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Original Article

Effect of Steroid Prophylaxis on Nerve Function Impairment in Multi-bacillary Leprosy Patients on MDT-MB

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The effects of corticosteroids in varying doses and duration for the treatment of reaction and nerve function impairment (NFI) in leprosy have been studied extensively. However, an optimal dose and duration of steroid when used as a prophylactic agent for NFI is yet to be established. This study was aimed to determine whether addition of low dose steroid for the initial 8 months of multi drug therapy (MDT) can prevent further deterioration of nerve function (DON) in multibacillary leprosy patients. Sixty multibacillary leprosy patients were randomized into two groups A and B consisting of 30 patients each. Group A received MDT-MB for 12 months with prednisolone 20 mg/day from the beginning of treatment for 6 months followed by tapering by 5 mg/2 weeks in 7th and 8th month. Group B received MDT-MB alone for 12 months. Nerve function assessment (NFA) using various modalities was done at the beginning (0 month), at the end of 8 months and at the completion of MDT (12 months). The proportion of patients showing DON was significantly higher in group B, while proportion of patients showing improvement was more in group A. This study thus shows all MB cases with or without NFI at registration should receive prophylactic steroid at least for 8 months. Since preventing deformities using prophylactic steroids in leprosy is an important issue larger randomized control trials using longer duration of low dose steroid with a longer follow up period should be conducted.

Keywords : Leprosy, Multibacillary, Steroid Prophylaxis

Introduction

Nerve function impairment (NFI) in leprosy varies from 6-56% in newly diagnosed patients with leprosy and can even deteriorate during and after treatment as a result of immunological reactions (Saunderson et al 2000). Prospective studies have demonstrated that multibacillary (MB) leprosy patients and those with existing impairment of nerve function are at the greatest risk of new NFI and reaction (Croft et al 2000). The effects of corticosteroids in varying doses and duration for the treatment of reaction, neuritis and nerve damage have been studied in India and outside (Naafs 1996, Rao et al 2006). However, research focusing on their effect in preventing the occurrence or reducing the frequency of reaction and/or NFI is still in its infancy. Previous studies on steroid prophylaxis of NFI in leprosy have used

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shorter regimens varying in duration from 3 to 5 months, how ever, an optimal dose and duration of steroid when used as a prophylactic agent is yet to be established (van Veen et al 2008). We hereby attempted to evaluate the effect of steroid prophylaxis in low dose but for a longer duration for prevention of NFI in leprosy. In addition, research should focus also on possibilities of timely detection and treatment of early (silent) neuropathy in order to prevent NFI and its consequences. We have compared various modalities of nerve function assessment (NFA) to find the most sensitive and specific modality to identify patients at risk of deterioration of nerve function so that treatment with steroids can be initiated early.

Materials and Methods

Sixty consecutive adult cases of leprosy classified as MB according to the W.H.O. classification 1998 (WHO 1998) at Urban Leprosy Centre (ULC) of Post Graduate Institute of Medical Education and Research (PGIMER) & Dr Ram Manohar Lohia Hospital, New Delhi from November 2011 to December 2012 were included in the study. They were randomized into two groups A and B consisting of 30 patients each. Patients who had indication for full dose steroids e.g. impending paralysis, nerve tenderness/neuritis and type 1 & 2 reactions; contraindication for oral cortico-steroid e.g. DM, HTN, peptic ulcer, glaucoma, TB; pregnant and lactating female patients; and difficult to follow-up (migrant population, long distance from site of study) patients were excluded. Group A received MDT-MB for 12 months along with prednisolone 20 mg/day from the beginning of treatment for 6 months and then tapered by 5mg per 2 weeks in 7th and 8th month. Group B received MDT-MB alone for 12 months. All patients underwent clinical examination, slit skin smear (SSS) examination at four sites (right earlobe, left eyebrow and two skin lesions), a skin biopsy from the margin of skin lesion and nerve function assessment (NFA) at the beginning (0 month), at the end of 8 months and at the completion of MDT (12 months) in both groups and results were compared. Bacillary index (BI) was graded as per Ridley scale (Ridley 1958).

NFA was done using the following modalities after getting an informed consent:

a) Palpation (NP) of peripheral nerves for nerve thickness: Nerve thickening was graded into four groups (0, 1, 2, and 3) according to WHO grading (Table 1).

b) Clinical sensory testing using standard set of Semmes-Weinstein (SW) monofilaments (MF) (Bell-Krotoski 1990). The monofilaments used were 0.05g (green), 0.2g (blue), 2g (purple), 4g (red), 10g (orange) and 300g (light red). Normal thresholds were 0.2g for the hand and 2g for the foot (Anderson and van Brakel 1998). Ulnar, median, radial nerves were tested in upper limbs while deep peroneal, and posterior tibial nerves were tested in lower limbs. The test sites used are shown in Fig 1. Sensory impairment was diagnosed in the following situations: a) The monofilament threshold increased by 3 or more

Table 1 : WHO grading of nerve thickness

Grade	Degree	Description
0	Not thickened	nerve not thickened and feels normal
1	Mild thickened	thickened compared to contra lateral side
2	Moderate	thickening is rope like
3	Severe	nerve thickened and also nodular or beaded

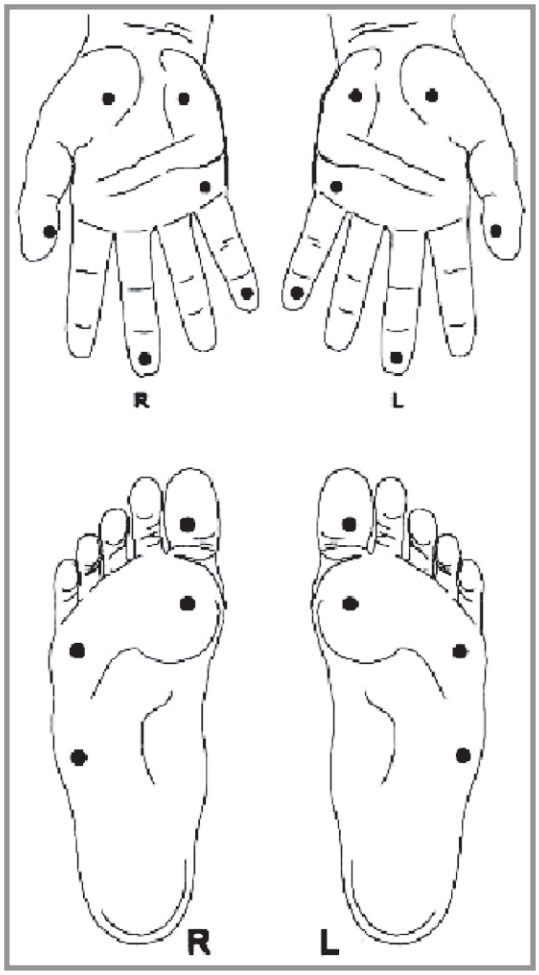

Fig 1 : Test sites for clinical sensory testing using SW monofilament

levels in one site or, b) By 2 levels in one site and 1 level in another site or, c) By 1 level in all 3 sites for a nerve tested. c) Clinical motor testing via Voluntary muscle testing (VMT) using the 0-5 modified MRC scale (vanBrakel et al 2005). A nerve scoring lower than 5 was considered impaired; d) Motor nerve conduction (MNC) measurements (using a Sierra Wave 4 channel combined electromyography, NC/EP machine (Cadwell, USA): MNC parameters were measured on four nerves bilaterally (ulnar, median, tibial and common peroneal). The ulnar nerve was stimulated at the wrist and across the elbow (above and below the elbow), and recordings were taken from the abductor digiti minimi muscle. The recordings of the median nerve were made from the abductor pollicis brevis muscle by stimulating the wrist, elbow and axilla; abductor hallucis muscle for the tibial nerve after stimulating the ankle and popliteal fossa; and extensor digitorum brevis muscle for the common peroneal nerve after stimulating ankle, head of the fibula and popliteal fossa. Motor distal latencies, amplitudes and motor conduction velocities were evaluated. e) Sensory nerve conduction measurements (SNC): SNC parameters were measured bilaterally on three nerves (ulnar, median and sural) using the same equipment as described for MNC. The sensory conduction velocities were recorded from the wrist after index finger and fifth finger stimulation for the median and the ulnar nerve, respectively and from lateral malleolus after stimulation of the leg's midline for the sural nerve. The amplitudes, distal and peak latencies and sensory nerve conduction velocities were studied. Any nerve tested for SNC and / or MNC found abnormal by any one parameter (latency, amplitude, velocity) was considered as abnormal.

Criteria for improvement and deterioration followed were:

a) NP: Improvement - Reduced score from 3+ or 2+ to 1+/0; Deterioration - Increased score to 3+/2+/1+.

b) MF and VMT testing: Improvement / Deterioration - increment / decrement in score by $\geq$ 1 point (mild), $\geq$ 2 points (moderate), $\geq$ 3 (severe).

c) MNC/SNC: Improvement/Deterioration - Increment/decrement of abnormal baseline values by 15% or attainment of normal values for the parameters of latency/conduction velocity and/or amplitude.

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 17.0. The significance of associations were tested using Chi-square and Fisher's exact tests. Kaplan meier survival curves were drawn of the percentage of patients surviving without a first event of deterioration of nerve function or improving against time since registration. The log rank test was carried out to assess the significance of differences between the curves at end-point, and the P-values are given in the text.

Results

The baseline characteristic features of MB patients in two groups are shown in Table 2. The two groups were comparable in baseline demographic, clinical and histological characteristics.

At the time of registration, Mean BI of group A and group B was 1.4 (range: 0 to 3.8) and 1.7 (range: 0 to 4.1) respectively. At the end of 12 months, there was 78% and 65% decline in mean BI in group A and B respectively (mean BI was 0.3 and 0.59). Statistically percentage improvement of mean BI was significantly high in group A. This observation indicates that addition of low dose of steroid for prolonged period (up to 8 months) has no significant negative impact on bacteriological clearance.

Table 3 shows number of patients showing improvement and deterioration of nerve function at 8 and 12 months in group A and B. In group A, 26 (86.67%) patients presented with one or more thickened peripheral nerves while in group B peripheral nerves were thickened in 28 (93.33%) patients at 0 month. The proportion of patients showing improvement in nerve thickness was significantly (p=0.0384) higher in group A (4/30=13.33%) than in group B (nil); whereas, the proportion of patients showing deterioration was more in group B (2/30=6.67%); but it did not reached the value of statistical significance (p=0.1503) at the end of 8 months. There was no further change in thickness on nerve palpation in both groups at the end of 12 month.

At the time of registration, 11 (36.67%) patients in group A and 8 (26.67%) patients in group B showed sensory NFI (using MF), whereas, 8 (26.67%) patients in group A and 11 (36.67%) patients in group B had motor NFI assessed by VMT. At the end of 8 months the proportion of patients showing deterioration in both sensory (8/30=26.67%) (p=0.0024) and motor [7(13.33%)] (p=0.0049) nerve function were significantly higher in group B. Whereas, proportion of patients showing improvement [7(23.3%)] in motor NF was significantly

Table 2 : Baseline demographic and clinical characteristic of study population

	Group A	Group B
Mean Age (Range)	**38.5 (18-58) yrs**	**39 (17-71) yrs**
Sex ratio (M:F)	4:1	4:1
Family history positive	3.3 %	3.3%
Mean duration of disease	7.5 months	5.8 months
Mean BI at time of presentation	1.4	1.7
Clinical nerve enlargement on NP	26 (86.67%)	28 (93.33%)
Grade 2 deformity	0	0
Histopathology (BB:BL:LL:PN)	(5:9:9:2)	(9:5:4:0)

Table 3 : No. of patients showing improvement and deterioration assessed by different modalities in groups A and B at the end of 8 & 12 months

			At 0 month	At the end of 12 months			At the end of 8 months		
				I	D	NC	I	D	NC
On nerve palpation	Group A	N	4	-	0	4	-	0	4
		EN	26	4	0	22	4	0	22
		Total	30	4	0	26	4	0	26
	Group B	N	2	-	2	0	-	2	0
		EN	28	0	0	28	0	0	28
		Total	30	0	2	28	0	2	28
On monofilament testing	Group A	N	19	-	0	19	-	0	19
		AB	11	3	0	8	3	0	8
		Total	30	3	0	27	3	0	27
	Group B	N	22	-	1	21	-	1#+3 =4	18
		AB	8	0	7	1	0	7	1
		Total	30	0	8	22	0	11	19
On voluntary muscle testing	Group A	N	22	-	0	22	-	0	22
		AB	8	4	0	4	4+2	0	2
		Total	30	4	0	26	6	0	24
	Group B	N	19	-	5	14	-	2#+3 =5	14
		AB	11	0	2	9	0	2	9
		Total	30	0	7	23	0	7	23
On sensory nerve conduction study	Group A	N	8	-	0	8	-	3	5
		AB	22	9	9	4	9	9	4
		Total	30	9	9	12	9	12	9
	Group B	N	12	-	6	6	-	6#+1 = 7	5
		AB	18	0	11	7	0	11#+6 = 17	1
		Total	30	0	17	13	0	24	6
On motor nerve conduction study	Group A	N	6	-	0	6	-	1	5
		AB	24	15	5	4	15+1 =16	5	3
		Total	30	15	5	10	16	6	8
	Group B	N	4	-	4	0	-	4	0
		AB	26	1	20	5	1	20#+3 = 23	2
		Total	30	1	24	5	1	27	2

N = number of patients without motor nerve impairment, EN = number of patients with motor nerve impairment, I = improvement, D=Deterioration, NC=No change, # = further improvement or deterioration in the same patient.

(p=0.0384) higher in group A, but improvement in sensory NF in group A (3/30=10%) did not reached the level of statistical significance (p=0.0756). At the end of 12 months there was no

further improvement or deterioration in SNF in group A, while 3 new patients deteriorated in group B. In Motor NFA, improvement was shown by 2 more patients of group A while in group B out of 7 (16.67%) patients showing deterioration, 2 (6.67%) had further deterioration in muscle power as shown in Table 4. Thus, it can be concluded with confidence that low dose (20mg) steroid upto 8 months has a definite preventive effect on both sensory and motor NFI.

Table 4 shows changes in clinical grading of sensory and motor testing at the end of 8 & 12 months. In group A, at the end of 8 months, out of 3 patients who had improvement in SNF, 1 had moderate (by 2 points) and 2 showed good or severe (by 3 points) improvement whereas improvement in MNF was seen in 4 patients (1mild, 2 moderate and 1 severe). At the end of 12 months, improvement in MNF was noted in 2 more patients by 1 point each. In group B, a total

Table 4 : Change in grading of sensory testing and muscle power at the end of 8 & 12 months

			Deterioration			Improvement		
			Mild (by 1 point)	Moderate (by 2 point)	Severe (by 3 point)	Mild (by 1 point)	Moderate (by 2 point)	Severe (by 3 point)
Grading of sensory testing using SW mono-filament	Group A	At the end of 8 months	0	0	0	0	1	2
		At the end of 12 months	0	0	0	0	0	0
	Group B	At the end of 8 months	4	2	2	0	0	0
		At the end of 12 months	4+2	2+1	2	0	0	0
Change in grading of muscle power using voluntary muscle testing	Group A	At the end of 8 months	0	0	0	1	2	1
		At the end of 12 months	0	0	0	1+2	0	0
	Group B	At the end of 8 months	4	2	1	0	0	0
		At the end of 12 months	0	2#	0	0	0	0

= further improvement or deterioration in the same patient, + = new patients

of 8 patients (4 mild; 2 moderate and 2 severe) deteriorated in SNF and 7 (4 mild; 2 moderate and 1 severe) deteriorated in MNF over a period of 8 months. At the end of 12 months, deterioration of SNF was noted in 3 more patients (2 mild, and 1 moderate) and out of 7 patients showing deterioration of MNF, 2 patients deteriorated further by 1 point each.

Fig 2 depicts the percentage of patients showing improvement (I) /deterioration (D) detected by different modalities in both groups. It can be clearly seen that I and D were better detected via nerve conduction studies in both groups. Neurophysiologically, 22 (73.33%) patients in group A and 18 (60%) patients in group B had impaired sensory nerve conduction (SNC) at 0 month while clinically SNFI was detected in 11 (36.67%) and 8 (26.67%) patients in group A & B respectively (which is ~40% more than what is observed clinically). Similarly, 24(80%) and 26(86.67%) patients had impaired motor nerve conduction (MNC) in group A and B respectively at baseline (compared to 8(26.67%) & 11 (36.67%) cases observed clinically respectively). Thus nerve conduction studies help to assess silent neuropathy in leprosy patients. At the end of 8 months, the proportion of patients showing improvement in both SNC [9 (30%)] (p=0.0011) and MNC [15 (50%)] (<0.0001) in group A was significantly higher than that of group B (SNC=nil, MNC=3.33%) while the proportion of patients showing deterioration in both SNC [17(56.67%)] and MNC [24(80%)] were significantly higher (p=0.0371) in group B than that of group A (SNC=nil, MNC=16.67%). At the end of 12 months, deterioration of SNC was noted in 3 more patients of group A and in 7 (16.67%) more patients in group B, while, one more patient of group A showed improvement of MNC. While no further improvement was seen in group B.

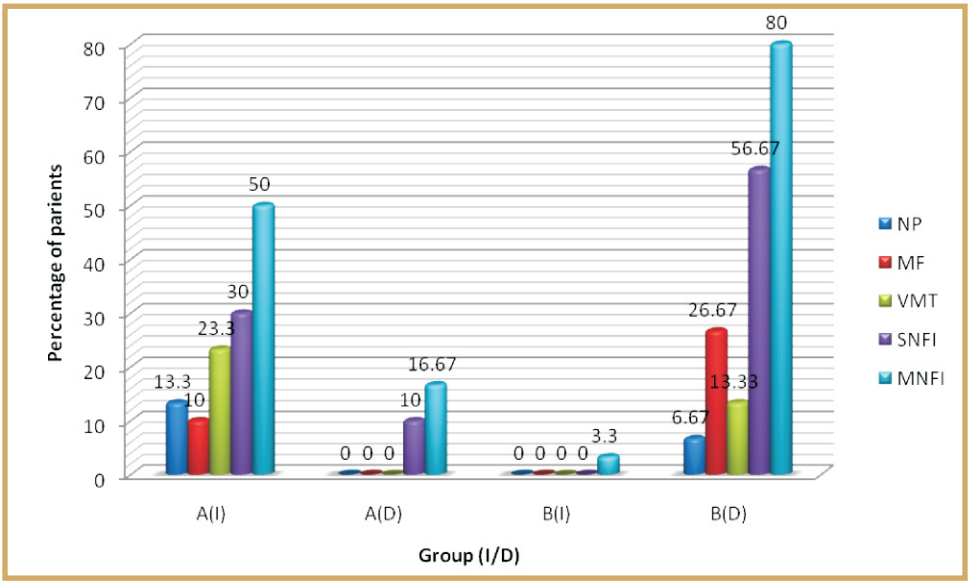

Fig 2 : Percentage of patients showing improvement (I) /deterioration (D) in both groups detected by different modalities

Kaplan Meier survival curves (Fig 3) of percentage of patients surviving without deterioration of nerve function (DON) or showing improvement against time since registration were drawn to assess the significance of difference. For group A patients, the proportion surviving without DON was 80%, which is in sharp contrast to group B patients, of whom only 13.3% survived without DON (Fig 3a). Fig 3b shows survival according to study group (A/B), with and without NFI at registration. In group A, the proportion of patients with no NFI at registration surviving without developing NFI during the observation period was 83.33%. The figure for those with NFI at registration was 79.17%. In Group B, among patients with NFI at registration, the percentage surviving without DON during the observation period was only 11.5%. Of those without NFI at registration, interestingly none (0%) survived without developing new NFI during study period.

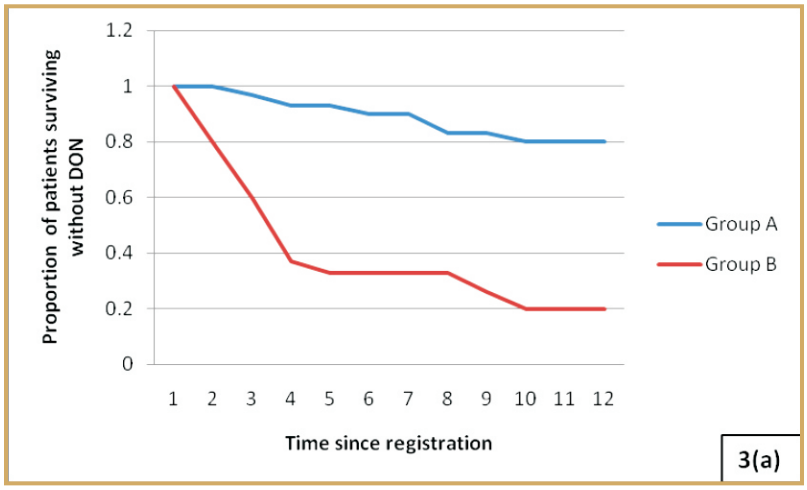

Fig 3 : Survival curves to first event of deterioration of nerve function (DON) during study period : (a) according to study group as whole, (b) history of NFI at registration by study group

In Figs 3a and 3b the difference between the curves at end-point were statistically significant (P-value log rank test < 0.05).

None of the patients had any episode of reaction in group A during the course of treatment while in group B two patients developed type 1 reaction (T1R) and one patient developed type 2 reaction (T2R). All three patients who developed reaction were treated with full dose of steroid (1 mg per KG body weight to start) with gradual tapering dose for adequate duration. None showed deterioration of nerve function. None developed deterioration or any significant steroid related side effect (acute or chronic infections, diabetes, hypertension, peptic ulceration, or bone pains) in group A.

Discussion

Early detection and treatment of NFI is of paramount importance in leprosy to prevent deformities. van Brakel and Khawas (1994) recommended that all leprosy patients should have NFA at every visit to the clinic at least during their first year of treatment. They compared various diagnostic tests for early detection of leprosy neuropathy and observed that impairment of SNC and warm perception often preceded deterioration in MF or VMT scores by 12 weeks or more (van Brakel et al 2008). Other studies (Samant et al 1999, Donde et al 1993) have also shown that sensory fibers are damaged early in leprosy and therefore show more quantum of changes in conduction velocities as compared to motor nerve fibers in the early stages of damage. However, the amplitude changes are much more marked for motor nerve fibers. In our study also we found SNC studies to be most sensitive to detect DON (56.6%) whereas MNC study identified maximum (50%) number showing improvement. Hence it can be inferred that electrophysiological examination of nerve function must be conducted in all multibacillary patients at least once during first 6 months of MDT treatment to detect silent neuropathy and treatment with steroid must be initiated to prevent deformities.

The effect of steroid in various dosages and duration to treat existing NFI and reactions in leprosy during MDT has been comprehensively reviewed (Pai et al 2012). But its use to prevent the occurrence of first event of NFI in leprosy has not been studied extensively. A randomised control trial (TRIPOD 1) to investigate the effect of steroid prophylaxis using low dose (20 mg) prednisolone for first 4 months of MDT could not find significant and sustained benefit at the end of 12 months (Smith et al 2004). Similarly, another randomised control trial using higher initial dose of corticosteroid (40 mg prednisolone) with slow tapering (by 5 mg every 2 weeks) starting from 2nd week for 4 months also could not find demonstrable additional improvement in nerve function in the prednisolone group at the end of 12 months (Richardus et al 2003).

We hereby attempted to further evaluate the effect of steroid prophylaxis with longer duration (upto 8 months) of low dose steroid in MB cases. There are two important considerations in the prophylactic use of steroids: first is the potential risk of activation of latent infections e.g. tuberculosis and added risk of chronic diseases like hypertension, diabetes, and glaucoma. In our study we did not encounter any of these side effects. Possibly 20 mg prednisolone dose is low enough to produce significant immune-suppression. However, careful screening of cases with these diseases at beginning and at monthly intervals is necessary. Second is its effect on bacteriological (*M. leprae*) clearance. Shetty et al (2010) followed a cohort of 200 untreated MB patients, a comparable group of 100 each receiving MDT + steroids (group A) vs MDT alone (group B) assessed at 18 months as compared to

month zero. At 18 months, decline in bacterial index was closely comparable in the two groups. These results are concordant with our results.

The probability of occurrence of first event of NFI or deterioration of already existing NFI can be best described as Kaplan meier survival curves. The pattern of the survival curve (Fig 3a and b) suggests a significant increase in probability of survival without NFI in prednisolone group (A) throughout the observation period. In group A, among patients who did not had any NFI at the time of registration, none showed any deterioration of nerve function (DON) till 8 months, after which 3 patients showed mild deterioration, whereas, among those already having NFI at registration, none showed further DON after initial 4 months during which period only 5 patients (2 mild, 2 moderate and 1 severe) experienced DON. On the other hand in group B, there is a gradual decline in number of patient surviving without further DON with steep fall in the first 4 months. The difference between survival curves for group A and B makes it clear that extending the duration of steroid prophylaxis from four months to eight months is definitely beneficial as far as progression of NFI is concerned. No patient in either group developed any grade 2 deformity till the end of follow up period.

Conclusion

The importance of balancing the risks of infections and chronic diseases with the benefits of preventing deformities using prophylactic steroids in leprosy is an important issue and larger randomized control trials using longer duration of low dose steroid with a longer follow up period should be conducted. In the light of present study we recommend that all MB cases with or without NFI at registration should receive prophylactic steroid atleast for 8 months.

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