclusion and exclusion criteria were allocated into two groups. Group A PRT, Group B ART with twenty-nine participants in PRT group and twenty eight in ART Group. AKE and Sit and reach test was measured using goniometer to determine effectiveness of the technique and concluded ART can be used asaneffective physiotherapeutic intervention inreducingham stringstight nessinstantly.[11]

Gopi contracture MPT Rehabilitation 2017 conducted study on Effect of activerelease technique on hamstrings flexibility in patients having chronic low back pain. 15 subjects were taken in the study. Measurement of the severity of pain by using VAS degree of hamstrings tightness by active knee extension test and functional disability by Modifies Oswestry disability index was done. They all were given ART, isometrics back exercise and hot pack to back. Conclusion was that ART improves hamstrings flexibility and reduce LBP and disability over.[12]

Andrew R Mohr et. al on 2014 conducted study on effect of form roller and static stretching on passive Hip flexion ROM. Forty subjects volunteered to participate in these investigations. During each of 6 session subjects passive hip flexion ROM was measured before and immediately after staticstret ching,formrollingandstaticstretching, form rolling or nothing. Result was supported the use of form roller in combination with a static stretching protocol.[13]

Vijay Kage, Rakhi Ratnam on 2014 conducted study on Immediate effect of active release technique and mulligan bent leg raise in subjects with hamstring tightness, total 40 normal healthy subjects (20 in each group) were included in the study under simple randomization method. Group A given Active Release Technique and Group Bgiven Mulligan Bent Leg Raise technique for hamstring tightness and result shown that single session of Active release technique is better as compared to Mulligan bent leg raise technique to improve hamstring flexibility and range of motion.[14]

Kwangsun Do et. al on 2018 did study on acute effect of self myofascial release using a form roller on the plantar fascia on hamstring and lumbar spine

superficial backline flexibility. The participants were then randomly assigned to SMR group, then the group received passive mobilization of ankle joint in the supine position and the showed that SMR on plant arfascia was immediately effective fori mproving the flexibility of SBL of lumbar spine and hamstring.[15]

Vibhuti Vinod Singh Gaur et. al. on 2020 conducted study on Short Term Effects of Muscle Energy Techniquevs. Active Release Technique in Improving Hamstring Flexibility and Pain in Patients with Acute Anterior Cruciate Ligament (ACL) Tear. 60 subjects were divided into three groups. The muscle energy technique group included 5 minute warm up followed by MET routine for 6 minutes and ART group included 5 minute warm up followed by an ART routine for 6 minutes and concluded that both the techniques muscle energy technique and active release technique are equally effective.[16]

Divya. G Patel et. al 2016 conducted study on Immediate effect of application of bilateral self myofascial release on plantar surface of foot on hamstring and lumbar spine flexibility: A study was conducted on 30 subjects who were randomly allocated into 2groups. Group A self myofascial release was given. Group B was a control group (no therapy). Baseline and post flexibility was assessed by sit and reach test (SRT) and Active Knee Extension (AKE) test and concluded that a single session of SMR on bilateral plantar aspect of foot is effective in increasing hamstrings length, but there was no change seen in lumbar spine flexibility in young asymptomatic individuals.[17]

Dr. Jash Desai et. al (2020) did study on Comparison on self myofascial release techniques using form roller and Lacrosse ball in individuals with hamstring tightness. 32 individuals, 18-30 years, both genders, with Hamstring Tightness, divided in two groups. Group A(n=16) performed foam rolling and Group B(n=16) performed self release with lacrosse ball and concluded that Self myofascial release with foam roller showed statistically significant difference in improving Hamstrings flexibility as compared that with Lacrosse balls.[18]

Methodology

Sample

30 patients with Hamstring tightness by finger to floor distance test who were willing to take treatment for four weeks session after a written consent were taken.

Sample random sampling was applied and 30 patients were selected by finger to floor distance test and was included in the study .Study Centre Shri Mahant Indresh Hospital /University Patel Nagar Dehradun. UK. Study Duration. The duration of study was four weeks. selection criteria inclusion criteria Age group between 18 to 30 years were affected by hamstring tightness. Gender Heterogeneous population. Hamstring tightness present in college students (finger to floor distance test) exclusion criteria any history of lower extremity injury in past 3 months, UMN, LMN, Chronic low back pain, No recent injuries of hamstring muscles. Variables. Independent Variables Foam Roller. Active Release Technique. Dependent Variables Hamstring Flexibility Hip and Knee Rom

Outcome Measures Sit and Reach Test (Srt), Active Knee Extension Test (Aket) Sit and Reach Test

Material Used

- Couch.
- Foam roller (Cylindrical roller and ball).
- Yoga mat.
- Goniometer.
- Stop Watch.
- Stepup.
- Pen and note book.
- Sit and reach box.
- Measuring.

Procedure

30 patients between age group of 18-30 years were included in study after taking a written consent from patients. Patients werem a deawa reof the research study and procedure to be followed. 30 patients were selected that is both male and female by finger to floor distance test. All 30 patients follow the pre tests that is Sit and reach test and Active knee extension test and then treatment were given which included foam roller on hamstring and roller ball on sole of foot and then Active release technique for hamstring muscle and then post tests were done.

The study was of 4 weeks, 6 days per week at department of Physiotherapy in Indresh hospital Examination included assessment which was performed on first day than at the mid and then last day of treatment and data was recorded.

Treatment

Foam roller on hamstring muscles

In the foam roller technique generally in previous articles it was observed that foam roller was applied actively on patients mostly the athletes because they were trained and have strong biceps so they easily done it on sitting position. This study is on college going students, they were not able to applied form roller actively on hamstring because of weak biceps so passive foam roller treatment was given by therapist. Position of patients was prone lying and then the rapist applied form roller pressure on hamstring to release the muscle.

From the distal end of hamstrings (the popliteal fold) to the proximal end (glutealfold) a roll was started and then reversed. The roller intensity is maintained constantac cording to patient not too high not too low. During the treatment the roller was rolled by a constant pressure by the therapist. Four sets were performed which included 30 second sexercise and 30 second rest. (Fig. 4.7).

Foam roller ball on sole of foot

The patients were asked to take a sitting position. They were then instructed to roll the ball on sole of each foot, from behind the metatarsal head to the heal concentrating on the medial arch. Participants were instructed to feel discomfort but no pain, by applying as much pressure as possible to the soles, as greater pressure help to increase the flexibility. Four sets were performed-30 second exercise and 30 second rest. (Fig. 4.6)

Active Release Technique

Patient was in apron position on treatment table. The knee was then flexed to shorten the hamstrings. The therapist then evaluated the texture and tightness of hamstrings by palpating and manually contacting the exterior skin to see where maximum tightness could be felt. Tension was placed on bellies of hamstrings longitudinally at a specific tension and asked the patient to extend his knee as per protocol. Cycle was repeated 10 times. (Fig. 4.8)

Fig. 4.6: Foam roller ballon sole.

Fig. 4.7: Foam Roller on hamstring.

Fig. 4.8: Active release technique.

Fig. 4.9: Hamstring stretching.

Data Analysis

This chapter deals with the statistical analysis of the 2 outcome measure that is SRTand AKET, between pre, mid and post treatment of hamstring tightness patients. The datawasanalyzed by one Samplet testused to comparepre, mid and post treatments cores of SRT and AKET. The data was analyzed by SPSS 20 (Statistical Package for the ocial Sciences)

Result

This chapter deals with the result of data analysis of the data of two outcome measures that is SRT and AKET with in 30 patients. The score were analyzed and interpreted to determine the treatment is effective in improving hamstring tightness in college students one sample t-test was used to analyze and compare pre, mid and post treatment score within the 30 patients. Significant level of 0.05 was used for data analysis.

T-Test

Table 6.1: One Sample Statistics.

	N	Mean	Std. Deviation	Std. Error Mean
Srtpre	30	16.40	2.717	.496
Srtmid	30	20.97	2.404	.439
Srtpost	30	24.96	1.950	.356

Table 6.2: One Sample Test.

	Test Value=0					
	t	Df	Sig. (2-tai-led)	Mean Differ-ence	95% Confidence Interval of the Difference	
					Lower	Upper
Srtpre	33.072	29	.000	16.403	15.39	17.42
Srtmid	47.776	29	.000	20.973	20.08	21.87
Srtpost	70.115	29	.000	24.960	24.23	25.69

SRT Comparison of Premid and Post Values.

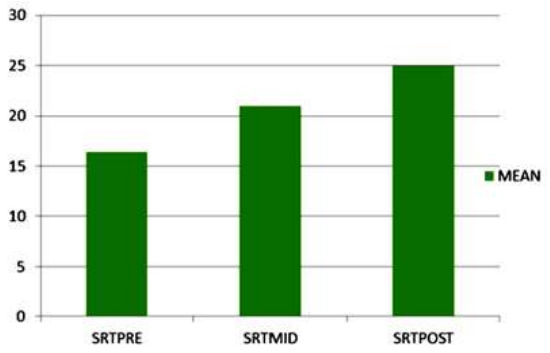

Fig. 6.1: SRT Comparisonof Pre, Mid and Post Value.

Explanation

From the above table we can check the value of mean is less in PRESRT than it improve in MID SRT and highest in POST SRT. It shows that there is significant improvement in POST SRT as compared to PRE SRT and MID SRT. Thus Foam roller on hamstring and plantar fascia in combination with active release technique is effective in improving hamstring tightness in college students. Analyzing SRT revealed significant difference in POST SRT, Mean and standard error of mean (24.96 ± .356) when compared to PRE SRT Mean and standard error of mean (16.40±.46) and MID SRT Mean and standard error of mean (20.97±.439). (Table 6.1, 6.2) (Fig. 6.1)

T-Test

Table 6.3: One Sample Statistics.

	N	Mean	Std. Deviation	Std. Error Mean
Akepre	30	34.53	5.211	.951
Akemid	30	29.77	6.306	1.151
Akepost	30	25.93	6.958	1.270

Table 6.4: One Sample Test.

	Test Value=0					
	t	df	Sig.(2-tailed)	Mean Differe-nce	95% Confidence Interval of the Difference	
					Lower	Upper
Akepre	36.298	29	.000	34.533	32.59	36.48
Akemid	25.853	29	.000	29.767	27.41	32.12
Akepost	20.415	29	.000	25.933	23.34	28.53

AKE Comparison of PREMID and Post Values.

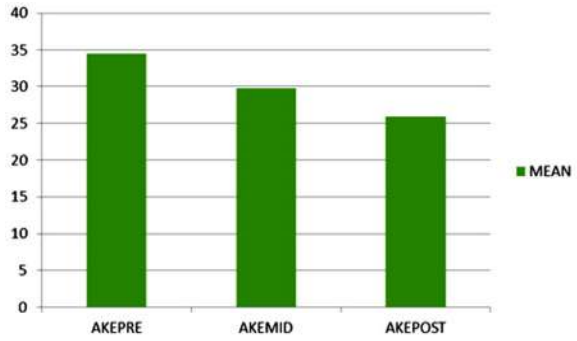

Fig. 6.2: AKE Comparison of Pre Pre, Mid and Post Values.

Explanation

From the above table we can check the value of

mean is high in Preake than low in Mid Ake and lowest in Post Ake. In patients with improvement by treatment the Ake value decreases. It shows that there is a significant improvement in Post Ake as compared to Pre Ake and Mid Ake. Thus Foam roller on hamstring and plantar fascia in combination with Active release technique is effective for hamstring tightness in college students. Analyzing Ake revealed significant difference in Postake, Mean and standard error of mean (25.93±1.270) when compared to Pre Ake Mean and standard error of mean (34.53±.951) and Mid Ake Mean and standard error of mean (29.771±1.151). (Table 6.3, 6.4) (Fig. 6.2).

Discussion

The purpose of study was to study the effect of foam roller on hamstring and plantar fascia with ART for hamstring tightness in college going students. In this study 30 subjects were included according to FFDT of agegroup 18 to 30 years.

Improvement in hamstring flexibility in college going students is one of the most important aim of treatment so they can do their activity of daily living properly. If hamstring flexibility can maintain it prevent the back pain of students because now a days due to sedentary life style of student's hamstring flexibility decreases. Working on computer, desk work for long periods of time and less involvement in sports activity make hamstring tight easily. Mainly the goal of treatment of foam roller and ART is to improve hamstring flexibility so patient can do their daily activity without restrictions. In this study patient was selected by finger to floor distance test and then two outcome measures was used as pretests and posttests. Post tests show marked improvement in patients by giving the treatment which is foam roller and ART technique.

In a research by Mansi Gala et . al proved that Self myofascial release therapy and transverse massage therapy both are effective in improving hamstring flexibility in desk job workers but self - myofascial release therapy showed better results. One more study by Hariharasudhan Ravichandran et al show that effectiveness of active release technique may varies among athlete and non athlete which requires future studies. So this study was done to see effect of foam roller and Active release technique together in hamstrung tightness. Through in this study improvement was seen when treatment was given to subject. Pre tests and post tests help to see the improvement in subjects.

Limitation of Study

- In college going students, giving foam roller actively is not possible as they are not trained like a athlete and their biceps are weak, therefore, passive foam roller treatment was given by me. It was not possible to measure the amount of pressure applied to hams by me and it only depended on my patient's comfort and tolerance level.
- This treatment has shown its beneficial and desired effects in around 10 to 15 days but how long its effect will last is also a part of study as there is no follow up done by me.
- Proper follow-up was not done due to Covid19 pandemic.

Future Research

The future research can be proceeded on study not only by releasing hamstring muscle and by releasing the sole of foot for hamstring tightness to prevent LBP. We can also release the calf muscles to increase hamstring flexibility because calf muscles have direct link to hamstring muscle and it can show more better effect. Subjects can be asked to do actively and result scan be compared between the active and passive procedures.

Conclusion

Foam roller on hamstring (passively by the rapist) and foam roller ball (actively by patient) on sole of foot in combination with Active release technique have shown its beneficial effect on increasing hamstring flexibility in college going students. So, it is better to use the foam roller technique and active release technique to increase hamstring flexibility and decrease the low back pain especially for those who have sedentary lifestyles. Foam roll can be used for different group of muscles that is for hamstring, calf muscle and for sole of the foot. Thus the Experiment hypothesis that is Foam roller on hamstring and plantar fascia in combination with Active release technique is effective is accepted.

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Review Article

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Effect of Aquatic Therapy Approaches on Balance in Geriatric Population: A Scoping Review

Purnima Singh

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Abstract

Background: Apart from neurological disorders, musculoskeletal abnormalities, sensory dysfunctions, and loss of anticipatory control mechanisms directly cause impairment of balance and gait in elderly. It is suggested that various aquatic therapy techniques using laws of fluid mechanics offer an effective environment for improving balance in elderly.

Objective: To conduct a scoping review of studies that assesses the effectiveness of aquatic therapy techniques on improving balance in elderly.

Methods: The research was conducted in PubMed databases from 31 December 2007 till 30 December 2020. The PICO model was used in the selection of the articles. Studies: randomized controlled trials (RCT) or quasi-experimental studies or pilot trials.Population: elderly with/without neurological deficits, independent in ADL. Primary outcome: balance. Methodological quality was assessed using the Downs and Black checklist. The data was analysed and synthesized by two independent reviewers.

Results: The methodological quality of NINE studies included in this review ranged from fair to good. Two studies found improvements in balance using Ai Chi as aquatic therapy intervention. There were significant improvements in the balance in the Halliwick method of aquatic therapy intervention group when compared with the control group in 5 studies. Similar results were found in 4 studies where BRRM intervention is used to improve Balance.

Conclusion: There are scientific evidence regarding the positive impact of various technics of aquatic therapy program in improving balance in older adults and consequent reduction in risk of falls. However, future studies with more rigorous study designs and with more structured and outlined programs are needed to prove the efficacy of these methods in improving balance and risk of falls in geriatric population.

Keywords: Elderly; Balance; Aquatic Therapy.

Introduction

Ageing is a dynamic, progressive and physiological process accompanied by functional, morphological, biochemical and psychological changes. India being the second most populous country in the world has seen a sharp increase in the population of elderly and it has been projected that it would rise to about 324 million by 2050.[1]

Balance, or postural control, can be described as the ability to control one's body position in space for the dual purposes of stability and orientation.[2] Balance depends on vision, vestibular system, proprioception, muscle strength and reaction time. A poorer functioning of these systems in the elderly can lead to disturbances of balance.[3] It is one of the most common problem that remain unnoticed before it causes serious injuries and one of the reasons that older adults seek medical help.[4] Balance dysfunction results in a variety of mobility

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disorders; the most significant of which is falls.[5] Among older adults, falls are the leading cause of injury and deaths and the most common cause of nonfatal injuries and hospital injuries for trauma.[6]

Even fallers who are not injured are likely to develop a fear of falling and may limit their activities resulting in reduced mobility and physical fitness, increasing their risks for future falls.[7]

Evidence suggests that participation in exercise programs not only strengthens the working muscles, increase walking velocity[8], with improved response time and balance control[9] but also enhance functional performance and quality of life in elderly.

There is speculation that an aquatic environment will increase proprioceptive input to the immersed body by providing more stability and body alignment, leading to enhancement of balance.[10]

Sensory feedback may also increase, promoting a sense of body awareness, because resistance to movement through a viscous fluid (water) is greater than resistance through air.[11]

Therefore, the aquatic environment may be an effective medium for balance training in elderly. Various aquatic therapy methods include-

Halliwick Ten-point program/Water specific Therapy

Clinical Ai Chi

Bad Ragaz Ring Method

Watsu

Aqua running

Burdenko Method

Till date, there has not been any review evaluating the effects of these aquatic therapy techniques on improving balance in elderly. The aim of this study is to review the evidence from randomized controlled trials (RCTs), quasi-experimental studies & Pilot trials to assess the effectiveness of aquatic therapy techniques on balance in elderly.

Methods

Literature search

An electronic literature search was conducted in Medline, Pedro, Amed, using the following combination of various terms: (aquatic exercise or aquatic therapy or water-based exercises or water exercises or pool exercises) and (balance or postural control) and (elderly). We limited our review to publications prior to December 31, 2007. Only articles written in English were included. Inclusion criteriawere

- Elderly patients (60 years and above) with balance dysfunctions;
- Trials included only Clinical Ai chi, BRRM and Halliwick method (Water Specific Therapy) methods;
- The outcome measure was balance and/or gait performance.
- Studies were excluded when-
- Methods or technics are not clearly documented;
- Other forms of aquatic therapy were considered as an intervention;
- The interventions failed to meet the recommendation of exercise for improving balance ability.
- The studies that delivered the intervention <2 weeks and
- Studies appeared in previous relevant systematic reviews.

Data extraction and Management

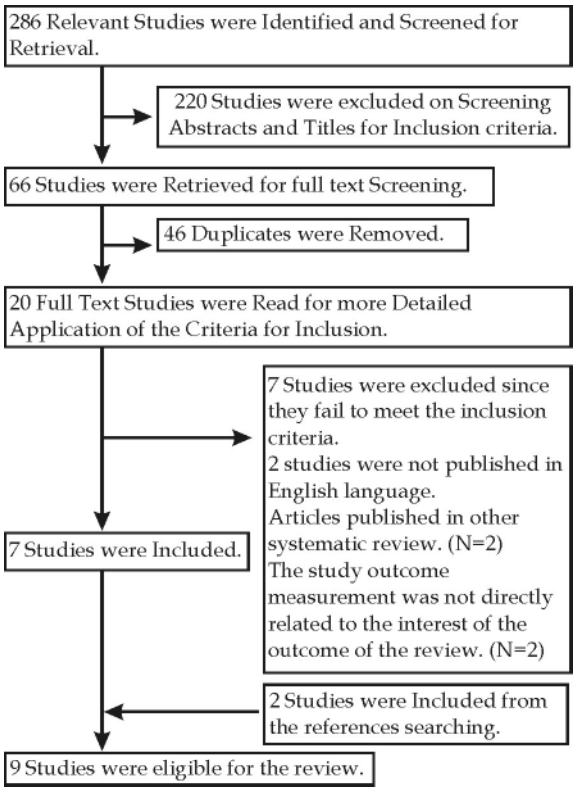
Independent reviewers, individually merged and screened all the titles and abstracts from the databases. Studies that failed to meet the selection criteria were excluded. Data extraction was analyzed and synthesized by two reviewers independently. The data extraction form was developed based on the PICO questions[12] on population, intervention, comparison, and outcomes.

Methodological quality

The quality of included studies was assessed by two independent reviewers using the criteria proposed by Downs and Black. Quality scores above 19 were considered as "good," between 11 and 19 as "moderate," and below 11 as "poor".[13]

Results

The flow chart below shows the steps in the selection of studies. From the electronic databases, a total of 286 published articles were identified. Of these, 220 were eliminated after screening of titles and abstracts. After duplicates were excluded, 20 remained. After reading the full-text articles, 13 more studies were excluded because they failed to meet the inclusion criteria; adding two articles from reference search; thus, the NINE remaining studies were included in the review.



Study characteristics

Table 1 provided data for 272 participants: 128 were community dwelling older adults with balance impairments[14,15,17]; 47 with Parkinson's disease[21, 22;] and 97 with stroke.[18-20,22] Six of the studies were RCTs [14, 17-20, 22], one was quasi-experimental studies[21], one 3 arm parallel pilot study[15] and another being single blind pilot trial.[16] The aquatic intervention comprised the following: Halliwick, Ai-Chi & BRRM.

Focusing on the aquatic setting, studies reported the dimensions of the therapeutic pool are,[14-16, 18,19, 22]. One study used 2 different community pools[17], though the dimensions are not reported. Only in two studies[20,21] failed to identify the place where the intervention took place. Eight studies[14-19,21], had comparison groups and of these, six studies[14-18, 20, 22] compared the aquatic intervention with a land-based exercise. Terrens et al[16] & Covill et al[17] compared two aquatic therapy technics viz aquatic-Ai-Chi with Impairment based aquatic therapy (IBAT) and halliwick method with traditional aquatic therapy exercises respectively. Single study[21] does not have a control group. To deliver the intervention, Nissim et al[15] used certified hydro therapist Ai Chi instructors.[14,16-18,20,22] used physiotherapists trained in specific aquatic therapy technics, study[19] used physiotherapists but their training in aquatic therapy is unclear. In the study by Pompeu et al [21] physiotherapy students provided the exercises to the participants.

The duration of the intervention varied between

Table 1: Main characteristics of the NINE eligible studies.

Reference	Design	Type of Partic-ipants (N)	Drop-outs (e/c)	Mean Age (Yrs.)	Interventions			Dosage		Dur-ation (wk.)	Outcome Measures			
								Min/ ses	T/ wk					
Silva C et al, 2020	RCT N=38	Elderly	03	65	Halli-wick + BRRM N=16	Land based PT N=19		50	2	3	T U GT	FRT	Sit to stand in 30 secs	
Michal Nissim et al, 2020	3-arm pilot trial	comm-unity dwelling elders. N=42	NIL	74.4	API (Ai Chi) N=13	N=14 OLPI	N=15 NPI	30	2	24	Tinn etigait and bala-nce test	DSF & DSB	CBTF & CBTB	
Terrens AF et al, 2020	Single blind Pilot trial	Parki-nson Disease N=30	3	72	N=11 Halli-wick	N=10 Tradi-tional Aqua	N=9 Land based	60	1	12	BBS	Mini BES Test	UPD RS-111	mF FS
Covill et al, 2017	RCT	Older adults with balance impair-ments N=48	NIL	72.2/ 75.5	N=15 N=26 Ai Chi	N=17 IBAT		35	2	6	BBS	TUG	ABCS	NP RS

Table to be cont....

Hyun - Gyun Cha et al, 2017	RCT	Chronic stroke N=22	NIL	64.0/ 63.3	N=11 BRRM + land rehab (NDT) N=11	N=11 Land rehab (NDT)	60	3	6	EMG	TUG	Bala-nce index	
Kim EK et al, 2015	RCT	Chronic stroke N=20	NIL	69/ 68	N=10 BRRM	N=10 Land PNF	30	5	6	BBS	TU GT	FRT	10M WT
Tripp F, Krakow K. 2014	RCT	Post-acute stroke N=30	03	64.8	N=12 Halli-wick + CON PT	N=15 Standard PT	45	3+2	2	BBS	FR	FAC	RMI
Jose Pompeu et al, 2013	QES	Parkin-son Disease N=17	NIL	67.58	N=17 Halli-wick + BRRM + Ai Chi	–	40	3	12	BBS	TUG	DGI	UPD RS
Noh DK et al, 2008	RCT, PILOT	Chronic stroke N=25	NIL	61.9/ 66	N=12 Halli-wick + Ai Chi	N=13 Gym Exs	60	3	8	BBS	Weig-ht bearing ability	Ms Strength	Gait

studies from 30 minutes/session to 60 minutes/ session. Three studies[14, 15, 17] used two times a week protocol and four studies[18, 20-22] used three times a week protocol. One study[19] used five times a week protocol and another one[16] used once in a week protocol. The length of provision of the exercise intervention ranged from 2 weeks to 24 weeks.

Because of the heterogeneity of the study designs, participants, and outcome measures, it was impossible to conduct a meta-analysis. The measure of balance included Timed Up and Go Test, Berg Balance Scale, dynamic balance, functional reach test, 10-minute Walk test, One leg stance test, TinnetiGait and Balance test, Activity Specific Balance Confidence Scale, Mini BESTest, Balance index and Dynamic Gait Index. Balance measurement was performed in all studies before and after intervention. One study tested balance at baseline, after six weeks and 12 weeks intervention.[15] Silva et al[14] measured the outcomes at the baseline, after 10 sessions and after the end of 20 sessions. Another study monitored balance performance of patients one month after the end of the intervention.[21] Long term follow up was not performed in any of these studies. Of these,[14-16,18, 20-22] provided concealed randomization.

Methodological quality

Results of the methodological quality assessment, modified from the Downs and Black's checklist, are presented in Table 2. The methodological quality of the included studies in this review are variable:

Table2: Down & Black Checklist.

N = answer is no; P = partial answer; U = unable to determine; Y = answer is yes.

Studies →	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Study Aim	Y	Y	Y	Y	N	Y	Y	Y	Y
Main Outcome	Y	Y	Y	Y	Y	Y	Y	N	Y
Participant Characteristics	Y	Y	Y	Y	Y	Y	Y	Y	Y
Description Intervention	Y	Y	Y	Y	Y	Y	Y	Y	Y
Principal Confounders	Y	Y	Y	Y	Y	Y	Y	N	Y
Outcome Data	Y	N	Y	Y	N	N	Y	Y	Y
Range of Results	Y	Y	Y	Y	Y	N	Y	Y	Y
Adverse Effects	N	N	Y	N	N	N	N	N	N

Table to be cont....

Lost To Follow Up	Y	Y	Y	Y	Y	N	Y	Y	Y
Probability Value (Exact)	Y	Y	Y	Y	N	N	Y	Y	Y
Source Population	U	Y	Y	Y	Y	Y	U	Y	Y
Representative Of Population	Y	Y	Y	Y	Y	Y	Y	Y	Y
Staff, Place, Facility	Y	N	Y	Y	Y	Y	Y	Y	Y
Participants Blind to Intervention	Y	N	N	N	Y	N	N	N	N
Blind Assessors	Y	Y	Y	N	Y	N	Y	Y	Y
Data Dredging	Y	Y	Y	Y	Y	Y	Y	Y	Y
Same Length of Follow Up	Y	Y	Y	Y	Y	Y	Y	Y	Y
Appropriate Statistical Tests	Y	Y	Y	Y	Y	Y	Y	Y	Y
Compliance with the Intervention	Y	U	Y	N	Y	Y	Y	U	Y
Accurate Outcome Measures	Y	Y	Y	Y	Y	Y	Y	Y	Y
Control Recruited Same	Y	Y	Y	Y	Y	Y	Y	Y	Y
Recruitment at the same Time	U	U	Y	U	Y	U	Y	N	Y
Randomization Allocation	Y	N	Y	N	Y	Y	Y	N	Y
Concealed Randomization	Y	N	Y	N	N	N	Y	N	Y
Adjustment for Confounders	Y	Y	Y	Y	Y	N	Y	U	Y
Participants Lost to Follow Up	Y	Y	Y	Y	Y	U	Y	U	Y
Power Analysis	Y	Y	Y	Y	N	N	U	N	N
Total Score-28	25	20	27	21	22	16	24	16	25
	Good	Good	Excellent	Good	Good	Fair	Good	Fair	Good

the overall quality is rated as Fair to excellent (range from 15 to 27). One study[16] has excellent methodological quality. Six included studies demonstrated good methodological quality.[15,17,18,20,22] Eight studies reported randomization.[14-18,20-22] Only four studies[14-17] conducted a power calculation. Six studies provided statements of single blinding:[15, 16,18,20-22]. Only two studies[14,17] where participants blinded to intervention. Three studies reported[14,16 &20] patient dropout. Only one study[16] reported occurrence of adverse events.

Effect of Ai Chi on Balance performance

Four studies[15,17,21&22] assessed balance control using Ai Chi as aquatic physical intervention. One study[21] used combination of Ai Chi, Halliwick and BRRM. Another study[22] combined Ai Chi with only halliwick method. There was variation in design, intensity, frequency, duration of exercise and even in the type participants across the studies (Table 1). Participants for the study[15,17] are community dwelling older adults with balance impairments; study[21] was on Parkinson's Disease Patients; and study[22] was conducted on Chronic Stroke patients. However, it was concluded that Ai Chi in water improved balance control across the patients.

Study[15, 17] assessed balance control in community dwelling older adults, despite the variation in the intervention, dosage and duration, both studies demonstrated a statistically significant improvement in their outcome measurement scores of balances. Study[17] compared 2 aquatic therapy interventions (Ai Chi & IBAT-Impairment based aquatic therapy), it revealed no difference in any of the outcome measures, but all participants as a group showed statistically significant improvement in the BBS and TUG scores.

Jose Pompeu et al[21] evaluated balance of Parkinson's patients on stages (1-4) of Hoehn and Yahr scale. Intervention program composed of combination of Halliwick, Bad Ragaz Ring method and Ai Chi. There was a statistically significant difference among results before and after the intervention evaluated by BBS and TUG.

Noh D K et al[22] evaluated balance in stroke survivors using aquatic therapy. Aquatic therapy was given in the form of Halliwick& Ai Chi. The aquatic therapy group showed improvements in the mean BBS ($p = 0.032$) compared to control group.

In all the studies there was overall improvement of balance using aquatic physical therapy compared to any land based exercises but the study[24] that compared Ai Chi with other aquatic physical therapy intervention showed no significant difference in the balance score.

Effect of Halliwick method (Water Specific Therapy) on Balance performance

Five studies[14,16,20-22] improved balance control using Halliwick method as aquatic physical therapy intervention. Two studies[16,21,] where Halliwick method was used to improve balance control in the Parkinson's population and other two studies[20,22] assessed balance control in the stroke population. Two studies[16,20] administered only Halliwick method as aquatic physical therapy intervention. Study[16] compared Halliwick with traditional aquatic therapy and land-based therapy. No significant differences were found post intervention in BBS balance scores within the group but the Halliwick aquatic group improved significantly in the Mini BES Test post-intervention ($p = 0.011$). In Tripp F et al[20] study, compared to the control group, significantly more subjects in the Halliwick-Therapy group (83.3% versus 46.7%) attained significant improvement in the Berg Balance Scale ($P < 0.05$).

Silva et al[14] combined Halliwick and BRRM as aquatic physiotherapy to assess risk of fall/ balance in elderly. Both aquatic and conventional interventions, showed to be greatly efficient however aquatic physiotherapy showed certain advantages compared to conventional physical therapy.

Effect of Bad Ragaz Ring method (BRRM) on Balance performance

Four studies[14, 18, 19, 21] improved balance control using BRRM as aquatic physical therapy intervention. Study[14,18,19] compared BRRM with land-based exercises.

The study population in two trials[18,19] had similar mean ages, symptom stage and intervention & both studies demonstrated a statistically significant increase in the TUG score ($p \leq 0.05$) in the experimental group. Study[18] used trunk pattern, Diagonal patterns of legs of BRRM. Apart from balance testing they also measured lower limb muscle activity using EMG. There weresignificant improvements in the activations of tibialis anterior ($p= 0.036$) and gastrocnemius muscles ($p= 0.029$). They also found that even the control group showed significant improvement in TUGT results.

Discussion

This review has provided information about the therapeutic effects of aquatic exercises viz on balance ability in selected neurological disorders, in comparison with land based exercises[14,15,16,18,20,22] other aquatic therapy methods[16&17] or with no comparison.[21] The findings of the review highlighted that all the aquatic technics might increase static and dynamic balance in community dwelling older adults with balance impairments with/without other associated neurological disorders.

When considering external validity of the studies in this review, the patients included in the studies were not representative of the neurological population. Five studies[17-21] have small samples and four studies reported consideration of powering the sample.[14-17] A small sample size can increase the risk of a Type II error and a false-negative result.[23]

Halliwick method

This review was able to find one quasi-experimental studies[21] and two pilot studies[16, 22] and two RCT [14, 20] examining the therapeutic effects of halliwick method of aquatic exercises on balance in elderly patients with neurological deficits and without neurological deficits. The results of the studies demonstrated that proposed aquatic therapy in respective studies promoted improvement in static and dynamic balance assessed by the BBS and other outcome measurement tools.

In the similar study by Montagna et al in 2014 used the principle of Halliwick (2x of 40 minutes per week) to improve balance and corporal symmetry in stroke survivors.After intervention, participants had a significant improvement on their static balance measured by Berg Balance scale and TUG.[24]

The findings of the review suggest that Halliwick method of aquatic exercise programs alone or when combined with other techniques like BBRM, Ai Chi benefit elderly with balance impairment.

The Halliwick method, through the water properties like the hydrostatic pressure, turbulence and buoyancy, creates instability that increases sensory stimulation and, as a consequence, causes balance reactions that could contribute to improvement on postural control and mobility of patients.[22]

Clinical Ai Chi

Four studies investigating the effects of Clinical Ai Chi aquatic exercises across elderly population with or without neurological deficits were identified in this review.[15, 17, 21, 22]

Even in 2020 study by Ku PH et al who

investigated the effectiveness of Ai Chi compared to conventional water-based exercise on balance performance in individuals with chronic stroke. Both groups showed significant improvement in BBS and FMA yet the Ai Chi group demonstrated significantly better results than control group ($p = 0.025$).[25]

Improvement after Ai Chi may be attributable to the buoyancy of water supporting body weight and enhancing the ability to move. Water turbulence and resistance might also provide a suitable environment for balance.[26] It is possible that the superior results shown in aquatic Ai Chi group exercise may be also due to the degree of exercise supervision influencing exercise compliance. It is suggested that patients have better compliance, motivation, and adherence to exercise when they participate since Ai Chi majorly done in group or have an instructor to guide them.[27]

BRRM

Four studies included in this review that evaluated the effect of BRRM on Balance in elderly.[14, 18, 19, 21] In 2008 a Korean study by Song JM et al also assessed balance performance in stroke patients using aquatic PNF (BRRM). The results of the study showed that intervention of aquatic exercise program applied PNF patterns improved the balance performance in people who had stroke.[28]

The reason for the increase in balance is when Bad Ragaz Ring Method was applied underwater, muscle activation and proprioception for maintaining balance and stabilizing the trunk are enhanced. Therefore, the Bad Ragaz Ring Method is considered to be a method that can clinically improve the leg strength and balance ability without putting an excessive joint load on the joint.[27]

Limitations of the review

One generalized limitation of all aquatic therapy studies is low uptake of participants into the study. The majority declined to participate or were unable to attend. The main reason for declining to participate is that participants are not interested in water exercises, transport and availability difficulties. Most of the studies are done with combining various aquatic therapy methods and on patients with neurological deficits affecting balance.

No studies included where the balance impairment is due to orthopedic or other issues in elderly. Only two studies were done on community dwelling older adults. Further limitations include the small number of trials meeting the eligibility criteria and the dearth of methodological quality. In addition, most studies had small sample sizes and significant heterogeneity in the treatment protocols. For example, the different outcome measures used in studies prevented the statistical calculation and comparison of effectiveness among these studies. This limits the generalizability of this review.

Conclusion

This review identified nine studies that investigated the effect of aquatic therapy methods on balance in elderly patients. There was substantial variation in population characteristics, treatment protocols, and outcome measurements among the studies. Hence, a comparison between studies is difficult due to this heterogeneity. Participants in the studies had evidence of balance and gait impairment that may be due to differences in balance mechanisms and the nature of their clinical disorder. It is possible that the effectiveness of aquatic exercise is dependent on the nature of the underlying disease or impairment.

The overall methodological quality of eligible trials in the review was fair to good and only five RCTs were found. Inadequate description of population characteristics (i.e., duration of symptom and baseline impairment) and some missing information (i.e., adverse effects) potentially decreases the reliability and validity of the included studies.

In conclusion, the findings of this review suggest that therapeutic benefits are gained from the use of these technics in water for patients with balance deficits. However, the superiority of aquatic exercise program over other interventions (i.e., conventional aquatic therapy program, conventional physiotherapy, land-based exercises) and between them is unclear due to the limitations of existing research.

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Case Report

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Combined Effect of Nebulization and Chest physiotherapy in Management of Bronchiolitis: A Case Study

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Abstract

Introduction: Bronchiolitis is a common lung infection in infants and young children during the winter season. The use of chest physiotherapy may be indicated to reduces duration of oxygen therapy, facilitates the clearance of secretions and airway obstruction.

Methodology: A 4-month male child with cough, fever, breathlessness, rapid breathing from last two days was taken for this study. Chest physiotherapy (CPT) was given after nebulization therapy (0.9% saline) and was followed by gentle nasopharyngeal suction for next three days. Subject's Clinical assessment and measurement was done before and after physiotherapy management for respiratory status by using observation sheets, pulse oximeter, respiratory rate timer, stethoscope and X-ray.

Results: The present case report shows significance changes from chest physiotherapy in the natural course of acute viral bronchiolitis by showing improvement in all the parameters like FIO2,SPO2 ,HR,RR,Auscultation finding and X ray finding.

Discussion: This study demonstrated that chest physiotherapy with nebulization in bronchiolitis is a safe and effective way of treatment. It reduces severity and number of hospital stay days of the subject.

Conclusion: The study results can be considered to be included in the hospital guidelines to encourage physiotherapists in mobilization of secretion in bronchiolitis subjects.

Keywords: Bronchiolitis; Chest physiotherapy; FIO2 (Fraction of Inspired Oxygen); SPO2 (Saturation of Peripheral Oxygen); HR (Heart Rate); RR (Respiratory Rate).

Introduction

Bronchiolitis is a common lung infection in young children and infants during the winter season. It causes inflammation and congestion in the small airways (bronchioles) of the lung. It affects children in the age group of 3 months to 2 years but the most common age affected by bronchiolitis is between 3 to 6 months because their lungs and immune systems are not fully developed. About 10-30% of children under the age of 2 years are affected by bronchiolitis at some point in time.[1]

Virus is the causative agent for bronchiolitis and the most common virus causing the disease is Respiratory Syncytial Virus (RSV) (72%) and Human Rhinovirus (HR)(26%). Bronchiolitis starts with symptoms like common cold, progresses to cough, wheeze and sometimes difficulty in breathing. Symptoms of bronchiolitis can last for several days to a week.[2]

Untreated bronchiolitis leads to complications like pneumonia many times. Most babies presented with cough, fever, rapid breathing (more>60),

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grunting, cyanosis, refusal to feed, irritability, no wet diapers. These symptoms last for 7 to 10 days. Complications of severe bronchiolitis may include, blue lips or skin (cyanosis), caused by lack of oxygen, pauses in breathing (apnea), which is most likely to occur in premature babies and in babies within the first two months of life, dehydration and Low oxygen levels and respiratory failure.[3]

There is no specific treatment. Most children with bronchiolitis can be treated at home. About 3% of the children with bronchiolitis need hospitalization. The risk of death who are admitted to the hospital is about 1%. Supportive treatment is indicated in the form of oxygen therapy, Antibiotics therapy, intravenous fluids, nebulization, hypertonic saline.[4]

Etches and Scott et al. suggested a superiority chest physiotherapy technique with regards to the amount of secretion removed in infants with bronchiolitis. Chest physiotherapy suctioning with nebulization to take out mucus in the form of vibration, percussion is routinely used and indicated to promote airway clearance.[5]

The use of chest physiotherapy reduces duration of oxygen therapy. Chest physiotherapy facilitates the clearance of secretions and airway obstruction, decreases airway resistance, improves gas exchange, and thus makes breathing easier. This technique in infants has no common adverse effects such as bradycardia and bleeding of nasal mucosa.

There is controversy regarding the effectiveness of chest physiotherapy to solve airway obstruction problems experienced by children younger than two years of age with bronchiolitis. However, these studies were based on chest physiotherapy techniques starting from day one. Therefore, we take our case study after two days of admission.

Aim of the Study

The aim of this study was to determine the effectiveness of chest physiotherapy techniques with nebulization and suctioning for bronchial obstruction and signs, symptoms of respiratory distress. Therefore, we have chosen this area of bronchiolitis. For our research work to enrich and elaborate the role of chest physiotherapy.

Methodology

Inclusion Criteria

- Ages eligible for study-up to 12 Months (Child)
- Clinical diagnosis of bronchiolitis.
- Exclusion Criteria:
- Patients with heart or neurological diseases.
- Previous episodes of wheezing.
- Chronic conditions such as bronchopulmonary dysplasia, immunodeficiency, or congenital diseases.
- Need of mechanical ventilation in Intensive Care Unit
- Contraindication criteria for chest physiotherapy (i.e. Pneumothorax, ribs fractures, hemodynamic instability)
- Patients not receiving supplementary oxygen.

History taking

A 4-month male child admitted with cough, fever, breathlessness, rapid breathing, and dehydration for three days. There was no history of any hospitalization in the last 3 days. Baby was delivered normally. There was no past history of significant illness and of any medication.

Assessment and examination

- Baby was conscious, alert, irritable, dyspnea, average build and nutrition.
- Respiratory system examination:
- Inspection: symmetrical chest, subcostal retraction present
- Palpation: apex beat normally placed; no added sound palpable
- Percussion: equal and resonance
- Auscultation: bilateral crepitus and wheezing heard
- X-ray findings: consistency with bronchiolitis as reported by Radiologist.
- The diagnosis of bronchiolitis made by consultant pediatrician.
- Medical treatment: Oxygen therapy, intravenous fluids, nebulization, intravenous antibiotics, bed rest, on day 3 physiotherapy.

Data collection

Subject's Clinical assessment and measurement was done before and after physiotherapy management. The Physiotherapist noted all the parameters for respiratory status by using observation sheets, pulse oximeter, respiratory rate timer, stethoscope and X-ray.

Physiotherapy management

Chest physiotherapy (CPT) was given after nebulization therapy (0.9% saline) and was followed by gentle nasopharyngeal suction. CPT applied in the form of chest percussion with a cupped hand, vibration with fingers for two minutes in each of the affected lung segments positions. CPT was given before meals or 1 to 1.5 hour after meals to minimize vomiting. These maneuvers applied on the thorax to improve mucociliary clearance of bronchial mucus and also ease its removal. Five cycles of manual chest wall percussion/vibrations was administered twice daily. 6

Outcome Measures

The effectiveness of chest physiotherapy is measured by

- FIO2/Duration/Hours of supplementary oxygen
- SPO2 by pulse oximeter
- Heart rate
- Respiratory rate
- Auscultation finding/wheezing/crackles
- General observation/Rib cage retractions
- X ray finding.

Results

The findings of the study depicted that there was improvement of all the respiratory parameters after administration of CPT. There was no improvement in any respiratory parameters in first 2 days when the patient was not given CPT as shown in table below.

Table 1: Respiratory Parameters findings on day 1 to day 2 and Pre-CPT, Post CPT findings from day 3 to day 5.

Day		Before PT (Mean)	After PT (Mean)
Day-1		HR: 141 RR: 70 SPO_2: 74% FIO_2 /O_2 flow /Duration: 3 l/min AF: High Crackles and wheezing	
Day-2		HR: 138 RR: 65 SPO2: 84% FIO_2 /Duration: 3 l/min AF: Crackles and wheezing	**No Physiotherapy treatment**
		Physiotherapy treatment start after two days	
Day-3 XF		HR: 136 RR: 56.5 SPO_2: 84% FIO_2 /Duration: 3 l/min AF: Crackles and wheezing	HR: 132.5 RR: 46 SPO_2: 88% FIO_2 /Duration: 2 l/min AF: -Diminished Crackles and wheezing
Day-4 HR: 127.5		HR: 127.5 RR: 48 SPO_2: 88% FIO_2 /Duration: 1 l/min AF: Wheezing	HR: 122 RR: 42.5 SPO_2: 92% FIO_2 /Duration: 1 l/min AF: Diminished wheezing
Day-5 XF		HR: 111.5 RR: 40 (mean=39) SPO_2: 92% FIO_2 /Duration: No O_2 AF: Few wheezing	HR: 100 RR: 31.5 SPO_2: 98% FIO_2 /Duration: No O_2 AF: Normal sound

*HR (heart rate), RR (respiratory rate), AF (Auscultation finding), SPO_2 (peripheral capillary oxygen saturation), XF (X-ray finding)

Discussion

Nebulization and suctioning were the conventional techniques for secretion removal during the first 48 hours of hospitalization but its benefit to infants was not much appreciable. Chest physiotherapy requires considerable handling. Chest physiotherapy was done with nebulization for better results. Subjects don't show any sign to necessitate immediate cessation of physiotherapy during treatment. No adverse effects such as rib fractures were found related to the chest physiotherapy.

The results of this study differed from those of the previous one, which stated chest physiotherapy was not too effective for children who have bronchiolitis. This may be because chest physiotherapy may not be combined with nebulization. Therefore, we have designed our study to find the effect of chest physiotherapy with nebulization in acute bronchiolitis after 48 hours of admission. The present case report shows positive benefit from chest physiotherapy in the natural course of acute viral bronchiolitis by showing improvement in all the respiratory parameters.

Etches and Scott et al, Guy Postiaux PT et. al. also suggested that chest physiotherapy in acute viral bronchiolitis is mainly symptom based and hypertonic saline should precede the CPT maneuvers. They found that chest physiotherapy technique to be superior with regards to the amount of secretion removed in infants with bronchiolitis. It is still not clear the action of this technique in infants but it is widely used and has no common adverse effects such as bradycardia and bleeding of nasal mucosa. There are numbers of others randomized controlled trials that have reported good results with conventional chest physical therapy in hospitalized patients with bronchiolitis.[5,7]

Evelim L.F.D. Gomes et al. also shows the benefits of the chest physiotherapy (CP) method on several scored respiratory parameters over the course of time in infants with RSV bronchiolitis. Perrotta C et al. also describes improvement in ventilation and perfusion after physiotherapy in a 5-month-old infant with bronchiolitis.[8,9]

M. Chalumeauet et al, concluded that chest physiotherapy was used in the procedural arrangement of passive treatment for patients with bronchiolitis and pneumonia. Chest physiotherapy is effective and safe in removal of secretion. J.L. Lukrafka, et al, also demonstrated that Chest physiotherapy included postural drainage, vibration, and percussion cleared chest secretion more effectively. [10, 11]

The results of our study revealed differences in respiratory status (heart rate, respiratory rate, and oxygen saturation) before and after treatment from day 2 to day 5. This means that nebulization and chest physiotherapy are effective in bronchiolitis. The combination of chest physiotherapy with nebulization followed by suctioning is more effective than chest physiotherapy or nebulization only. It is important to reconsider the combination of nebulization and chest physiotherapy to overcome airway obstruction problems.

G. S. Chaves et al, concluded that combination of nebulization and chest physiotherapy was proven more effective than nebulization treatment only. Similar results occurred with respiratory rates in children with pneumonia who were under the age of five. Thus, combination of nebulization and chest physiotherapy had a positive impact because it stabilized or normalized heart and respiratory rates. C. Paludo, et al. also agree with the previous study, which described the possibility of significant improvement towards heart and respiratory rates after chest physiotherapy.[12,13]

Results of our study demonstrated the significance improvement in SPO_2 and O_2 duration after starting the chest physiotherapy from day 2 onwards to 5 days in this case during hospitalization. This result corresponded to the previous study in that the oxygen saturation significantly improved before and after treatment.

S. Zhao et al. C.P. Jacinto et al. Safdar et al. shows that chest physiotherapy affect and improve the oxygen saturation in bronchiolitis subjects, They have demonstrated that secretions reduction and improvement in mucociliary clearance They explained that providing nebulization prevents sputum stoppage in the respiratory tract due to the excessive production.[14,15,16]

The results of our study revealed that combination of nebulization and chest physiotherapy have significant positive effects on heart rate, respiratory rate, and chest x-ray presentation by reducing secretion and work of breathing.

Nur Eni Lestari et al. Shows the combination of nebulization and chest physiotherapy is more effective than nebulization only. It is important to reconsider the combination of nebulization and chest physiotherapy to overcome airway obstruction problems and to assist in the clearance of tracheobronchial secretions.[17]

Result of our study is able to explain that 0.9% saline for nebulization with chest physiotherapy

is clinically effective in secretion removal in acute bronchiolitis. Bhagwan S Sharma et al. Concluded that, nebulized 3% hypertonic saline is not superior to 0.9% saline in infants and children with clinically diagnosed acute bronchiolitis (without RSV confirmation). Frequent normal saline nebulization is as good as 3% saline nebulization in hospitalized infants with moderate to severe acute bronchiolitis.[18]

Results of our study data show a sharp improvement after starting physiotherapy and help in minimizing the subject's hospital stay. D.V. Cano et al. study explained that chest physiotherapy could in fact offer some benefits. Study revealed that one benefit of chest physiotherapy was that it helped reduce the number of days a child was hospitalized.[19]

So, our study demonstrated that chest physiotherapy with nebulization in bronchiolitis is a safe and effective way of treatment. It reduces severity and number of hospital stay days of the subject. We recommend the chest physiotherapy with nebulization as the choice of treatment for secretion in routinely management of acute bronchiolitis.

Conclusion

The study revealed that combination of nebulization and chest physiotherapy has positive effects and improvement in different parameters such as heart rate, respiratory rate, and oxygen saturation etc. As a result of the study, it is advised that the combination of nebulization, chest physiotherapy and suctioning may be clinically practices in physiotherapy field. The study results can be considered to be included in the hospital guidelines to encourage physiotherapists in mobilization of secretion in bronchiolitis subjects.

Limitation of the study

The short length of hospital stay and single case study may not be enough to demonstrate full benefit for clinical implication of techniques.

Future study

There has been an evolution in the knowledge of chest physiotherapy effect on respiratory mechanics of infants. The techniques method may be investigated and applied on more sample size based on physiopathology and grading of bronchial obstruction to find the longest detailed benefit.

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[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006; 35: 540–7.

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Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone-iodine antisepsis. State of the art. Dermatology 1997; 195 Suppl 2: 3–9.

Corporate (collective) author

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Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979–2001. www.statistics.gov.uk/downloads/theme_health/HSQ20.pdf (accessed Jan 24, 2005): 7–18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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