Indian Journal of
Physical Medicine and Rehabilitation

IJPMR 2014 March; Volume 25 (Number 1)

Contents

Editorial

World Health Day 2014: preventing Vector-borne Diseases. RN Haldar.

Original Articles

i) Pain and Disability in Patients Suffering from Adhesive Capsulitis of Shoulder. Hmigthanmawii, Zonunsanga C, Minggam Pertin, Chongreilen Chiru, Romi Singh N.

ii) Effectiveness of the home-based habilitation programme for children with cerebral palsy. Maja Racic, Srebrenka Kusmuk, Vesna Krstovic-Spremo.

iii) Deformities and bony changes in leprosy. Wadhwa Ranjan Kumar, Kothari SK, Swamy MKS.

Case Reports

i) Spinal cord injury in decompression sickness: a case report. Henry Prakash M, Ramaswamy Hariharan, Bobeena Chandy.

ii) Post Polio Syndrome: Report of 3 Cases and Brief Review of Literature. Gogia VS, Singh U.

PG Forum

i) Rehab Challenges
ii) Book News
iii) Article News
iv) Rehab Quiz

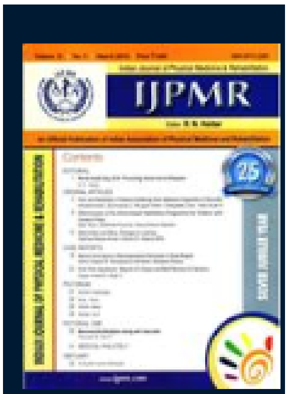
Pictorial CME

Medical Philately

Obiturary

IJPMR Editorial Board

IAPMR Executive Committee



Print Edition

Editor:

Prof RN Haldar

ISSN

0973-2209

Web administration and designing: Dr U Singh. *First built:* April 15, 2004. *Last updated:* June 23, 2014

Original Article

Pain and Disability in Patients Suffering from Adhesive Capsulitis of Shoulder

Hmigthanmawii[1], Zonunsanga C[2], Minggam Pertin[3], Chongreilen Chiru[4], Romi Singh N[5]

Abstract

Study design: Cross-sectional study.
Set up: Department of Physical Medicine and Rehabilitation (PMR), Regional Institute of Medical Sciences, Imphal.
Duration of study: Two years October 2011- September 2013.
Aims and objects: To measure the pain and disability in patients suffering from adhesive capsulitis of shoulder and its relation with stages of adhesive capsulitis.
Study population: Idiopathic adhesive capsulitis patients attending PMR Department who fulfilled the inclusion criteria.
Results: Fifty-six patients suffering idiopathic adhesive capsulitis of the shoulder were included in the study. The mean age of the study population was 56.30±8.17 (range 40-70) years, male comprised 57.1% while female 42.9%. Shoulder ROM showed rotation most restricted followed by abduction, flexion and extension. Mean VAS pain score was highest in stage 1 (80.36±8.42) and lowest in stage 4 (38.33±7.42) and it was found to be statistically significant ($p< 0.001$). Mean SPADI disability score was highest in stage 3 (68.56±5.79) and lowest in stage 1 (41.14±7.90) and found to be statistically significant ($p<0.001$).
Conclusion: Stages of adhesive capsulitis are found to be closely related to pain and functional disability of the patient. SPADI can be used in recording pain and disability in patients suffering from adhesive capsulitis and can be useful in planning the treatment of such patients in local context.

Key words: **Adhesive capsulitis, Shoulder pain and disability index, Visual analogue scale pain.**

Introduction:

Adhesive capsulitis is a painful restriction in shoulder range of motion in a patient with normal radiographs[1]. It has been divided into 4 stages depending on the duration, symptoms and signs[1,2]. The quantification of pain and disability is necessary not only for treatment of the condition, but also for evaluation of outcome measures of impairment and disability. Adhesive capsulitis has a significant impact on the quality of life of the patient and causes functional limitation at every stage of the disease.

A valid and reliable shoulder disability questionnaires: the shoulder pain and disability index (SPADI)[3] was used in this study. It is a self administered questionnaire consisting of two dimensions, pain (5 items) and disability (8 items) and requires 5-10 minutes for a patient to complete. The pain dimension measures the severity of the pain, disability dimension measures the degree of difficulty an individual has with various activities of daily living (ADL) that require use of upper extremity.

As limited studies have been carried out in this part of the country to assess the pain and functional disability in adhesive capsulitis patients, the present study carried

Author's affiliations:
[1] MBBS, Postgraduate student
[2] MBBS, Postgraduate student
[3] MBBS, Postgraduate student
[4] MBBS, Postgraduate student
[5] MBBS, Diplomate NB (P M & R), MNAMS; Professor
Department of Physical Medicine and Rehabilitation, Regional Institute of Medical Sciences, Imphal-795004 (Manipur, INDIA)

Cite as:
Hmigthanmawii, Zonunsanga C, Minggam Pertin, Chongreilen Chiru, Romi Singh N. Pain and disability in patients suffering from adhesive capsulitis of shoulder. *IJPMR March 2014*; Vol **25 (1):** 2-5.

Correspondence:
Dr. N. Romi Singh, Professor
Department of Physical Medicine and Rehabilitation, Regional Institute of Medical Sciences, Imphal-795004, (Manipur, INDIA)
Email: dr.romi.singh@gmail.com

Received on 11/08/2013, Accepted on 30/01/2014

out in our clinical settings to measure the pain and functional disability pattern on patients suffering from idiopathic adhesive capsulitis of shoulder.

Materials and Methods:

In this cross-sectional study carried out during October 2011- September 2013, a total of 56 patients diagnosed as idiopathic adhesive capsulitis of the shoulder, the age group being 40-70 years were included. Approval from Institutional Ethics Committee (IEC), RIMS, Imphal was taken before starting the study.

We exclude adhesive capsulitis patients resulting from trauma, surgery, bony metastasis, rheumatoid arthritis, etc. All the patients recruited for the study were subjected to detailed history along with stages of the disease, clinical examination including VAS pain and shoulder range of motion (ROM), laboratory, radiological investigations and SPADI questionnaire. The SPADI was translated into local language and pre-testing of the SPADI Manipuri version was done in 10 patients in a target population by using the probe technique.[4] The final accepted Manipuri version was then used for the study purpose. Pain was measured by visual analogue scale (VAS), ROM of shoulder by universal goniometer, shoulder pain and disability index (SPADI) questionnaire was administered and data was recorded in pretested proforma for each of the patient.

Two of the disability questionnaire ie, ‘Putting on your pants’ was modified to ‘putting on your sarong’ (garment consisting of long piece of cloth wrapped round the body and tucked round the waist) and ‘removing something from your back pocket’ was also modified to ‘reaching back of waist by back of hand’ for female patients.

The SPADI pain score, SPADI disability score were calculated separately from the two sub-items. Then the means of the two subscales were averaged to produce a total SPADI score ranging from 0 (best) to 100 (worst).

Statistical Analysis:

Data collected were recorded in microsoft excel and analysed by using SPSS version 16. The mean difference between the scores of ROM of shoulder, VAS pain, SPADI pain score, SPADI disability score, SPADI total score and stages of adhesive capsulitis were analysed by using analysis of variance(ANOVA) test and post hoc analysis. P<0.05 was taken as significant for all tests.

Results and Observations:

Out of 56 patients included, the mean age of the patients was 56.30± 8.17 years. Male comprised 57.1% and female 42.9% (Table 1). Between the age group 40 and 70years, 51-60 years group contributed 44.6% (Fig 1).

Table 1: *Demographic Profile of the Study Subject*

Parameters		**Mean ± SD**	**No. of cases (%)**
Age in years		56.30 ±8.17	
Sex	Male		32 (57.1%)
	Female		24 (42.9%)
Duration of illness (in months)		4.05 ± 3.06	
Side	Right		29 (51.8%)
	Left		27 (48.2%)

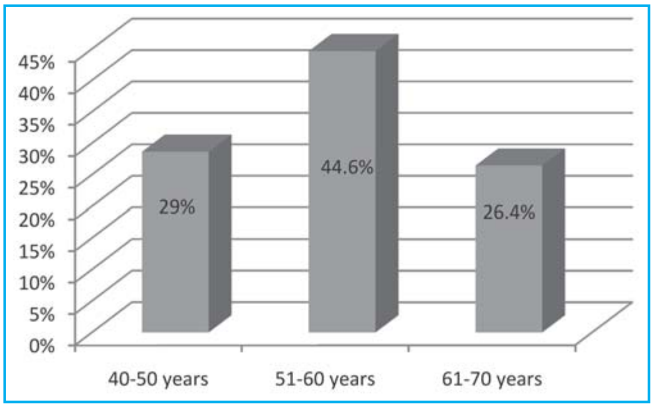


Fig 1- *Showing Age in Years*

ROM of shoulder was restricted in all the ranges; rotation was found to be most restricted followed by abduction, flexion and extension. The percentage of restriction calculated from full range was internal rotation 69%, external rotation 67%, abduction 44% and flexion 28%, with internal rotation showing the maximum restricted range.

Mean SPADI pain score was 61.52±9.74 and mean SPADI disability score was 54.46±11.93. Mean total SPADI score was 57.25±8.15 indicating moderate amount of pain and disability in our study population.

Distribution of mean scores of ROM, VAS pain, SPADI pain, SPADI disability, SPADI total score in relation to stages of adhesive capsulitis were calculated by ANOVA test.

Mean score shoulder ROM- flexion/extension arc (240 degrees), IR/ER arc (160 degrees), abduction (180 degrees), in relation to different stages of adhesive

Table 2: *Distribution of Mean Score ROM, VAS Pain, SPADI Pain, SPADI Disability, SPADI Total Score in Relation to Stages of Adhesive Capsulitis by Analysis of Variance(ANOVA) Test*

Variable	Stage 1	Stage 2	Stage 3	Stage 4	F value	P value
#Flex/ Ext arc	194.29±37.151	170.00±29.221	178.89±51.586	165.00±42.308	2.178	0.146
## IR/ER arc	58.57±25.603	39.63±28.787	65.00±53.151	75.00±40.866	1.656	0.204
Abduction	110.71±37.512	95.19±28.335	106.67±32.404	108.33±34.303	0.001	0.977
VAS pain	80.36±8.42	62.78±8.35	57.78±12.01	38.33±7.42	94.111	0.000***
SPADI pain score	66.36±7.821	58.30±10.178	66.22±8.393	57.67±7.421	1.336	0.253
SPADI disability score	41.14±7.90	58.81±6.75	68.56±5.79	44.83±6.85	17.628	0.000***
SPADI total score	51.86±7.04	58.41±5.97	67.22±5.54	49.67±5.53	3.150	0.082

Flexion/ extension arc in degrees; ## Internal rotation/ external rotation arc in degrees; *** p <0.001

capsulitis (Table 2). Among the 4 stages, maximum restriction from full range in terms of shoulder ROM was observed in stage 2 and stage 4. In IR/ER arc and abduction, stage 2 showed the most restricted range. The mean score difference between flexion/ extension arc, IR/ER arc, abduction and stages of adhesive capsulitis were found to be statistically not significant.

In the distribution of mean VAS pain score and SPADI scores (viz, SPADI pain, SPADI disability, total SPADI) in relation to stages of adhesive capsulitis, we observed that only mean VAS pain score and SPADI disability score were significant(p<0.001). Post hoc analysis showed significant differences between mean VAS pain score, mean SPADI disability score and stages of adhesive capsulitis (p<0.001) (Table 3).

Discussion:

In this study, the mean age of the study population was 56.30±8.17 years (range: 40-70 years) similar to studies reported by Marx *et al*[5], Quraishi *et al*[6], Tveita *et al*[7], Vora[8] where they stated that adhesive capsulitis was most common during 4th to 7th decades of life. Frequency of males were more than females in contrast to earlier study conducted by Binder *et al*[9]. This may be due to the small sample size in this study. But similar results were also found by Vora[8] and Siraj *et al*[10], where the frequency was more in males compared to females. In this study limitation of shoulder ROM was found in all the ranges. The finding was in agreement with that Marx *et al*[5] and Kivimaki and Pohjolainen[11].

The mean scores of SPADI pain, SPADI disability and total SPADI score were 61.52±9.74, 54.46±11.93, 57.25±8.15 respectively. Our findings showed similar results observed by Tveita *et al*[7] and Oster *et al*[12]. It also showed that different stages of adhesive capsulitis were responsible for different pain score, disability score and total SPADI score.

Table 3: *Difference of Mean VAS Pain Score, Mean SPADI Disability Score among Stages of Adhesive Capsulitis*

Variable	Stage	Stage	Mean difference±SE	P value
VAS pain	Stage 1	Stage 2	17.579±2.952	.000
		Stage 3	22.579±3.830	.000
		Stage 4	42.024±4.374	.000
	Stage 2	Stage 3	5.000±3.450	.920
		Stage 4	24.444±4.046	.000
	Stage 3	Stage 4	19.444±4.725	.001
SPADI disability score	Stage 1	Stage 2	-17.672±2.284	.000
		Stage 3	-27.413±2.963	.000
		Stage 4	-3.690±3.384	1.000
	Stage 2	Stage 3	-9.741±2.669	.004
		Stage 4	13.981±3.130	.000
	Stage 3	Stage 4	23.722±3.655	.000

VAS pain score was highest in stage 1 (80.36±8.42), decreased in 2nd and 3rd stages and lowest in stage 4 (38.33±7.42). Also observed by Hannafin and Chiaia[2] in their study, pain was more in stage 1 and gradually decreased as the duration of illness increased. This was also found to be statistically significant in the present study ($p<0.001$).

Mean SPADI pain score was highest in stage 1(66.36±7.821) and stage 3 (66.22±8.393). This showed that some activities can still produce pain irrespective of stages of the disease. But the above findings were found to be statistically not significant. Mean SPADI disability score was highest in stage 3 (68.56±5.79) and lowest in stage1 (41.14±7.90). This was found to be statistically significant ($p<0.001$). Our findings was in agreement with that of Hannafin and Chiaia[2] where they also stated that patients in stage 3 presented with significant limitation of motion with rigid end feel. Mean SPADI total score was highest in stage 3 (67.22±5.54) when compared to other stages. As noted earlier by Hannafin and Chiaia[2], in presence of pain, limitation in ROM was maximum in stage 3. However, the above finding was not statistically significant.

Few limitations of SPADI were noted when analyzing the data collected in our study. Certain functional items seemed to be related with pain items that included 'reaching' and 'carrying heavy weight' component. However, it was uncertain whether the two could be assessed separately in this way since pain and disability might be very closely related to the daily functional activities performed by these patients. Difficulty in doing activities involving above items might be related to pain that is difficult to differentiate from the stiffness component while performing these activities. Tveita *et al*[7] also shared such limitations where they also reported the difficulty in differentiating between the two factors.

Conclusion:

From the present study we found that adhesive capsulitis can be a persistent and often disabling condition affecting both sexes in their 4th to 7th decades of life. Pain and restriction of shoulder was found in all the stages of adhesive capsulitis. Shoulder pain and disability index serves an useful tool for measuring pain and disability in patients with adhesive capsulitis. It measures the extent of pain and how it affects an individual on activities of daily living.

We also found that stages of adhesive capsulitis were closely related to amount of pain and disability in our study population. SPADI can be used in recording pain and disability in patients suffering from adhesive capsulitis and can be useful in planning the treatment of such cases.

References:

1. Jonathan TF. Musculoskeletal Problems of the upper limb. In: Ralph MB, Chan L, Karen JK, Edward RL, Dennis JM, Kristjan TR, editors. Randall L. Braddom Physical Medicine and Rehabilitation. 3rd ed. New Delhi: Elsevier Saunders, 2007: 825-53.
2. Hannafin JA, Chiaia TA. Adhesive capsulitis: a treatment approach. *Clin Orthop* 2000; **372:** 95-109.
3. Bicer A, Ankarali H. Shoulder pain and disability index: a validation study in Turkish women. *Singapore Med J* 2010; **51:** 865-70.
4. Ruperto N, Ravelli A, Pistorio A, Malattia C, Cavuto S, Gado-West L, *et al*. Cross-cultural adaptation and psychometric evaluation of the Childhood Health Assessment Questionnaire (CHAQ) and the Child Health Questionnaire (CHQ) in 32 countries. *Clin Exp Rheumatol* 2011; **19:** S1-S9.
5. Marx RG, Malizia RW, Kenter K, Thomas LW, Hannafin JA. Intra-articular corticosteroid injection for the treatment of adhesive capsulitis of the shoulder. Springer HSS J. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2504264/. (accessed September 12, 2013).
6. Quraishi NA, Johnston P, Bayer J, Crowe M, Chakrabarti AJ. Thawing the frozen shoulder: a randomised trial comparing manipulation under anaesthesia with hydrodilatation. *J Bone Joint Surg Ann* 2007; **89:** 1197-00.
7. Tveita EK, Sandvik L, Ekeberg OM, Juel NK, Bautz-Holter E. Factor structure of the shoulder pain and disability index in patients with adhesive capsulitis. *BMC Musculoskelet Disord* 2008; **9:** 1-7.
8. Vora P. Study of conservative management of frozen shoulder. *Natl J Integrated Res Med* 2010; **1:** 21-4.
9. Binder AI, Bulgen DY, Hazleman BL, Roberts S. Frozen shoulder: a long term prospective study. *Ann Rheum Dis* 1984; **43:** 361-4.
10. Siraj M, Anwar W, Iqbal MJ, Rahman N, Kashif S, Khan A, *et al*. Effectiveness of intra-articular corticosteroid injection in the treatment of idiopathic frozen shoulder. *J Surg Pak* 2012; **17:** 57-60.
11. Kivimaki J, Pohjolainen T. Manipulation under anesthesia for frozen shoulder with and without steroid injection. *Arch Phys Med Rehabil* 2001; **82:** 1188-90.
12. Oster AJK, Richards CA, Prevost AT, Speed CA, Hazelman BL. Diagnosis and relation to general health of shoulder disorders presenting to primary care. *J Rheumatol* 2005; **44:** 800-5.

IJPMR EDITORIAL BOARD

EDITORIAL BOARD : 2013 – 2015

EDITOR : Dr. R. N. Haldar

EMERITUS EDITORS – Dr. A.K. Agarwal, Dr. Suranjan Bhattacharji, Dr. U. Singh

ASSOCIATE EDITORS – Dr. Mrinal Joshi, Dr. Rajesh Pramanik, Dr. S.L. Yadav

ASSISTANT EDITORS – Dr. Anupam Gupta, Dr. Anil Gaur, Dr. N. Romi Singh

MEMBERS – Dr. N. George Joseph, Dr. Asim Palit, Dr. S. Sunder, Dr. Rajendra Sharma, Dr. Ajay Gupta, Dr. George Zacharia, Dr. P. Ray, Dr. Avishek Srivastava

EX-OFFICIO – Dr. K. B. Wangjam, Dr. P. Thirunavukkarasu

ADVISORY BOARD (NATIONAL)

Dr. A.B. Tally
Dr. Abdul Gaffor
Dr Ajit Kumar Varma
Dr. A.K. Joy Singh
Dr. A.K. Mukherjee
Dr. Ambar Ballav
Dr. B.D. Athani
Dr. B.G. Dharmanand
Dr. B.K. Choudhury
Dr. C. Ramesh
Dr. Feroz Khan
Dr. Ganesh Arun Joshi
Dr. George Tharion
Dr. K. Sunder S
Dr. M.K. Mathur
Dr. Nonica Laisram
Dr. Nirmal Surya
Dr. P.K. Mandal
Dr. R.K. Ghatak
Dr. R.K. Srivasthava
Dr. Sanjay Wadhwa
Dr. S. Hariharan
Dr. S.K. Jain
Dr. S.Y. Kothari
Dr. T.J. Renjanathan
Dr. T. Sreedhar
Dr. U.N. Nair
Dr. V. K. Sreekala

ADVISORY BOARD (INTERNATIONAL)

Dr. Joel A DeLisa (USA)
Dr. Walter Frontera (USA)
Dr. Andrew Haig (USA)
Dr. John L Melvin (USA)
Dr. Jianan Li (China)
Dr. John Olver (Australia)
Dr. Marta Imamura (Brazil)
Dr.Linamara Battistella (Brazil)
Dr. Germano Pestelli (Italy)
Dr. Alessandro Giuestini (Italy)
Dr. Gerold Stucki (Germany)
Dr. Gulseren Akyuz (Turkey)
Dr. Chang-il Park (Korea)
Dr. Tai Ryoon Han (Korea)
Dr. Apichana Kovindha (Thiland)
Dr. Areerat Supputttitada (Thiland)
Dr. Md. Taslimuddin (Bangladesh)

Deformities and Bony Changes in Leprosy

Wadhwa Ranjan Kumar[1]*, Kothari SY*[2]*, Swamy MKS*[3]

Abstract

India has eradicated leprosy as per WHO norms but the cases with residual deformities will persist for long. With this idea, a study was undertaken on consecutive 70 patients coming to the outpatient section of Physical Medicine and Rehabilitation Department of Safdarjang Hospital, New Delhi to study various deformities and bony changes. All the patients were leprosy cured but attending hospital for their deformities only. Specific bony changes were seen in multi-bacillary patients, while the non-specific and osteoporotic changes were seen in all types of patients. Patients appeared more willing to get the deformities treated than hiding the same from the society.

Key words: **Deformities, bony changes, leprosy.**

Introduction:

India has the largest number of leprosy patients in the world and has eradicated it as per WHO norms[1]. National Leprosy Eradication Programme (NLEP)[2] has extensively covered leprosy patients across the length and breadth of our country, declaring them cured as per guidelines of multidrug therapy. But the deformities are persisting with these patients, being permanent.

These cases have visible deformities of the hands, feet and face. These deformities are clawing and loss of fingers and toes, wrist or foot drop, lagophthalmos, trophic ulcers, depressed nose, etc.

Bony changes usually occur in leprosy patients of long duration. These are divided into specific, non-specific and osteoporotic.

Specific bone changes are caused by direct invasion of the bones by *Mycobacterium leprae* causing granulomatous lesions seen as focal areas of rarefaction on x-rays. Job *et al*[3] have attributed nasal bone changes to specific infection. Nasal bone destruction is associated with destruction of septal cartilage, the alar cartilages and the perpendicular part of ethmoid and vomer bones. Boocock *et al*[4] have documented presence of new bone formation in maxillary sinuses followed by pitting.

In the feet, these changes include honeycombing, pseudocysts, enlarged nutrient foramina and areas of bone destruction leading to concentric cortical erosion and thinning to collapse of bone. Healing is seen as periosteitis and sclerosis.

Non-specific bone changes are caused by destruction of nerve supply leading to sensory loss and disuse atrophy. Vascular changes, trauma and secondary infection also contribute to non-specific changes[5]. There are many other factors responsible for these changes. These changes may be absorptive, destructive or erosive.

In hands, distal phalanges undergo gradual atrophy due to absorption. Tuft erosion is the commonest change in the distal phalanges. Later on, the distal phalanges thin out due to rarefying osteitis, known as 'concentric bone atrophy'. Progressive shortening of the phalanges and metatarsals may be observed over years. Distal ends of metatarsals are affected giving an appearance of 'penciling' or 'sucked candy-stick' appearance[6]. It can cause carpal or tarsal bone disintegration. Eccentric absorption occurs due to infection in anaesthetic hands and feet. Osteomyelitis is seen with its varying degree of destruction in association with trophic ulcers.

Cupping of joints, sub-articular bone erosion, absorption

Author's affiliations:

[1] *DPMR, DNB-PMR, Sr.C.M.O. (SAG)*
[2] *M.S.-Ortho; DNB-PMR, Prof. & Spl. DGHS*
[3] *M.S.-Ortho; Prof. & Consultant*
Department of Physical Medicine & Rehabilitation, V.M.M.C. & Safdarjang Hospital, New Delhi.

Cite as:

Wadhwa Ranjan Kumar, Kothari SK, Swamy MKS. Deformities and bony changes in leprosy. *IJPMR March 2014*; Vol **25 (1):** 13-7.

Correspondence:

Dr. S.Y.Kothari; M.S.-Ortho; DNB-PMR
Prof. & Spl. DGHS, V.M.M.C. & Safdarjang Hospital, New Delhi.
E-mail: kothari_sy@ yahoo.com

Received on 26/05/2012, Revised on 17/12/2013,
Accepted on 17/02/2014

of joint ends and disintegration of joint space may lead to subluxation, dislocation and contractures. Neuropathic changes in hands and feet lead to micro-fractures followed by healing.

Osteoporotic changes are thought to be due to high bacillary load and/or reaction to an active lesion in the surrounding area or due to immobilisation and disuse atrophy[5,7,8]. Testicular atrophy and subsequent low levels of testosterone contribute to generalised osteoporosis in males[9]. Malnutrition, debility and senility may also contribute to the osteoporosis.

Motor paralytic deformities occur as a result of peripheral nerve trunk involvement. This gives rise to characteristic deformities like foot drop, claw fingers, ape thumb or facial palsy/lagophthalmos, etc. Hand functions are impaired, high stepping gait develops and the cornea is at risk of injury.

Sensory deformities develop as a result of glove and stocking anaesthesia, cutaneous/truncal nerve paralysis and anaesthetic patches. Overlying trauma and autonomic paralysis lead to hand and feet ulcers, damage/shortening of phalanges and neuropathic damage to feet leading to amputations in some cases.

Osteoporotic changes occurring due to various reasons as explained, add to the neuropathic damage. Infection from plantar ulcers is another contributory factor for downhill journey.

Incidence of bony changes in leprosy varies in different studies.Chamberlain *et al*[9] reported bony changes in 15%, Faget and Mayoral[10] in 29% and Basu,[11] in 91% cases.

Bandil *et al*[12] observed 12 cases out of 55 patients studied.

Materials and Methods:

Seventy leprosy patients attending Physical Medicine and Rehabilitation (PMR) department's outpatient section and from a nearby leprosy patients' colony were selected for this prospective study. Informed consent was obtained. Only patients with some deformity were included so as to obtain distribution of deformities in these patients. Very old patients were excluded who could not come to the hospital. Demographic, clinical and radiological findings were recorded.

Clinical records included- clinical typing, bacteriological status, treatment and deformity status and photographic records and tracings. The data compilation and tabulation done in scientific manner, unveiled association of clinicoradiological features with the deformities. Seventy patients presented with – deformed upper limbs, – deformed lower limbs and – deformed faces.

Observations and Results:

This study was done on seventy consecutive patients attending outpatient section of PMR Department of Safdarjang Hospital, New Delhi and a leprosy patients' colony from adjacent area. Out of these cases 56 were males while 14 were females. Most of the patients belonged to 21 years to 60 years age group (Table 1) and belonged to South Indian States (Table 2)

Most of the patients had the disease for more than 10 years and all had taken adequate drug treatment and were in the "cured" category (Table 3), but all the patients had permanent residual deformities (Table 4).

Table 1: *Age and Sex Distribution*

Age Group (Years)	No of cases		Total
	Male	Female	
11-20	2	0	2 (2.85%)
21-30	13	1	14 (20%)
31-40	12	9	21 (30%)
41-50	18	1	19 (28.6%)
51-60	8	3	11 (15.71%)
61-70	3	0	3 (4.3%)
Total	**56**	**14**	**70 (100%)**

Table 2: *Statewise Distribution*

Native State	No of cases
Karnataka	55
Andhra Pradesh	1
Tamilnadu	2
Delhi	1
UP	5
Uttarakhand	1
Bihar	4
West Bengal	1
Total	**70**

Table 3: *Duration of Illness*

Duration of Illness (years)	No of cases
4-10	9
11-20	23
21-30	27
31-40	10
41-50	1
Total	**70**

Table 4: *Clinicoradiological Deformities*

Deformities	Face	Hands	Feet	Both	Total
Nose depression	33	–	–	–	33 (47.24%)
Leonine faces	11	–	–	–	11 (15.71%)
Tuft changes	–	24	4	12	40 (57.14%)
Absorption					
Distal phalanx	–	6	5	56	67 (95.71%)
Middle phalanx	–	6	10	50	66 (94.28%)
Proximal phalanx	–	6	12	35	53 (75.71%)
Metacarpal	–	–	–	–	–
Metatarsal	–	–	24	6	30 (42.85%)
Concentric absorption	–	7	5	49	61 (87.14%)
Eccentric absorption	–	–	11	4	15 (21.42%)
Contracted fingers, Claw fingers/toes	–	10	6	32	48 (68.57%)
Foot drop			5		5 (7.14%)
Cupping	–	2	3	–	5 (7.14%)
Arthritis	–	2	11	12	25 (35.71%)
Secondary periosteitis	–	4	10	16	30 (42.85%)
Osteomyelitis	–	–	15	22	37 (52.85%)
Carpal/tarsal disintegration	–	–	19	6	25 (35.71%)
Subluxation/dislocation	–	6	7	17	30 (42.85%)
Fracture	–	–	1	1	2 (2.85%)
Ulcer		7	21	17	45 (64.27%)
Soft tissue changes	–	3	6	15	24 (34.28%)
Osteoporosis	–	5	5	41	51 (72.85%)

Specific bony deformities (Fig 1) were seen only in multibacillary cases while the non-specific and osteoporotic bony changes were distributed equally among both the types of cases.

Out of 33 patients having depressed bridge of nose, only 11 showed typical lion like faces.

As most of the patients were having the disease for a long duration, the bony deformities of hands and feet were very commonly seen, including tuft changes and shortening of the phalanges. Plantar ulcers were seen in 21 patients while 7 had hand ulcers and 17 had ulcers both on the hands and feet. Thirty-eight patients had plantar ulcers despite free availability of well padded foot wear.

Clawing of the fingers and toes was the result of truncal nerve paralysis and was seen in more than 75% cases while osteoporosis was seen in 73% cases. Both these changes are indicative of long standing residual effects of the disease. As the burnt out and treated cases are added to the society after treatment of the active disease, these problems will persist lifelong to be taken care of. Even neuropathic degenerative changes are being seen commonly in the form of carpal and tarsal disintegration, subluxation/dislocation, fractures, degenerative arthritis, cupping and absorption of phalanges because most of these patients have a long standing burnt out disease giving rise to such chronic and inevitable problems.

Plantar ulcers, osteomyelitis, reactive periosteitis and other neuropathic changes in the tarsal bones are again the result of long standing anaesthetic changes in the feet, exposed to vagaries of life in these poor patients. All the patients had some or other of these changes.

Fig 1- *Bony Changes in Hands and Feet*

Thus it is evident that, as the patients with lifelong residual deformities of leprosy are being added to the society, this will remain a big public health burden despite elimination of the active leprosy cases.

Discussion:

We have tabulated the results of various authors for easy comparison and discussion on our findings regarding deformities and bony changes found in our patients afflicted with leprosy (Table 5).

These studies were done in leprosy cases irrespective of their treatment status. So the profile of various bone changes and deformities is variable. But it can be observed that the later studies are showing more of non-specific, osteoporotic and overall changes suggesting inclusion of chronic cases as the leprosy was being effectively treated the world over, more so in the western world. Our study included treated cases at a stage when the leprosy in India was on the verge of elimination. Hence, all the cases had some or other of the non-specific bone changes. Most of our patients had come from a leprosy patient's colony that had treated and burnt out disease remaining with its sequelae. None the less, our study is reflective of the status of leprosy cases after its elimination and the residual public burden of the deformities in the coming years (Table 6).

Comparison of various bone changes seen in earlier studies with that seen in our study reinforces the same changing pattern and points to the future scenario of the burden of deformities in our society. Moreover, most of our patients were included from nearby leprosy colony having long standing affection with glove and stocking anaesthesia and multiple truncal nerve damage.

Table 5: *Types of Deformities*

Sl. No.	Authors	Specific bone changes (%)	Non-specific bone changes (%)	Osteoporosis (%)	Overall bone changes (%)
1	Barrington[13] (1931)	—	—	—	13.0
2	Chamberlain *et al*[9] (1931)	—	—	—	15.0
3	Faget and Mayoral[10] (1944)	—	—	—	29.0
4	Patterson[14] (1955)	—	—	—	90.0
5	Patterson[5] (1961)	14.3	45.0	10.0	—
6	Basu[11] (1961)	—	—	—	91.0
7	Yadav and Makhani[15] (1969)	10.0	80.0	—	—
8	Basu[16] (1972)	—	—	47.7	—
9	Chhabriya *et al*[7] (1985)		66.0	50.0	—
10	Thappa *et al*[17] (1999)	22.4	78.9	28.9	82.9
11	Present study	63.0	100	73	100

Table 6: *Comparison of Types of Deformities*

Deformity/bony changes	Patterson[5] (1961)	Chhabriya *et al*[7] (1985)	Thappa *et al*[18] (1992)	Chaudhuri *et al*[17] (1999)	Present study
Tuft erosions	27.0%	56.0%	—	13.6%	57.14%
Arthritis	24.0%	—	—	26.4%	35.71%
Secondary perioseitis	15.4%	—	—	3.6%	42.28%
Concentric absorption	14.0%	68.0%	39.5%	32.7%	87.14%
Terminal phalanx absorption	—	84.0%	59.2%	48.2%	95.71%
Middle phalanx absorption	—	72.0%	34.2%	27.2%	94.28%
Proximal phalanx absorption	—	60.0%	—	13.6%	75.71%
Soft tissue changes	—	74.0%	39.5%	44.5%	34.28%
Contractures- claw hand and claw toes	—	—	36.8%	22.7%	68.57%
Tarsal bone disintegration	1.8%	—	—	1.8%	35.71%
Eccentric absorption	—	2.0%	—	2.7%	21.42%
Osteoporosis	—	10-50%	—	38.1%	72.85%

Conclusion:

1. Though the disease of leprosy comes to the stage of eradication, the persistent deformities in the patients pose a major public health problem to deal with.
2. Reconstructive surgery needs to be taken up at a large scale to cover all the cured patients with residual deformities.
3. Cured patients with persistent sensory deficit need constant care of the hands and feet. Neuropathic changes also need continuous and lifelong care.

Acknowledgement:

No financial or other help was obtained in this work or in the preparation of this paper.

References:

1. WHO. The World Health Report, 1996, Fighting Disease-Fostering development, Report of The Director General, WHO.
2. Govt. of India. Annual report 1995-96, New Delhi.
3. Job CK *et al*. Leprosy: Diagnosis and Management. New Delhi: Hind Kushth Niwaran Sangh, 1975.
4. Boock PA,Roberts CA,Manchester K. Prevalence of maxillary sinusitis in leprous individuals from a medieval hospital. 1955
5. Patterson DE. Bone changes in leprosy, their incidence, progress, prevention and arrest. *Int J Lepr* 1961; **29:** 393-422.
6. Karat S, Karat ABA, Foster R. Radiological changes in the bones of the limbs in leprosy. *Lepr Rev* 1968; **39:** 147-69.
7. Chhabriya BD, Sharma NK, Aggarwal GR. Bone changes in leprosy. *Indian J Lepr* 1985; **57:** 632-9.
8. Jopling WH, Mc Dowell AC. Handbook of leprosy, 1992.
9. Chamberlain WE, Wa NE, Wayson NE, Garland LH. The bone and joint changes; a roentgnological study. *Radiology* 1931; **17:** 930-9.
10. Faget CH, Mayoral A. Bone changes in leprosy–a clinical and roentgenological study of 505 cases. *Radiology*1944; **42:** 1-13.
11. Basu SP. Radiological observations in leprosy. *Indian Practitioner* 1962; **52:** 53-9.
12. Bandil *et al*.Changes in bones in leprosy. Madras Rakshabandhu Trust (1979).
13. Barrington J. Pathogenesis of bone changes in neural leprosy. *Int J Lepr* 1931; **19:** 297-307.
14. Patterson DE. Radiological bone changes and angiographic findings in leprosy with special reference to pathogenesis of atrophic conditions of digits. *J Fac Radiol*1955; **7:** 35-6.
15. Yadav SS, Makhani JS. Osteo-articular changes in leprosy-Radiological investigations. *Indian J Orthopaedics* 1969; **3:** 30-8.
16. Basu SP. Bone changes in leprosy. Dr Dewan Chand Aggarwal Memorial Oration for 1972. *Indian J Radiol* 1972; **26:** 239-49.
17. Choudhuri H, Thapa DM, Kumar Rh, Elngovan S. Bone changes in leprosy patients with disabilities/deformities (a Clinico-Radiological Correlation). *Ind J Lepr* 1999; **71:** 203-15.
18. Thapa DM, Sharma VK, Kaur S, Suri S. Radiological changes in hands and feet in disabled leprosy patients: a clinical-radiological correlation. *Indian J Lepr* 1992; **64:** 58-66.

PG Forum

BOOK NEWS

1. Francois Bethoux .Ambulation in Adults with Central Neurologic Disorders, An Issue of Physical Medicine and Rehabilitation Clinics. ISBN: 978-1-4557-7140-0; Elsevier: April 2013.
2. Robert Meier .Amputee Rehabilitation- an Issue of Physical Medicine and Rehabilitation Clinics of North America. ISBN: 978-0-323-26678-9; Elsevier: December 2013.
3. Michael Furman .Atlas of Image-Guided Spinal Procedures. ISBN: 978-0-323-04299-4; Saunders: March 2012.
4. Walter Frontera, Julie Silver, Thomas Rizzo. Essentials of Physical Medicine and Rehabilitation. ISBN: 978-1-4557-7577-4; Saunders: August 2014.
5. Jon A. Jacobson MD .Fundamentals of Musculoskeletal Ultrasound. ISBN-13: 978-1455738182; Edition: 2: November 21, 2012.

ARTICLE NEWS

1. Anis Jellad, Sana Salah, Zohra Ben Salah Frih .Complex Regional Pain Syndrome Type I: Incidence and Risk Factors in Patients With Fracture of the Distal Radius. *Archives of Physical Medicine and Rehabilitation*; **95(3):** 487-92.
2. Tyler Rickards, Chelsey Sterling, Edward Taub et al. Diffusion Tensor Imaging Study of the Response to Constraint-Induced Movement Therapy of Children With Hemi paretic Cerebral Palsy and Adults With Chronic Stroke. *Archives of Physical Medicine and Rehabilitation*; **95(3):** 506-14.
3. Alberto Esquenazi. Gait Analysis in Lower-Limb Amputation and Prosthetic Rehabilitation. *Physical Medicine and Rehabilitation Clinics of North America*; **25(1):** 153-67.
4. Robert H. Meier, Danielle Melton. Ideal Functional Outcomes for Amputation Levels. *Physical Medicine and Rehabilitation Clinics of North America*; **25(1):** 199-212.
5. Louise A. Connell, Naoimh E. McMahon, Janice J. Eng, Caroline L. Watkins. Prescribing upper limb exercises after stroke: A survey of current UK therapy practice. *Journal of Rehabilitation Medicine*; **46(3):** 212-8.

PG Forum

BOOK NEWS

1. Francois Bethoux .Ambulation in Adults with Central Neurologic Disorders, An Issue of Physical Medicine and Rehabilitation Clinics. ISBN: 978-1-4557-7140-0; Elsevier: April 2013.
2. Robert Meier .Amputee Rehabilitation- an Issue of Physical Medicine and Rehabilitation Clinics of North America. ISBN: 978-0-323-26678-9; Elsevier: December 2013.
3. Michael Furman .Atlas of Image-Guided Spinal Procedures. ISBN: 978-0-323-04299-4; Saunders: March 2012.
4. Walter Frontera, Julie Silver, Thomas Rizzo. Essentials of Physical Medicine and Rehabilitation. ISBN: 978-1-4557-7577-4; Saunders: August 2014.
5. Jon A. Jacobson MD .Fundamentals of Musculoskeletal Ultrasound. ISBN-13: 978-1455738182; Edition: 2: November 21, 2012.

ARTICLE NEWS

1. Anis Jellad, Sana Salah, Zohra Ben Salah Frih .Complex Regional Pain Syndrome Type I: Incidence and Risk Factors in Patients With Fracture of the Distal Radius. *Archives of Physical Medicine and Rehabilitation*; **95(3):** 487-92.
2. Tyler Rickards, Chelsey Sterling, Edward Taub et al. Diffusion Tensor Imaging Study of the Response to Constraint-Induced Movement Therapy of Children With Hemi paretic Cerebral Palsy and Adults With Chronic Stroke. *Archives of Physical Medicine and Rehabilitation*; **95(3):** 506-14.
3. Alberto Esquenazi. Gait Analysis in Lower-Limb Amputation and Prosthetic Rehabilitation. *Physical Medicine and Rehabilitation Clinics of North America*; **25(1):** 153-67.
4. Robert H. Meier, Danielle Melton. Ideal Functional Outcomes for Amputation Levels. *Physical Medicine and Rehabilitation Clinics of North America*; **25(1):** 199-212.
5. Louise A. Connell, Naoimh E. McMahon, Janice J. Eng, Caroline L. Watkins. Prescribing upper limb exercises after stroke: A survey of current UK therapy practice. *Journal of Rehabilitation Medicine*; **46(3):** 212-8.

Effectiveness of the Home-based Habilitation Programme for Children with Cerebral Palsy

Maja Racic[1], Srebrenka Kusmuk[2], Vesna Krstovic-Spremo[3]

Abstract

Objective. This study was undertaken with the aim to compare the effects of home-based habilitation programmes with the effects of hospital-based habilitation programme for children with cerebral palsy (CP) on motor performance and daily functioning.

Patients and methods. The study was conducted on a sample of 60 children with cerebral palsy. First group included 30 children, 5 to 12 years old, who had a continued physical home treatment and education in public/special school. The second group consisted of 30 children, from Banja Luka region, who continued inpatient habilitation programme and training. Habilitation outcomes were analysed by measuring muscle tone (using original Tardieu Scale), muscle strength, range of motion (ROM), gross motor functions (gross motor function measure-88) and the Barthel Index of activities of daily living (ADL).

Results. The proportion of clinically significant change in gross motor functions, ADLs, ROM and muscle strength didn't show major differences between the two groups.

Conclusion. There were no significant differences in effectiveness between home-based and hospital-based habilitation programmes according to the treatment outcomes. The effectiveness of home-based programme increases when supplemented by frequent consultations with the rehabilitation team members and occasional out-patient physical therapy treatment, education as well as counselling and support for parents.

Key words: **Cerebral palsy, home-based habilitation, interdisciplinary care.**

Introduction:

The term habilitation has been used to describe ongoing care and multiple medical, therapeutic and educational interventions that children with developmental diasabilities receive through their lives. One way to approach this issue is to define habilitation in terms of participation. The term participation broadly characterises the core mechanism that operates at each stage of the human cycle. Disability is the loss of opportunities for participation in the goods of society, so working to enhance a child's ability to participate in settings and to be engaged in relationships and age appropriete activities presents a good way of increasing the probability that an improvement will occur.

In order for habilitation to be successful, different approaches to care are often necessary. Two such approaches are the interdisciplinary approach and the family centred approach. Both approaches involve drawing on the expertise of other individuals in order to provide optimal health care for the patient[1,2].

The interdisciplinary approach involves teams of medical professionals from such backgrounds as physicians. The team identifies specific problems and issues which must be addressed, and collaborates with one another to find optimal therapeutic solutions. Treatment of children with CP requires a long-term process during growth by an interdisciplinary team, focusing on all developmental

Author's affiliations:
[1] *MD, PhD (Family Medicine, postgraduate studies in Physical medicine and rehabilitation), Assistant Professor*
[2] *MD (Family Medicine), Family Medicine Department*
[3] *MD, PhD (Occupational medicine), Assistant Professor*
Department of Occupational Medicine, Medical faculty, University of East Sarajevo, Bosnia and Herzegovina.

Cite as:
Maja Racic, Srebrenka Kusmuk, Vesna Krstovic-Spremo. Effectiveness of the home-based habilitation programme for children with cerebral palsy. *IJPMR March 2014*; Vol **25 (1):** 6-12.

Correspondence:
Dr Maja Racic
Medicinski fakultet, Studentska 4, 73300 Foca, Bosnia
E mail : majaracic@excite.com

Received on 23/03/2013, Revised on 08/11/2013,
Accepted on 28/11/2013

aspects of the child and planning interventions in relation to the most urgent needs of the child and the family. The long-term goal is the optimal functioning in adulthood[3].

The family centred approach involves drawing on the life expertise of family members and other care-givers who are involved in the patient's life. Realising that these individuals are the ones most intimately familiar with the patient's overall health, it would be remiss to not involve them in the overall treatment programme[4,5].

Some habilitation programmes in Bosnia and Herzegovina have even included families as faculty members in educating medical professionals on the care and treatment of individuals with disabilities. Such persons not only have a great deal of knowledge regarding the patient, but often have unique and different perspectives on what may work best in terms of treatment. In this stage, families determine the interventions that are appropriate based on their knowledge of their child and their own circumstances.

Very often, interdisciplinary care is institution-based, so the children with CP needing some therapeutic intervention have to be hospitalised in order to obtain it, what means that they will be placed away from their families and absent from their schools and communities for extended period of time. The underlying assumption in these instances is that therapeutic procedures will generally prevent future limitation, enhance better quality of life and improve function or future participation in the society. But, for many children these short or long-term hospitalisations accumulate until they represent a pattern of lost opportunities[6].

In order to overcome this problem, different home-based habitation programmes, aiming to support and assist with the acquisition, retention, or improvement in skills for living successfully in the community through ongoing daily home programmes, have been introduced.

This study was undertaken with the aim to compare the effects of home-based habilitation programmes with the effects of hospital-based habilitation programme for children with CP on reducing the impairment and improving the function.

Materials and Methods:

This prospective study included sixty children with cerebral palsy divided into two groups. The first group consisted of 30 children, from Sarajevo region, who were included in the home-based habilitation programme after initial institutional treatment.

Before the hospital discharge, the members of interdisciplinary team have educated parents to address education and therapeutic needs of their child, through the individually tailored, daily home-based programme of physical, task-oriented and speech improvement exercises.

During the first six weeks, the home-based habilitation programme included daily visits by physiotherapists to a child and family at home, helping family members to adopt and to comply with the programme activities.

During the next three years, the parents themselves continued to provide the treatment programme for their children, which consisted of physical therapy based on Bobath concept, occupational therapy focusing on everyday tasks and emotional resources and speech therapy. Beside three patients with spastic CP who were receiving botulinum toxin injections annually, none of other children used any kind of medications. The treatment programme was followed by the GPs and community-based nurses.

Every six months, children were referred to community-based rehabilitation centres or local hospitals for follow up, additional physical treatments, occupational and speech therapy and orthopaedic consultation or treatment, respectively. The children attended school for the children with special needs.

This programme was conducted in the period from 2008 to 2011.

The second group consisted of 30 children, from Banja Luka region, who continued inpatient habilitation programme and training in institution for physical medicine and rehabilitation, including the daily individual work with a physical therapist, occupational therapists, special educators, psychologists, speech therapists and orthopaedists.

Matching of the children in the two groups was performed with predefined inclusion and exclusion criteria. Inclusion criteria were children with a diagnosis of CP, aged 5-12 years. Exclusion criteria were severe mental retardation defined ($IQ<020$) according to International Classification of Diseases[7], severe visual impairment and severe hearing impairment.

Habilitation outcomes were analysed by measuring muscle tone (using original Tardieu Scale)[8,9], muscle strength, range of motion (ROM), gross motor functions (gross motor function measure-88)[10] and the Barthel Index of activities of daily living (ADL)[11]. Intellectual functions were assessed using the standardised set of tests. Clinical assessments and examinations were done at the beginning of habilitation programmes and three years later.

Data obtained from the clinical examination was recorded and interpreted.

Chi-square test was done to see proportion of change. All analyses were performed using the SPSS statistical software package.

Results:

Male:female ratio 39 : 21.

Majority of the children had spastic type of CP (88%). Mental retardation was found in 27 children (45%) (Table 1).

The proportion of change on GMFM-88 total score and dimension A-E after the period of three years did not show any statistically significant difference between two groups (Table 2).

There were no statistically significiant differences between the children with normal intelligence and different degree of mental retardation when it came to GMFM-88 total score (p>0.5).

The parent who took the role of care-giver in home-based habilitation programme was the mother in all 30 children involved with the programme. Four mothers (13%) had basic or primary school education (8 grades), 17 (57%) high school education and 9 (30%) held a university degree.

The most significant improvement was found in the children whose mothers had university education (Fig 1).

Mucle tone of both legs and left arm was significantly

Table 1: *Distribution of Children according to the Type of Cerebral Palsy and Degree of Mental Retardation*

Type of cerebral palsy	Home-based habilitation programme			Hospital-based habilitation programme		
	Normal intelligence N (%)	Mild MR N (%)	Moderate MR N (%)	Normal intelligence N (%)	Mild MR N (%)	Moderate MR N (%)
Spastic	14 (47%)	8 (27%)	4 (14%)	12 (40%)	12 (40%)	3 (10%)
Ataxic	1 (3%)	0	1 (3%)	0	2 (7%)	0
Athetoid	1 (3%)	0	0	0	0	1 (3%)
Mixed	1 (3%)	0	0	0	0	0

Table 2: *A Comparison of the Proportion of Change on GMFM-88 Total Score and Dimension A-E after the Period of Three Years for Both Groups*

GMFM-88	Change	Home-based habilitation	Hospital-based habilitation	Chi-square	P-value
Total score	Improved Unchanged Deterioration	8 22 0	10 20 0	3,471	0.05
Lying and rolling	Improved Unchanged Deterioration	16 14 0	17 13 0	0,0673	0.5
Sitting	Improved Unchanged Deterioration	7 23 0	9 21 0	0,14066	0.5
Crawling, kneeling	Improved Unchanged Deterioration	6 24 0	8 22 0	0,37267	0.5
Standing	Improved Unchanged Deterioration	10 20 0	8 22 0	0,31746	0.5
Walk, run, jump	Improved Unchanged Deterioration	8 19 3	10 19 1	0,15098	0.5

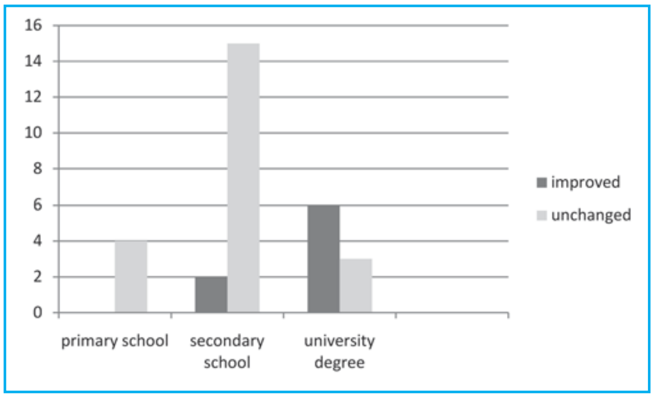


Fig 1- *The Proportion of Change on GMFM-88 Total Score according to the Care-giver's Education*

higher in children who were included in home-based habilitation programme after three years, while the proportion of change on muscle strength and range of motion was not statistically significant (Table 3).

The proportion of change on bathing and managing the stairs was statistically different between the groups, while the proportion on change on bowel, bladder managing, toileting, feeding, mobility, transfer and dressing was not statistically different between two groups after three years (Table 4).

There were no statistically significiant differences between the children with different degree of mental retardation when it came to the proportion of change on the ADL.

Proportion of change in intelectual functioning was statistically different between the groups (Hi^2 20.37, for df 1 and p 0.005). Children on home-based habilitation treatment had more significant improvement in intelectual functioning compared with the group treated in the hospital.

Discussion:

Although the survey group who had home care had observable higher muscle tone and were less independent in bathing and managing the stairs, the proportion of change in gross motor function, muscle strength, ROM and other daily functions was not statistically significant between the two groups after the period of three years.

The parents were key participants in the team and were very important in the child's development, and the integration of their knowledge and experience in the rehabilitation process was beneficial to the child's physical therapy, mental development, and socialization (tasks are more often successfully completed at home than under the observation of others in an institutional setting). In any case, the treatment of CP represents a long and exhausting process that requires close collaboration of an interdisciplinary team along with the parents, as indicated by the fact that children who are treated at home and had the opportunity of regular follow-up with a physical medicine doctor and occasional participation in outpatient physical treatment showed better functional progress and significant reduction in muscle tone than children who didn't have the same opportunity.

Although the sample size was small, the level of care-giver's education was an important factor in the whole process of habilitation. Many families develop the power needed to effectively overcome the problems that occur with CP, but a number of parents are not able to adapt to the needs of a child with development disabilities and to the demands of the new socio-economic conditions which lead to a lack of co-operation with other team members and neglect of the whole rehabilitation process. The problem of lack of co-operation of the parents has become more extensive over the last few years due to the restrictions put in place by the Health Department and a lack of education of parents about the nature and course of the disease, the available forms of treatment, and the available forms of treatment that a child with CP can obtain. The need for continuing education through collaboration with the parents which is indicated by the fact that the majority of parents of children who were treated at home realise that professional help in physical therapy leads to a more effective rehabilitation, ease of care, lessening liability and offers the opportunity to be better informed.

Rehabilitation organisations and clinics base their treatment on interdisciplinary collaboration of experts and offers along with other things, a greater possibility of integration of therapies which is most often lacking in home care and which could have significant impact on muscle tone reduction.

According to the literature, mothers of children with developmental disabilities spend more time feeding, clothing and bathing than mothers of children who are developing normally. Over time an overprotective relationship by the parents develops leading to the lessening of the child's independence. Occupation and work therapy are helpful in the assessment and treatment of functional limitations which have an effect on performing fine motor skills, cognitive and perceptual development as well as psychosocial adaptation essential for the acquisition of self-care skills. By selecting

Table 3: *A Comparison of the Proportion of Change in Muscle Tone, Musle Strength and ROM after the Period of Three Years for Both Groups*

Measure	Change	Home-based habilitation	Hospital-based habilitation	Chi-square	P-value
Muscle tone					
Left arm	Improved	9	17	7,77	0.02
	Unchanged	16	13		
	Deterioration	5	0		
Right arm	Improved	12	17	5,86	0.5
	Unchanged	13	13		
	Deterioration	5	0		
Left leg	Improved	9	15	6,53	0.02
	Unchanged	16	15		
	Deterioration	5	0		
Right leg	Improved	9	19	9,5	0.001
	Unchanged	16	11		
	Deterioration	5	0		
Muscle strength					
Left arm	Improved	14	17	0,6	0.5
	Unchanged	16	13		
	Deterioration	0	0		
Right arm	Improved	17	17	0,00	0.5
	Unchanged	13	13		
	Deterioration	0	0		
Left leg	Improved	14	15	0,07	0.5
	Unchanged	16	15		
	Deterioration	0	0		
Rigt leg	Improved	14	19	1,68	0,4317
	Unchanged	16	11		
	Deterioration	0	0		
Range of motion					
Left arm	Improved	14	17	0,6	0.5
	Unchanged	16	13		
	Deterioration	0	0		
Right arm	Improved	17	17	0,00	0.5
	Unchanged	13	13		
	Deterioration	0	0		
Left leg	Improved	14	15	0,07	0.5
	Unchanged	16	15		
	Deterioration	0	0		
Right leg	Improved	14	19	1,68	0,4317
	Unchanged	16	11		
	Deterioration	0	0		

stimulating objects and activities, by education and support services to parents, the therapist encourage the introduction of therapeutic principles and techniques in their activities of daily living. Occupational therapy in rehabilitation centres is one of the basic components of habilitation and rehabilitation, while in a home care setting it is often neglected due to a lack of co-operation between the therapist and the parents after inpatient treatment as well as the limited number of outpatient occupational therapy clinic in the primary care setting. The opportunity to have home-based occupational therapy visits or outpatient consultations is an important factor for improving the effectiveness of home treatment[12-14].

The estimates of the initial and highest achieved levels of intellectual functioning were significantly different

Table 4: *A Comparison of the Proportion of Change on the ADL after the Period of Three Years for Both Groups*

ADL	Change	Home-based habilitation	Home-based habilitation	Chi-square	P-value
Bowels	Improved Unchanged Deterioration	12 18 0	14 16 0	0,27149	0.01
Bladder	Improved Unchanged Deterioration	12 18 0	14 16 0	0,27149	0.01
Grooming	Improved Unchanged Deterioration	12 18 0	14 16 0	0,27149	0.5
Toileting	Improved Unchanged Deterioration	12 18 0	14 16 0	0,27149	0.5
Feeding	Improved Unchanged Deterioration	10 18 2	11 19 0	0,00568	0.5
Dressing	Improved Unchanged Deterioration	12 18 0	14 16 0	0,27149	0.5
Transfer	Improved Unchanged Deterioration	10 20 0	8 22 0	0,31746	0.5
Mobility	Improved Unchanged Deterioration	8 19 3	10 19 1	0,15098	0.5
Stairs	Improved Unchanged Deterioration	6 21 3	14 16 0	6.88	0.02
Bathing	Improved Unchanged Deterioration	6 22 2	13 17 0	5.22	0.05

between the experimental and control groups. The mental development of children in home care was faster (and they had equally developing character) indicating the important role of the family in the process of cognitive and social development. It is interesting to note that children from families with three or four senior members of the household (total number of respondents) showed the most significant improvement over the three-year follow-up rehabilitation in terms of intellectual functioning and independence. Multiple stimulations through various activities lead to better adaptation of the child to the environment and positive responses to it as well, and the majority of authors agree that the home care setting is much more stimulating than the conditions that the best rehabilitation centre can offer[15-17].

The patients who had neurological symptoms diagnosed in the first or second month of life, and then included in a rehabilitation treatment programme, showed significant functional improvement compared with the patients where cerebral damage was diagnosed after the first year of life. The experiences of various authors suggest that the success of rehabilitation of children with CP depends primarily on the age of the child when their rehabilitation began and then on the severity of damage. The patients of this study with severe brain damage (quadriplegia), involved in rehabilitation during the first three months of life, began walking by early adolescent and fully or partially mastered the activities of daily living. In the first three months of life, a child with cerebral damage does not show any abnormal activities nor has developed motoric symptoms which allows for the development of normal positioning and movement. Whereas an older child comes with already established abnormal behaviours, cerebral damage is more complicated and their progress is slower. As a result, there is a need for a process of thorough psychomotor screening for every child in the primary care setting in order to identify neurological symptoms and provide the opportunity of early inclusion in treatment[18].

Conclusion:

There were no major differences in effectiveness between home-based and hospital-based habilitation programmes according to outcomes on motor performance and daily functioning.

The effectiveness of home-based programme increases when supplemented by frequent consultations with the rehabilitation team members and occasional outpatient physical therapy treatment, continuing and comprehensive education as well as counselling and support for parents.

Home-based programmes should be rigorous, daily, and stimulating with the goal of eliciting co-operation from the child, encouraging development as the child grows and tailored to the priorities of the family.

Family members are cornerstone in the process of motor, cognitive and social development.

Acknowledgement:

We would like to take this opportunity to extend our highest gratitude to Prof Gordana Nikolic for offering us the opportunity to pursue this postgraduate programme through which we have widened our knowledge in the field of physical medicine and rehabilitation.

Conflict of Interest: The authors declare no conflict of interest.

Carry home message: Rigorous home-based habilitation programmes supplemented by frequent consultations with interdisciplinary team members and outpatient physical treatments, represents an immensely effective medical treatment of children with CP.

References:

1. Dormans J, Pellegrino L. Caring for Children with Cerebral Palsy: A Team Approach. Baltimore: Paul H Brookes Publishing, 1998.
2. Nelson KB. The epidemiology and etiology of cerebral palsy. In: Capute AJ, Accardo PJ, editors. Developmental Disabilities in Infancy and Childhood: The Spectrum of Delopmental Disabilities. Baltimore: Paul H Brookes Publishing Co, 1996: 73-9.
3. Farrell SE, Pimentel AE. Interdisciplinary team process in developmental disabilities. In: Capute AJ, Accardo PJ, editors. Developmental Disabilities in Infancy and Childhood. Vol I. The Spectrum of Delopmental Disabilities. 2nd ed. Baltimore: Paul H. Brookes Publishing Co, 1995: 431-41.
4. Duns CJ, Hamby D, Trivette CM, Raab M, Bruder MB. Every-day family and community life and children's naturally occurring learning opportunities. *JEI* 2000; **23:** 151-64.
5. Gallimore R, Keogh BK, Bernheimer LP. The nature and long-term implications of early developmental delays: a summary of evidence from two longitudinal studies. In: Glidden LM, editor. International Review of Research in Mental Retardation. San Diego: Academic Press, 1999: 105-135.
6. Gallimore R, Weisner TS, Bernheimer LP, Guthrie D, Nihira K. Family responses to young children with developmental delays: accommodation activity in ecological and cultural context. *AJMR* 1993; **98:** 185-206.
7. World Health Organisation. WHO ICD-10: International Statistical Classification of Diseases and Related Health Problems. Vol I. Geneva: World Health Organisation, 1992.
8. Tardieu G, Shentoub S, Delarue R. A la recherché d'une technique de mesure de la spasticite. *Rev Neurol* 1954; **91:** 143-4.
9. Salehi Dehno N, Noorizadeh Dehkordi S, Dadgoo M, Salehi M, Meftahi N. Inter rater reliability of the Modified Tardieu Scale in the assessment of spasticity in adults with cerebral palsy. *Mod Rehabil* 2012; **6:** 3.
10. Wood E, Rosenbaum P. The gross motor function classification system for cerebral palsy: a study of reliability and stability over time. *Dev Med Child Neurol* 2000; **42:** 292-6.
11. Collin C, Wade DT, Davies S, Horne V. The Barthel ADL Index: a reliability study. *Int Disabil Stud Dis* 1988; **10:** 61-3.
12. Guyard A, Fauconnier J, Mermet MA, Cans C. Impact on parents of cerebral palsy in children: a literature review. *Arch Pediatr* 2011; **18:** 204-14.
13. Light J, McNaughton D. Supporting the communication, language, and literacy development of children with complex communication needs: state of the science and future research priorities. *Assist Technol* 2011; **24:** 34-44.
14. Lin KC, Wang TN, Wu CY, Chen CL, Chang KC, Lin YC, Chen YJ. Effects of home-based constraint-induced therapy versus dose-matched control intervention on functional outcomes and caregiver well-being in children with cerebral palsy. *Res Dev Disabil* 2011; **32:** 1483-91.
15. Smits DW, Ketelaar M, Gorter JW, van Schie PE, Becher JG, Lindeman E *et al*. Development of non-verbal intellectual capacity in school-age children with cerebral palsy. *J Intellect Disabil Res* 2011; **55:** 550-62.
16. Smits DW, Ketelaar M, Gorter JW, van Schie P, Dallmeijer A, Jongmans M *et al*. Development of daily activities in school-age children with cerebral palsy. *Res Dev Disabil* 2011; **32:** 222-34.
17. Dahlgren Sandberg A, Smith M, Larsson M. An analysis of reading and spelling abilities of children using AAC: understanding a continuum of competence. *Augment Altern Commun* 2010; **26:** 191-202.
18. Poposka A, Georgieva D, Dzoleva-Tolevska R, Georgiev A. Prevention, management and rehabilitation of patients with cerebral palsy. *Prilozi* 2012; **33:** 153-61.

INDIAN ASSOCIATION OF PHYSICAL MEDICINE & REHABILITATION
EXECUTIVE COUNCIL 2013 - 2015

Frequency : Quarterly **ISSN0973-2209**

Full text of the Journal and Guidelines to the contributors are available on website.

Subscription :

Annual subscription is Rs 2000/- (India) and US $ 200 (other countries). Kindly send your request for subscription to the editor along with DD/ Cheque at par in favour of "Indian Journal of PMR" payable at Kolkata. Overseas per hardcopy 50$.

The journal is despatched in India by surface mail and abroad by sea mail.

Correspondence :

Editorial Office :

Prof (Dr) Rathindranath Haldar
Department of Physical Medicine & Rehabilitation,
Institute of Post Graduate Medical Education & Research & SSKM Hospital,
244, AJC Bose Road, Kolkata - 700020.
E-mail:indianjournalofpmr@gmail.com Phone no : 00 91 9830152173

Visit us :

www.ijpmr.com and www.iapmr.org/ijpmr

Editorial

World Health Day 2014: Preventing Vector-borne Diseases

“Small Bite, Big Threat”

World Health Day is on the 7th of April each year. This day marks the anniversary of the World Health Organization which was founded in 1948. WHO is the leading global health authority and the work is summarized through their 6 point agenda. *Promote Development, Fosters Health Security, Strengthens Health Systems, Harnesses information, research and evidence, Enhances Partnerships, Improves Performance.*

WHO use the anniversary of the founding day not only as an opportunity to celebrate the organization and its work but also as an opportunity to highlight a current global health priority. For each World Health Day, WHO designates a health challenge or theme. This year theme is **“Preventing Vector - borne diseases”.**

More than half the world’s population is at risk from diseases such as malaria, dengue, leishmaniasis, Lyme disease, schistosomiasis, and yellow fever, carried by mosquitoes, flies, ticks, water snails and other vectors. Every year, more than one billion people are infected and more than one million die from vector-borne diseases.

This World Health Day – 7 April – WHO is highlighting the serious and increasing threat of vector-borne diseases, with the slogan **“Small bite, big threat”.**

The Organization also emphasizes that these diseases are entirely preventable. Newly published “A global brief on vector-borne diseases” outlines steps that governments, community groups and families can all take to protect people from infection.

Schistosomiasis, transmitted by water snails, is the most widespread of all vector-borne diseases, affecting almost 240 million people worldwide. Children living and playing near infested water are particularly vulnerable to this disease which causes anaemia and a reduced ability to learn. Schistosomiasis can be controlled through regular mass treatment of at-risk groups with a safe, effective medicine, as well as improving access to safe drinking water and sanitation.

Within the past two decades, many important vector-borne diseases have also re-emerged or spread to new parts of the world. Environmental changes, a massive increase in international travel and trade, changes in agricultural practices and rapid unplanned urbanization are causing an increase in the number and spread of many vectors worldwide and making new groups of people, notably tourists and business travellers, vulnerable.

Mosquito-borne dengue, for example, is now found in 100 countries, putting more than 2.5 billion people - over 40% of the world’s population - at risk. Dengue has recently been reported in China, Portugal and the state of Florida, in the United States of America.

Reports from Greece say that malaria has returned there for the first time in 40 years. This highlights the continual threat of reintroduction and the need for continued vigilance to ensure that any malaria resurgence can be rapidly contained.

On World Health Day 2014, WHO is calling for a renewed focus on vector control and better provision of safe water, sanitation and hygiene – key strategies outlined in WHO’s 2011 Roadmap for the control, elimination and eradication of neglected tropical diseases, which sets targets for the period 2012–2020.

The job and responsibility of a physiatrist is two fold, firstly as a primary physician to prevent the disease occurrence and secondly as a specialist to treat the victims for their disability and proper rehabilitation in the society.

Last but not the least, the Editorial Board proudly and delightfully announces the celebration of 25th birth day of our beloved IJPMR, and observing year 2014 as Silver Jubilee year of publication. The present Editorial Board also acknowledges the contribution of past Editorial Boards and strongly believes that new look IJPMR will be able to fulfil the expectation of the members and readers.

– R. N. Haldar

Medical Philately

Almost 2 million participated in clinical trials of the Salk vaccination. By 1957 the numbers of polio cases were dramatically falling. It was time for a victory stamp. Note that it says "Honouring those who helped fight polio" not "Honouring those who are helping fight polio". It was clear that the fight had been won. Scott #1088 commemorates the 150th anniversary of the Coast and Geodetic Survey.

India - Scott No. 1712
Pulse Polio Immunization Denomination: 3r. Year of Issue: 1998.
Lot No. IND1712-01

Obituary

Dr Sudhir Kumar Banerjee

Dr. Sudhir Kumar Banerjee was born on 1st February 1922. He had done his medical graduation from Calcutta Medical College & Hospital, Kolkata. After working for five years in the department of surgery, he proceeded to England and acquired D. Phys. Med. (Eng) from Royal College of Physicians and Surgeons in1957.

He served as consultant physiatrist in B.C. Roy Polio Clinic and Hospital for crippled children and since then got associated with Eastern Railway Orthopaedic Hospital, K.P.N.R. Group of Hospitals (now known as NIOH), Institute of Child Health and many other institute.

He played a pivotal role in organising and teaching MD (Physical Medicine and Rehabilitation) under University of Calcutta. He was also associated with National Board of Examination and UPSC as an expert. He was a past president of IAPMR, Rehabilitation India and one of the founder member of IAPMR West Bengal branch. 7, Lord Sinha Road, Kolkata was a landmark place in the map of IAPMR West Bengal Branch, where his pleasant personality healed the suffering of ailing present. He was a senior member of prestigious Calcutta Club & Anderson Club. He was also a central figure of Durga Puja Committee of famous Mudiali Sporting Club of South Kolkata.

Our fraternity was orphaned on 10th February, 2014 by the passing of Dr. S.K. Banerjee, The Teacher of Teachers.

We are sure that, though he will not be with us in person, yet his blessings will continue to be showered on us to guide us.

We pray to almighty for his eternal peace and convey our sincere condolence to his bereaved family.

Pictorial CME

Mononeuritis Multiplex Along with Vasculitis

Pramanik R[1], Das P[2]

A 35 year female presented to PMR OPD with severe tingling and electric shock like pain in her both legs for last fifteen days. On closed questioner she also gave the history of arthralgia and low grade fever for last few months. She took homeopathy medicines for her joint pain and pyrexia. She also complained about painful skin lesion on her feet and legs for last five days. (Figs 1 & 2).

On inspection in our OPD multiple discrete tender macula-papular rashes like vasculitis were noticed. On thorough examination we also picked up butterfly type malar rashes over face (Fig 3) and few oral ulcers. She was not suffering from any alopecia, discoid rashes, serositis, psychosis and convulsion.

On investigation Hb% was 7.6 (normochromic normocytic type) and ESR was 86. Her ANF and AntiDsDNA were positive. Electrophysiological testing was suggestive of mononeuritis multiplex. Although her leg pain was not controlled sufficiently with pregabalin, amitryptiline and TENS, she became pain free with pregabalin and TENS along with the control of specific medications for systemic lupus erythromatosis like prednisolone, hydroxychloroquine and azathioprine.

Fig 1

Fig 2

[redacted]

Fig 3

Author's affiliations:
1 MD, MRCP (UK), PMR, IPGMER, Kolkata, Associate Professor
2 MD, PMR, BMC, Burdwan, Associate Proferror

Cite as :
Pramanik R, Das P. Mononeuritis multiplex along with vasculitis. *IJPMR March 2014*; Vol **25 (1):** 30.

Post Polio Syndrome: Report of 3 Cases and Brief Review of Literature

Gogia Virinder S[1], Singh U[2]

Abstract

Post polio syndrome, a well-recognised clinical entity now, has become a great challenge to the medical and surgical rehabilitation professionals, as more and more paralytic polio survivors age into fourth to sixth decades of their lives. Early diagnosis and timely rehabilitation of a person with post polio syndrome is important because at around this age one is just reaching the prime of one's productive life and starts consolidating socio-economic status of self and the family. There is paucity of literature or case reports on post polio syndrome from India. Here we report three cases of post polio syndrome in their forties and early fifties, attending outpatient rehabilitation programme. Their clinical presentation, rehabilitation management and outcome have been discussed. Diagnostic criteria and possible pitfalls in diagnosis in the light of available literature have been emphasised.

Key words: **Paralytic poliomyelitis, post polio syndrome, fatigue, strengthening exercise, muscle, joint, ADL, ambulation.**

Introduction

Following polio eradication measures on war footing through Universal Immunisation, "Pulse Polio" programme etc, the incidence of fresh cases has come down to practically zero. Studies[1-3] suggest that one-fourth to one-third of persons who had paralytic polio in the past may be experiencing post polio syndrome (PPS) at the present time. This proportion is likely to increase as these persons age into fourth to sixth decades of their lives with better health care services and rehabilitation. At around this age one is just reaching the prime of one's productive life and starts consolidating socio-economic status of self and the family. That is how; PPS has become a great challenge to the medical and surgical rehabilitation professionals. Considering the age and stage of one's career, early diagnosis and timely rehabilitation of a person with PPS is very important. Here 3 cases are reported with brief review of literature to emphasise the need for high index of suspicion while dealing with post polio persons.

Author's affiliations:
1 M.B.B.S., D.Orth., Dip.N.B. (P.M.R.), M.N.A.M.S., Assistant Professor
Department of Physical & Rehabilitation Medicine, Postgraduate Institute of Medical Education & Research, Sector-12, Chandigarh
2 M.B.B.S., D.P.M.R., Dip.N.B. (P.M.R.), Professor and Head of the Department
Department of Physical Medicine and Rehabilitation, All India Institute of Medical Sciences, Ansari Nagar, New Delhi

Cite as:
Gogia Virinder S, Singh U. Post Polio Syndrome: Report of 3 Cases and Brief Review of Literature. *IJPMR March 2014*; Vol **25 (1):** 22-6.

Correspondence:
Dr. Virinder S. Gogia, Assistant Professor
Department of Physical & Rehabilitation Medicine
Postgraduate Institute of Medical Education & Research
Sector-12, Chandigarh-160 012 India
Phone: +91-172-2756913, 6912, Mobile: +91-9478667738
Email: vsg.pgimer@gmail.com, drvsgogia@gmail.com.

Received on 25/04/2011, Revised on 02/01/2014, Accepted on 15/01/2014

Case No 1

A 50 years old, male executive with a corporate entity and a known case of post polio residual paralysis (PPRP) since the age of three years, having involvement of right upper and left lower limbs. He presented with complaints of weakness in the sound right lower limb leading to difficulty in walking and more fatigability for 3 months before consultation in this OPD. He did not remember having weakness in the right lower limb previously. He also complained of difficulty in climbing stairs, performing self-care and personal hygiene (toileting) activities, which he was able to do previously. Before that, he was ambulatory without any aids or appliances. He had good muscle strength around shoulder and elbow on the affected side but poor in the hand. The left lower limb was flail. Quadriceps on the previously unaffected side (right lower limb) was found to be grade 3/5. He had got electromyography (EMG) studies done before reporting to us, which showed fasciculations and normal nerve conduction velocities (NCV) and was earlier labeled as motor neuron disease (MND). A repeat EMG study showed no fasciculations and normal NCVs. Magnetic resonance imaging (MRI) of dorso-lumbar spine was also done to rule out any spinal pathology but it was normal. Hence a diagnosis of PPS was arrived at and he was put on rehabilitation programme. He was given graded, non-tiring strengthening, power maintenance exercises, and a little modification in lifestyle in the form of breaking long tiring activities into smaller stages so as to avoid fatigue/exhaustion. After one month, he had started showing appreciable improvement and then at the end of a year and a half follow-up he had got his right quadriceps improved to 4/5. The patient, however, did not show much of improvement in his activities of daily living (ADL).

Case No 2

The second case was a 54 years old, male hospital employee. He was a known case of PPRP since early childhood, having flail left lower limb with normal upper and right lower limbs. He was independent in ambulation without any aids or orthotic support. He sustained fracture of left tibial condyle (polio affected side) two years ago for which he was immobilised in plaster of Paris (POP) cast and confined to bed for eight months. After removal of plaster, he continued to be on prolonged rest. This resulted in a flexion contracture of left knee and fresh weakness in the right lower limb following deconditioning. After correction of the flexion deformity of the knee by stretching, he was fitted with left knee ankle foot orthosis (KAFO) since he could not manage to walk as he did prior to injury with trick movements balancing on the left lower limb while walking and ambulated with bilateral crutches. The acceptability to the orthosis was poor. After much persuassion and counselling, he put on the caliper. However, he was still unable to stand and walk due to added weakness in the right lower limb (contralateral side) with power in the right knee extensors to around 3. In addition, he had serious psychosocial problems as well, being single and deserted by the brother and sister-in-law. He lost self-confidence and was never sure of attaining the same pre-injury functional status. He also became depressed and started harbouring suicidal tendencies. Despite a lot of counselling from clinical psychologist and even psychiatric intervention he refused to return to work and finally abandoned the job. Ultimately he resorted to begging on tricycle. He used to roam in open and sleep on the road only, wherever and whenever he felt like. One fine morning he was found dead on the roadside.

Case No 3

The third case was a 48 years old housewife and engaged in desk job in an office. She was a known case of PPRP since the age of 5 years having involvement of both the lower limbs. She presented with complaints of extra weakness and fatigability noticed, during the last few months. She had started feeling difficulty in walking, was unable to climb the bus and stairs. Over the period she became even unable to walk and had to take leave from her job leading to further disuse and de-conditioning. The problems used to be more pronounced towards the afternoon and evening. She was ambulatory without any aid or appliance for more than thirty years before the onset of these problems and used to go to her office on foot and by city bus. On examination her muscle power in both the lower limbs was in the range of 2 to 4 with antigravity muscles being >3. She was advised non-fatiguing endurance enhancing exercises and to use crutches. After 8 weeks on this regimen she could regain her pre morbid functional status and resumed attending her office, of course, with crutches added as an aid.

Discussion:

There are many terms given to the problems faced by post polio patients. These include “late-onset poliomyelitis progressive muscular atrophy,” “late progressive post poliomyelitis muscular atrophy,” “late post poliomyelitis muscular atrophy,” “progressive post polio atrophy” and “progressive post poliomyelitis muscular atrophy”[4-8]. The empirical research data is lacking that can indicate progressive atrophy or rapid decline in strength hence the term **“post polio syndrome”** has been agreed upon universally to better describe the complaints and findings of polio survivors and does not make unfounded presumptions. PPS is essentially a diagnosis of exclusion[9] and can be arrived at through the following diagnostic criteria.

Post Polio Syndrome: Diagnostic Criteria

1. A confirmed history of paralytic polio.
2. Partial to fairly complete neurologic and functional recovery.
3. A period of neurologic and functional stability of at least 15 years duration.

4. Onset of two or more of the following health problems since achieving a period of stability:
    - i. Unaccustomed fatigue.
    - ii. Muscle and/or joint pain.
    - iii. New weakness in previously affected or unaffected muscles.
    - iv. Functional loss.
    - v. Cold intolerance.
    - vi. New atrophy.
5. No other medical diagnosis to explain these health problems.

The last criterion is very important and calls for a high index of suspicion on clinician's part while dealing with a post polio person. The second case had a clinical condition of fracture on the affected side which was duly treated. However, his continued rest perhaps led to apparent deconditioning and probably fresh weakness on the contralateral side due to post polio syndrome. Assigning the tag of post polio syndrome in this case won't be wrong since the disuse atrophy usually does not get that worse. Had it just been disuse atrophy, it would have affected all the muscle groups in the contralateral lower extremity than just quadriceps being affected mainly. Moreover, the right quadriceps had been subjected to years of overuse since he had not been using any orthotic support on flail left lower limb nor any walking aid for so many years. This might have surfaced up relatively rapidly due to post polio syndrome when the patient was not performing the walking and other day to day activities. This probably added to his going into depression and withdrawal from the ADL and work activities, leading to the painful period, prior towards the end to his life. Despite his being a hospital employee getting all the rehabilitation help, he could not come out of the situation and was a failed case of rehabilitation.

In all the three cases reported, routine haemogram, liver and renal function tests, blood sugar profiles and urine exams were done to rule out other likely diagnoses to explain these problems. Frequent clinical diagnoses given to such patients include muscle pain related to over-activity, overuse or myofascial pain, joint pain related to arthritis or mechanical problems in joints less well protected by weakened muscles. In 3 large patient series[9-11], frequently encountered complaints in these patients included fatigue (86-89%), muscle pains (71-86%), joint pains (71-79%), weakness in previously affected muscles (69-89%) and in unaffected muscles (50-77%). Other complaints also included[9,11] cold intolerance (29 and 56%) and atrophy (28 and 39%). The common ADL complaints included,[9,10] problems in walking (64-85%), stair climbing (61-83%)[9-11] and dressing (16-62%)[9-11].

Rehabilitation Management:

The treatment of PPS is based on evaluation of the individual situation. No two such cases are same in respect of symptomatology, severity and extent of involvement and in other demographic and socio-vocational aspects. Fatigue is a common problem. The cause of this complaint may be unknown or central in origin in at least some of the patients. Halstead and Rossi[10], in a survey of 539 polio survivors, reported that complaint of fatigue was significantly relieved by increasing the rest time, napping or reducing the overall activity level through the day. The most frequent rehabilitation interventions advised to PPS patients in two large series[9,11], included new or modified aids (87%)[9], that included durable products used to improve posture, diminish pain and enhance comfort, like corsets, lumber rolls, neck pillows, wheelchair positioners, canes and crutches. Other prescribed measures included, energy conservation techniques (64 and 73%), change in exercise programme (64%), change in orthoses (52 and 34%), weight loss (52 and 27%), new/ modified wheelchair (26%), gentle exercise programme[11], comprising aerobic (23%), stretching (46%) and strengthening (43%) exercises.

In addition to these measures almost all patients received counselling on the need to reduce stress in their lives– both physical as well as emotional[9]. Psychological counseling or participation in a post polio support group to learn new coping skills was also recommended for many patients[11].

The role of exercises on PPS patients has been found controversial in the past. Some of the early studies[12,13] showed beneficial effects of strengthening exercises while others reported that vigorous exercise and activity were detrimental[14-17]. However, a number of recent studies on effects of muscle strengthening exercises[18-21], general exercises or aerobic fitness training[22,23], efficiency of movement[24] and on aquatic exercises[25] reveal that it is the individualised and judicious exercise programme that is beneficial. It is found that that antigravity muscles and/or muscles having greater strength on manual muscle testing[26] can tolerate strengthening exercises[18-21]. Swimming and aquatic exercise may prove to be one of the best types of exercise in these persons as the buoyancy of the water reduces the effect of gravity on the patient's joints and limbs protecting them from overuse. The benefits can be seen in the form of improved muscle strength, cardio-respiratory fitness and the efficiency of ambulation in post polio patients. Achievement of benefits is further subject to avoidance of excessive fatigue and muscle and joint pains.

The main problem in prescribing any rehabilitation strategy lies in the uniqueness of each post polio patient. The physiatrist needs to make out patient-specific circumstances, including the location and degree of muscle weakness and that of subsequent arthralgia or arthropathy. Any rehabilitation programme should be aimed at protecting the involved joints and weakened musculature from overuse and the remaining joints and muscles that can withstand greater stress from disuse. Physiatrist has to strike a judicious balance of strengthening and reconditioning programme without tiring out the weaker muscles and stressing the joints. Deconditioning like leave from job, excessive rest at home should never be promoted as in second and third cases.

Rehabilitation Outcome

Compliance on part of the patient to clinical advice, made after physiatric evaluation, appears to be a crucial factor in determining outcome of the rehabilitation programme. Agre *et al*[11] reported improvement in 78% cases seen in follow-up while those who did not show any improvement were not compliant to the recommendations. Peach and Olejnik[27] also reported significant improvement in compliers out of 77 patients group divided into three groups of compliers, partial compliers and non-compliers. Four common symptoms, weakness, fatigue, muscle and joint pains were studied in this series. Nearly 100% of the complier group showed resolution or improvement in symptoms while nearly 100% of the non-complier group landed in no-change or increased symptoms category in these 4 symptoms. Patients, from partial complier group, were mostly in improvement category with significant minority in no-change category. This study concluded that patients who completely comply with clinical recommendations and could successfully control the factors responsible for the neuromuscular overuse did not lose muscle strength and had considerable improvement in symptoms. The results are summarised in Table 1.

Conclusions:

In all the three cases, it was noticed that fresh weakness and ADL problems cropped up in an otherwise settled life of a post polio survivor. Physiatrist has to be on guard to the possibility of PPS and avoid advising more than necessary rest from daily routine. Disuse further promotes weakness in PPS. At the same time exercise programme has to be tailored and customised for each individual patient to promote strengthening of involved muscles in such a way so as to prevent undue fatigability. Judicious exercise mix in the appropriate postpolio patient (the patient who can exercise and avoid undue

Table 1: *Symptom Status of Post Polio Patients at the Time of Follow-up (Average 2 years)*

Group and problems	No of cases	Resolved	Improved	No change	Increased
Complier group	30				
Weakness	23	17%	83%	0%	0%
Fatigue	28	4%	96%	0%	0%
Muscle pain	25	28%	72%	0%	0%
Joint pain	17	1%	53%	6%	0%
Partial complier group	32				
Weakness	29	0%	79%	21%	0%
Fatigue	31	0%	68%	29%	3%
Muscle pain	32	3%	88%	9%	0%
Joint pain	24	4%	83%	13%	0%
Non-complier group	15				
Weakness	14	0%	0%	64%	36%
Fatigue	14	0%	0%	64%	36%
Muscle pain	14	0%	14%	57%	29%
Joint pain	11	0%	0%	82%	18%

fatigue, muscle pain and arthralgia) is an important adjuvant to patient's overall therapeutic programme[28]. In addition, taking care of the psychosocial problem form an integral component of any successful rehabilitation programme, where we failed in the second case.

References:

1. Speir JL, Owen RR, Knapp M, Canine JK. Occurrence of post polio sequelae in an epidemic population. In: Halstead LS, Weichers DO, editors. Research and Clinical Aspects of the Late Effects of Poliomyelitis. White Plains, NY: March of Dimes Birth Defects Foundation, 1987: 39-48.
2. Codd MB, Mulder DW, Kurland LT, *et al*. Poliomyelitis in Rochester, Minnesota, 1935-1955: epidemiology and long term sequelae: a preliminary report: In: Late Effects of Poliomyelitis. Miami: Symposia Foundation, 1985: 121-34.
3. Ramlov J, Alexander M, LePorte R, *et al*. Epidemiology of post-polio syndrome. *Am J Epidemiol* 1992; **136**: 769-86.
4. Block HS, Wilbourn AJ. Progressive post polio atrophy: the EMG findings [abstract]. *Neurology* 1986; **36:** 137.
5. Dalakas MB, Elder, Hallat M, *et al.* A long-term follow-up study of patients with postpoliomyelitis neuromuscular symptoms. *N Engl J Med* 1986; **314**: 959-63.
6. Dalakas MC, Sever JL, Fletcher M, *et al*. Neuromuscular symptoms in-patients with post-poliomyelitis: clinical, virological and immunological studies. In: Late Effects of Poliomyelitis. Miami: Symposia Foundation, 1985: 73-90.
7. Dalakas MC, Sever JL, Madden DL, *et al*. Late post-poliomyelitis muscular atrophy: clinical, virological and immunological studies. *Rev Infect Dis* 1984; **6:** 562-7.
8. Kurent JE, Brooks BR, Madden DL, *et al*. CSF viral antibodies: evaluation in amyotrophic lateral sclerosis and late onset post-poliomyelitis progressive muscular atrophy. *Arch Neurol* 1979; **36**: 269-73.
9. Halstead LS, Rossi CD. Post-polio syndrome: clinical experience with 132 consecutive outpatients. In: Halstead LS, Weichers DO editors. Research and Clinical Aspects of the Late Effects of Poliomyelitis. White Plains, NY: March of Dimes Birth Defects Foundation, 1987: 13-26.
10. Halstead LS, Rossi CD. New problems in old polio patients: results of a survey of 539 polio survivors. *Orthopedics* 1985; **8**: 845-50.
11. Agre JC, Rodriquez AA, Sperling KB. Symptoms and clinical impressions of patients seen in post-polio clinic. *Arch Phys Med Rehabil* 1989; **70:** 367-70.
12. DeLorme TL, Schwab RS, Watkins AL. The response of the quadriceps femoris to progressive resistance exercises in poliomyelitis patients. *J Bone Joint Surg Am* 1948; **30**: 824-47.
13. Gurwitsch AD. Intensive graduated exercises in early infantile paralysis. *Arch Phys Med* 1950; **31**: 213-8.
14. Hyman G. Poliomyelitis. *Lancet* 1953; **i**: 852.
15. Knowlton GC, Bennett RL. Overwork. *Arch Phys Med Rehabil* 1957; **38**: 18-20.
16. Lovett RW. The treatment of infantile paralysis: preliminary report, based on a study of the Vermont epidemic of 1914. *JAMA* 1915; **64**: 2118-23.
17. Mitchell GP. Poliomyelitis and exercise. *Lancet* 1953; **ii**: 90-1.
18. Agre JC, Harmon RL, Carr JT, *et al*. Nonfatiguing muscle strengthening exercises can safely increase strength in post-polio patients. *Med Sci Sports Exerc* 1993; **25:** 5134.
19. Einarsson G. Muscle conditioning in late poliomyelitis. *Arch Phys Med Rehabil* 1991; **75:** 11-4.
20. Einarsson G, Grimby G. Strengthening exercises program in in post-polio subjects. In: Halstead LS, Weichers DO, editors. Research and Clinical Aspects of the Late Effects of Poliomyelitis. White Plains, NY: March of Dimes Birth Defects Foundation, 1987: 275-83.
21. Feldman RM, Soskolne CL. The use of nonfatiguing strengthening exercises in post-polio syndrome. In: Halstead LS, Weichers DO, editors. Research and Clinical Aspects of the Late Effects of Poliomyelitis. White Plains, NY: March of Dimes Birth Defects Foundation, 1987: 335-41.
22. Grimby G, Einarsson G. Post-polio management. CRC *Crit Rev Phys Med Rehabil* 1991; **2:** 189-200.
23. Jones DR, Speier J, Canine K, *et al*. Cardio respiratory responses to aerobic training by patients with post-poliomyelitis sequelae. *JAMA* 1989; **261:** 3255-8.
24. Dean E, Ross J. Effects of modified aerobic training on movement energetics in polio survivors. *Orthopedics* 1991; **14:** 1243-6.
25. Prins JH, Hurtung GH, Merritt DJ, *et al*. Effect of aquatic ecercisetrainig in persons with poliomyelitis disability. *Sports Med Training Rehabil* 1994; **5:** 29-39.
26. Medical Research Council. Aids to Examination of the Peripheral Nervous System. 2nd ed. Rev. War Memorandum No. 7. London: HMSO, 1943.
27. Peach PE, Olejnik S. Effect of treatment and non-compliance on post-polio sequelae. *Orthopedics* 1991; **14:** 1199-203.
28. Agre JC. The role of exercise in the patient with post-polio syndrome. *Ann NY Acad Sci* 1995; **753:** 321-34.

REHAB CHALLENGES

A 55 year old male driver by profession presented to PMR OPD with back pain and neck pain for last 3 months. He tried with several pain killers and muscle relaxants and got bit of pain relief. His X rays of cervical and lumbar spine (Fig 1, 2 & 3) were confirmatory of DISH (Diffuse Idiopathic Skeletal Hyperostosis) with normal sacroiliac joints. His ESR was 23 and CRP was negative.

Fig 1

Fig 2

Fig 3

On conservative management with exercise schedule and modalities the pain improved a lot but range of motion of spine was still very low. The patient was very much depressed because he lost his job due to inability to drive safely. On counselling he said that it was not at all possible to arrange owner's car modification and he was not trained for any other job.

Please opine regarding further rehabilitation plans including vocational rehabilitation.

PG Forum

REHAB QUIZ

1. **All are true about Fredrick ataxia except**
   A) Nystagmus
   B) Pes cavus
   C) Scoliosis
   D) Ophthalmoplegia

2. **Which is not true about unclassified spondyloarthropathy (USPA)**
   A) Females are common victims
   B) Onset in around 5th decade
   C) Mostly HLA B27 positive
   D) Dactilytis

3. **In fast walking, which one of the following is correct?**
   A) The trunk is inclined forward
   B) The period of double support is longer
   C) The step length is shorter
   D) The cadence is increased

4. **Which of the following is not characteristic of F wave?**
   A) Pathway involving only a motor fibre
   B) Does not disappear when a motor response is elicited
   C) Variable latency
   D) Longer latency than the H reflex of the same nerve muscle stimulation.

5. **The rigid dressing applied with immediate post surgical prosthesis benefits the patients mainly by**
   A) Assisting the patient to regain a better gait pattern.
   B) Assisting in primary closure of wound
   C) Preventing the swelling of stump
   D) Eliminating the need of a surgical drain

6. **Total hip arthroplasty is contraindicated in all of the following conditions except**
   A) Paretic gluteus medius
   B) Avascular necrosis
   C) Septic arthritis
   D) Neuropathic joint

7. **Port wine facial nevi, convulsion, calcified areas in cortex suggest the diagnoses of**
   A) Hemangioblastomas
   B) Von Recklinghausen's disease
   C) Sturge- Weber disease
   D) Tuberous sclerosis

8. **The propioceptive facilitation technique of irradiation requires**
   A) Passive movement
   B) Extrinsic stimulus
   C) Stretching
   D) Resistance

9. **Christmas tree appearance in fluoroscope is noticed in**
   A) Transforaminal epidural block
   B) Caudal epidural block
   C) Facet joint block
   D) Intralamilar epidural block.

10. **All are true regarding the doses guideline of botulinium toxin A for children except**
    A) Total maximum body dose per visit is 400 IU
    B) Maximum dose per large muscle per visit is 6 unit per kg
    C) Maximum dose per injection site is 80 unit.
    D) Reinjection is > = 3 months

ANSWERS

December 2013 issue:

1-B; **2**-A; **3**-D; **4**-A; **5**-D; **6**-B; **7**-D; **8**-C; **9**-B; **10**-C

Spinal Cord Injury in Decompression Sickness: A Case Report

Henry Prakash M[1], Ramaswamy Hariharan[2], Bobeena Chandy[3]

Abstract

Study Design: Case report.

Objective: To describe an unusual case of deep diving followed by spinal cord injury due to decompression sickness (DCS).

Setting: Princess Royal Spinal Injuries Centre, Sheffield Teaching Hospitals NHS Foundation Trust, England.

Method: Description and observation of management and outcomes, of spinal decompression sickness (DCS).

Results: The patient's symptoms and signs developed after she surfaced after a deep sea diving event. She was managed and treated in a tertiary level care hospital. MRI performed within 24 hours, showed signs of increased signal intensity in the cervical and thoracolumbar regions. She was treated with hyperbaric oxygen which improved her pain symptoms but there was no immediate resolution in motor sensory deficits. Repeat MRI done after a week showed resolution if hyperintensity in the cervical region but not in the thoracolumbar region. Patient progressed to have significant neurological recovery in the next 6 months. She became ambulant with unilateral ankle foot orthotic and a pair of crutches, she continued to have bladder incontinence at 1 year follow-up interval.

Conclusion: Central nervous involvement is not uncommon in decompression sickness in divers. Early diagnosis and proper management can reduce acute symptoms and prevent further complications of permanent neurological disability. Primary prevention by education and adhering to standard diving guidelines is needed to reduce mortality and morbidity in decompression sickness.

Keywords: **Decompression sickness (DCS), arterial gas embolism (AGE), patent foramen ovale (PFO), divers alert network (DAN).**

A 28 years old trained female certified diver with no significant past medical illness, felt unwell after controlled surfacing from depth of 20 metres. No history of injury during the dive. On surfacing she felt confused and had severe pain in her neck and shoulders. The pain was initially attributed to the heavy diving gear she was carrying but suspicion increased as her confusion continued for about 20 minutes. She progressed on to developed sensory loss predominantly noted on her left side with motor weakness on the right upper and lower limbs. She was unable to sit or weight bear, and developed incontinence of bladder. She was rushed to the local tertiary hospital where imaging with T2 weighted and STIR sequence of MRI revealed high signal intensity in the C2-C6 and T9-T10 cord segments (Fig 1).

Diagnosis of spinal decompression sickness was made. She was treated with hyperbaric oxygen following which there was significant improvement in her pain and alertness but the motor weakness and reduced sensations persisted. Subsequently progressive improvement was noted in the proximal muscle groups in the right upper and lower extremities. Repeat MRI done after ten days showed resolution of the hyperintensity in the T9/T10 segment but findings in the C2-C6 segment remained largely unchanged. MRI of the brain showed focal lesion on the right side of the splenium of the corpus callosum. She was transferred to a rehabilitation unit, where she

Author's affiliations:
[1] *DPMR, MD, DNB (PMR), Clinical Fellow*
[2] *DNB (PMR), CESR (RehabMed), Consultant*
[3] *MD DNB (PMR), Clinical Fellow*
Princess Royal Spinal Injuries Centre, Sheffield Teaching Hospitals, NHS Foundation Trust, England, S5 7AU

Cite as:
Henry Prakash M, Ramaswamy Hariharan, Bobeena Chandy. Spinal cord injury in decompression sickness: a case report. *IJPMR March 2014*; Vol **25 (1):** 18-21.

Correspondence:
Dr. Henry Prakash M, Management Corridor, Princess Royal Spinal Injuries Centre, Sheffield Teaching Hospitals, NHS Foundation Trust, Sheffield, S5 7HA, UK
Email: henry.cmcv@gmail.com

Received on 26/07/2013, Accepted on 07/03/2014

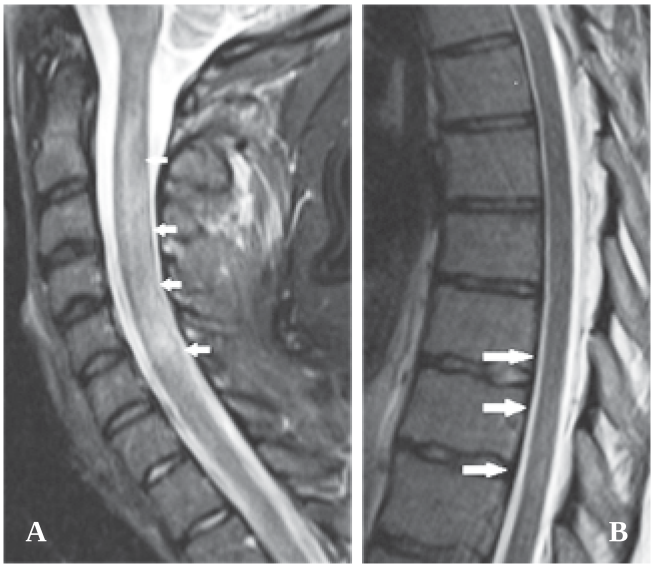


Fig 1- *MRI Showing High Signal Intensity in C_2-C_6 and T_9T_{10} Cord Segments*

continued to neurologically improve over the next few weeks. Following six months from the time of injury she became independent in all her activities of daily living and was able to ambulate with a pair of crutches and right ankle foot orthosis. She remained incontinent and was managing her bladder with clean intermittent catheterisation at discharge but eventually opted to have a suprapubic catheter.

Discussion:

We tend to hear a lot of the word "decompression" following spinal injuries which implies to the fact that the patient has had a surgical decompression of their spinal canal to reduce the impending damage to the spinal cord. Rarely do we hear or see a case of spinal injury and paralysis following decompression sickness (DCS) in our rehabilitation centres.

DCS was first described in 1841 and was commonly called the 'Bends'. DCS is commonly seen in under water and high altitude events and recreational activities, when the individual is subjected to sudden barometric pressure changes. In physics Henry's law states that "At a constant temperature, the amount of a given gas that dissolves in a given type and volume of liquid is directly proportional to the partial pressure of that gas in equilibrium with that liquid" (Figs 2 & 3).

When surrounded by high pressure like in diving, inert gasses like nitrogen dissolve and accumulate in blood and the tissues. Then during rapid accent or decompression, the inert dissolved gases predominantly nitrogen, returns to its gaseous form (out gassing). This out gassing usually happens in the lungs but when out gassing is too rapid, a lag occurs before nitrogen can diffuse back to the non-fluid space. This delay precipitates nitrogen bubbling while still in the fluid state, which if in blood stream may cause embolism, and disrupt cell architecture when within tissues. Dysbarism encompasses the conditions of decompression sickness, arterial gas embolism and barotraumas, whereas decompression sickness and arterial gas embolism (AGE) are commonly classified together as decompression illness[1]. DCS is classified into type I, II and AGE. For decompression sickness, the pressure changes should be of sufficient duration to create a gas load but not necessarily saturate tissues, and the onset of symptoms may take anywhere between 0-36 hours. The neurological deficits can manifest in spinal cord or the brain.

DCS type I (mild, the bends occurring in 70-85%) accompanied by pain, rash and pruritis, are self resolving.

DCS type II (serious) could present as shock and nervous system involvement, of which the spinal cord lesions are the most common. Spinal cord involvement in DCS presents with back pain and signs of paraesthesia, motor weakness and loss of sphincter control. Among these,

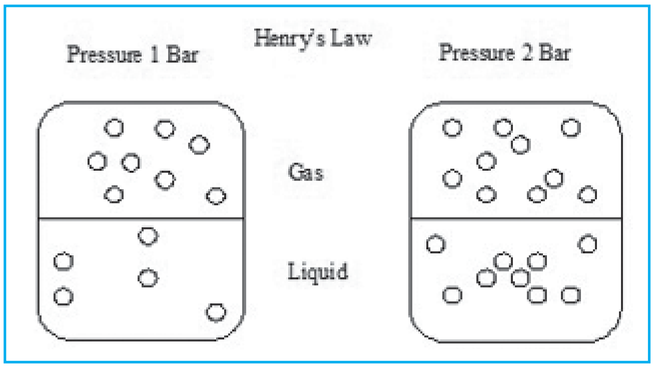


Fig 2- *Diagramatic - Henry's Law (a)*

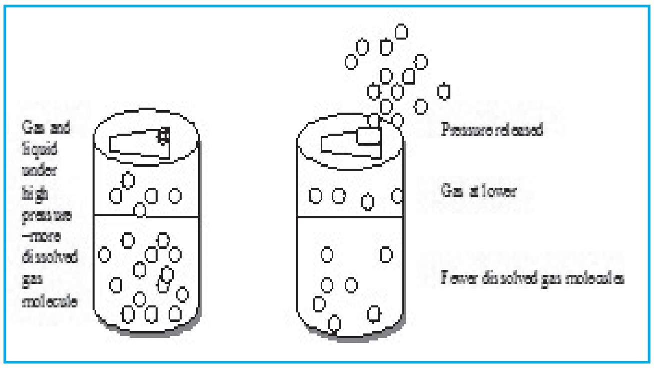


Fig 3- *Diagramatic - Henry's Law (b)* symptoms of back pain and girdle pain after a diving episode has been shown to be closely associated with a diagnosis of spinal decompression sickness[2,3]. The pulmonary vasculature is able to filter the bubbles and micro-emboli to a certain extent depending on the size of the bubbles. The microbubbles which pass through the pulmonary capillaries and enter the systemic circulation surprisingly do not cause any damage. As this blood circulates in the cerebral vasculature, much of the oxygen is extracted from this blood by the cortical grey matter, and the remaining is drained by capillary free zone, long veins which supply the white matter of the mid brain and the spinal cord. In this area, any compromise by micro-emboli will cause the hypoxic damage and dysfunction of the blood CNS barrier, leading to inflammation, demyelination leading to physiological or physical axonal dysfunction, also termed as perivenous syndrome[4]. This venous ischaemia of the cord causes myelitis in the cord in most patients with a diagnosis of DCS of the spinal cord. Interestingly, studies have shown that the blood bubble interface can cause mechanical stretch of the blood vessels and cause a foreign body effect that causes release of vasoactive amines and activates the complement and the coagulation pathways, aiding in formation of thrombus[5,6].

Another factor which can augment bubbles to come into the systemic circulation directly bypassing the pulmonary filter is patent foramen ovale. The prevalence of probe patent foramen ovale is about 27% in the normal population[7]. The DAN Report on Decompression Illness, Diving Fatalities and Project Dive Exploration, in 2006 had analysed 8,000 divers for around 100,000 dives and has reported an incidence of DCS as 3.6 per 10,000 dives[8]. Analysis of a cohort of divers with a diagnosis of DCS showed 50 -53% of them had a PFO, and in the group of divers who did not have a diagnosis of DCS, the incidence of PFO was 8%[9].

AGE occurs immediately after resurfacing, affecting the brain more than the spinal cord and is associated with complaints of headaches, giddiness, anxiety, altered sensorium and stroke. It can also cause embolism of the coronary vessels and lead to arrhythmia's and myocardial infarction.

Incidence of DCS: According to statistics from the US the incidence of DCS in divers is about 1000 per year[10]. Marx *et al* in 2010 showed the incidence of decompression sickness to be about 2.8 cases per 10,000 dives, with the risk 2.6 times more in males than in females. The DAN report of the "Project Dive Exploration" which reviewed data up to the year 2002 from 50,150 dives showed that the incidence was about 0.05% where as the DAN report based on DCS claims from the year 2000 to 2007 found to be about 217 cases per 100,000 (0.21%) among insured members. There is no substantial data from the Indian subcontinent, but there has been some surveys conducted among the Urak Lawoi fishermen from Thailand who dive using surface-supplied compressed air through rubber tubes. They found the diving related morbidity to be about 550 per 100,000 person-years and a mortality rate of approximately 300 per 100,000 person-years[11].

Management:

Patient must be kept supine, as the head down position increases risk of further damage to the blood brain barrier[12]. Treated with hyperbaric oxygen therapy is recommended, if near a centre with this facility. Otherwise, treating with 100% oxygen washes out and reduces risk of further damage by the dissolved nitrogen. It is more effective if administered within the first four hours and also reduces the number of therapies required[13].

Antiplatelets after ruling out, intracerebral and other hemorrhagic lesions, have been tried, though there is no evidence for this is not intervention[14].

Intubation, cardiopulmonary resuscitation, and chest tube insertions should be performed where ever necessary. Rehydration with intravenous fluids, with constant monitoring of haemodynamic parameters till adequate renal perfusion and urine output is obtained. Neurological symptoms, pulmonary symptoms, and skin changes should be managed with hyperbaric oxygen therapy if seen within 10 to 14 days of development.

The diagnosis of DCS is primarily based on history and clinical findings. Hyperbaric oxygen treatment should not to be delayed if DCS is the most likely diagnosis. Differential diagnosis includes alcohol/substance abuse, deep vein thrombosis, pulmonary embolism, hyperventilation syndromes and vasogenic shock. Full blood counts, electrolytes, blood sugars, arterial blood gases to be measured and appropriately corrected. Chest x-ray is done to rule out lung conditions like pneumothorax, pneumomediastinum, subcutaneous emphysema. If sensorium continues to deteriorate CT of head is required to rule out other causes of brain injury. Imaging with T2 and FLAIR sequences of MRI may show focal lesion in the spinal cord and brain. The sensitivity of picking up a lesion in the brain is more, than in the spinal cord[15]. One should be aware of the fact that a negative MRI finding does not rule out diagnosis of dysbarism.

Prognosis: Follow-up studies of DCS patients has shown that about 14.3% of the patients continued to have residual neurological deficits and symptoms from type II DCS and 7% from type I DCS. Permanent neurological sequelae have been reported to be around 16% in follow-up cases[16]. Other factors which are associated with poor outcomes are, age over 42 years, depth of the dive being greater that 39 metres, bladder dysfunction, and persisting or worsening of clinical symptoms before recompression therapy. The lag time to recompression therapy did not significantly influence recovery[3].

Prevention: Adhere to standard diving guidelines, limiting the depth and duration of deep water dives, avoiding substance abuse before diving, avoiding repeated dives within a 12-hour period. Slow accent after every dive, no faster than 9 metre per minute. A safety stop, before surfacing at 4.5 metre prior to reaching the surface for 3 to 5 minutes reduces the risk of DCS. This allows for "degassing" before surfacing.

Avoiding air travel within 24 hours of deep dives, avoiding air travel in non-pressurised aircraft, adequate hydration, can reduce risk of DCS.

Further research on improved primary prevention and medical treatment are needed to reduce mortality and morbidity in decompression sickness.

References:

1. M.D AAB, Davis JC. Bove and Davis' Diving Medicine. Elsevier Health Sciences, 2004.
2. Abstracts of the Aerospace Medical Association (AsMA) 84th Annual Scientific Meeting. May 12-16, 2013. Chicago, Illinois, USA. *Aviat Space Environ Med* 2013; **84:** 275-439.
3. Blatteau J-E, Gempp E, Simon O, Coulange M, Delafosse B, Souday V, *et al*. Prognostic factors of spinal cord decompression sickness in recreational diving: retrospective and multicentric analysis of 279 cases. *Neurocrit Care* 2011; **15:** 120-7.
4. James PB. Hyperbaric oxygenation in fluid microembolism. *Neurol Res* 2007; **29:** 156-61.
5. Huang KL, Lin YC. Activation of complement and neutrophils increases vascular permeability during air embolism. *Aviat Space Environ Med* 1997; **68:** 300-5.
6. Boussuges A, Succo E, Juhan-Vague I, Sainty JM. Activation of coagulation in decompression illness. *Aviat Space Environ Med* 1998; **69:** 129-32.
7. Hagen PT, Scholz DG, Edwards WD. Incidence and size of patent foramen ovale during the first 10 decades of life: an autopsy study of 965 normal hearts. *Mayo Clin Proc* 1984; **59:** 17-20.
8. DAN Report on Decompression Illness, Diving Fatalities and Project Dive Exploration. DAN; 2006.
9. Honek T, Veselka J, Tomek A, Srámek M, Janugka J, Sefc L, *et al*. Paradoxical embolization and patent foramen ovale in scuba divers: screening possibilities. *Vnitrní Lékarství* 2007; **53:** 143-6.
10. Pathophysiology, treatment and aeromedical retrieval of SCUBA – related DCI [Internet]. [cited 2013 Jun 18]. Available from: http://jmvh.org/article/pathophysiology-treatment-and-aeromedical-retrieval-of-scuba-related-dci/
11. Gold D. The indigenous fisherman divers of Thailand; in water recompression. *Int Marit Heal* 1999; **50:** 39-48.
12. De Watteville G. A critical assessment of Trendelenburg's position in the acute phase after a diving accident. *Schweiz Z Für Sportmed* 1993; **41:** 123-5.
13. Longphre JM, Denoble PJ, Moon RE, Vann RD, Freiberger JJ. First aid normobaric oxygen for the treatment of recreational diving injuries. 2007 [cited 2013 Jun 20]; Available from: archive.rubicon-foundation.org/xmlui/handle/123456789/5514
14. Bessereau J, Coulange M, Genotelle N, Barthélémy A, Michelet P, Bruguerolle B, *et al*. Aspirin in decompression sickness. *Therapie* 2008; **63:** 419-23.
15. Gao GK, Wu D, Yang Y, Yu T, Xue J, Wang X, *et al*. Cerebral magnetic resonance imaging of compressed air divers in diving accidents. *Undersea Hyperb Med J Undersea Hyperb Med Soc Inc* 2009; **36:** 33-41.
16. Nashimoto I, Lanphier EH. What is Bends? 1991 [cited 2013 Jun 18]; Available from: archive.rubicon-foundation.org/xmlui/handle/123456789/7997.