Dexamethasone and Methylprednisolone in Treatment of Indirect Traumatic Optic Neuropathy

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Abstract

A randomized, double blind study was carried out to compare the efficacy of dexamethasone and methylprednisolone in the treatment of indirect traumatic optic neuropathy. Twenty-one patients, 20 male and 1 female, were diagnosed as having suffered from indirect traumatic optic neuropathy. The time from injury to treatment was within 7 days. The average age was 26.38 ± 11.89 years. The most common cause of injury was motor vehicle accident (MVA). Associated head and maxillofacial injury were reported 43.48 and 34.78 per cent, respectively. Before treatment, no light perception was detected in 19.05 per cent of the participants. Treatments were randomized: ten patients received dexamethasone intravenously for 72 hours and 11 methylprednisolone. The best corrected visual acuities (BCVA) were determined using the Snellen Chart before and 1, 2, 3, 7, 14 and 60 days after treatment. Three or more lines of improvement of the BCVA, were found in 70 and 67 per cent of patients treated with dexamethasone, and 45.45 and 33.33 per cent of patients treated with methylprednisolone, at 2 weeks and 2 months, respectively. There were no significant differences in age, cause of injury, injury to treatment interval, initial BCVA and visual improvement between the two groups.

Key word : Traumatic Optic Neuropathy, Dexamethasone, Methylprednisolone

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Traumatic optic neuropathy can occur in 3 per cent of head and/or 2.5 per cent of maxillofacial injuries[1]. It is caused by an indirect impact injury not a penetrating wound the force being transmitted to the nerve *via* the bones or by motion of the globe to the optic nerve which results in partial to complete loss of vision. The loss of visual acuity is usually instantaneous and, without treatment, permanent. Injury can occur anywhere along the entire length of the optic nerve but is most com-

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Table 1. Basic data of patients treated with dexamethasone.

Case No, Age (Yrs), Sex	BCVA			Injury-to-treatment Interval	Follow-up	Cause
	Initial	Post-iv	Final			
1, 32, M	NOLP	NOLP	NOLP	4 d	2 m	MVA
2, 23, M	FC2'	6/36	6/12	1 d	2 m	Falling debris
3, 54, M	NOLP	NOLP	NOLP	1 d	2 m	MVA
4, 44, M	6/24	6/24	6/9	6 d	2 m	MVA
5, 16, M	1/60	5/60	6/36	2 d	2 m	Assaults
6, 26, M	6/36	6/6	6/6	1/2 h	2 m	MVA
7, 20, M	6/9	6/6	6/6	6 d	2 wk	MVA
8, 23, M	NOLP	NOLP	NOLP	4 d	2 m	MVA
9, 19, M	HM	1/60	6/24	3 d	2 m	MVA
10, 20, M	LP	LP	6/9	3 d	2 m	MVA

d = day
h = hour
m = month
wk = week

monly at the intracanalicular part. High dose, intravenous corticosteroids were introduced for the treatment of traumatic optic neuropathy based on their salutary effects in the treatment of experimental CNS injury[2]. Studies regarding the therapeutic effects of dexamethasone and methylprednisolone in the treatment of indirect traumatic optic neuropathy have not been published, so our research compared the two for such effectiveness.

PATIENTS AND METHOD

Our study was a prospective, double blind, randomized controlled trial. It was approved by the Ethics Committee of the Faculty of Medicine, Khon Kaen University. Written informed consent was obtained from 21 patients diagnosed with indirect traumatic optic neuropathy who were treated within 7 days of injury at Srinagarind Hospital, Khon Kaen University between March 1997 and August 1999. Exclusion criteria included : unconsciousness, an optic canal fracture detected by CT scan of the orbit, other ocular pathology known to interfere with VA, or patients for whom corticosteroids are contraindicated.

History was taken including a complete baseline ocular examination: VA, tonometry, biomicroscopy and fundoscopy. CT scan of the orbit was performed in all patients.

Patients received either dexamethasone or methylprednisolone according to randomization of treatments. Patients in both groups were stratified into 5 subgroups according to their initial BCVA, which included: 1) no light perception (NOLP); 2) light perception (LP) to hand motion (HM); 3) finger count (FC) to worse than 6/60; 4) 6/60 or better to worse than 6/12 ; and 5) 6/12 or better.

After randomization, the first group initially received 4 mg of dexamethasone intravenously and then 3 mg/kg four times a day. The second group initially received 30 mg/kg of methylprednisolone intravenously and then 15 mg/kg four times a day thereafter. After 72 hours, the intravenous treatments were discontinued and replaced by 1 mg/kg/day of oral prednisolone, which was discontinued within two weeks. The BCVAs were determined at 1, 2, 3, 7, 14 and 60 days after treatment.

Results were analyzed by Student *t*–test and the Fisher's exact test. Differences were considered significant at $p < 0.05$.

RESULTS

The patients 20 males and 1 female averaged 26.38 ± 11.89 years of age. Nine of the patients had injured their right eye. The causes of injury, in descending frequency, included: MVAs (71.43%), assaults (23.81%) and falling debris (4.76%). All patients received treatment within 30 minutes to 7 days. The basic data for all of the patients in both groups are shown in Tables 1 and 2. Both groups were comparable with respect to age, sex, cause of injury, loss of consciousness, initial BCVA and the injury-to-treatment interval (Table 3).

Cerebral, maxillofacial and cervical spine injuries occurred in 43.48, 34.78 and 8.69 per cent

Table 2. Basic data of patients treated with methylprednisolone.

Case No, Age (Yrs), Sex	BCVA			Injury-to-treatment Interval	Follow-up	Cause
	Initial	Post-iv	Final			
1, 19, M	6/60	6/36	6/36	6 d	2 m	MVA
2, 27, F	FC1/2'	6/36	6/36	7 d	2 wk	Assaults
3, 39, M	6/12	6/6	6/6	4 d	2 wk	Assaults
4, 11, M	1/60	4/60	6/60	5 d	2 m	Assaults
5, 20, M	NOLP	NOLP	NOLP	4 d	2 m	MVA
6, 42, M	1/60	6/60	6/24	2 d	2 m	MVA
7, 11, M	6/24	6/6	6/6	5 d	2 wk	Assault
8, 16, M	LP	HM	1/60	1 d	2 m	MVA
9, 38, M	6/12	6/9	6/6	5 d	2 m	MVA
10, 38, M	LP	LP	LP	1 d	2 wk	MVA
11, 16, M	LP	HM	6/60	1 d	2 wk	MVA

d = day
m = month
wk = week

Table 3. Demographic features of patients in both groups.

Characteristics	Total (n=21)		Dexamethasone (n=10)		Methylprednisolone (n=11)		P-value
1. Age, x (SD)	26.38 (11.89)		27.70(12.26)		25.18(12.01)		0.64 (*t*-test)*
	n	%	n	%	n	%	
2. Male	20	95	10	100	10	91	1.00 (FE)**
3. Causes							0.31 (FE)
MVAs	15	71.43	8	80.00	7	63.64	
Assaults	5	23.81	1	10.00	4	36.36	
Falling debris	1	4.76	1	10.00	-	0	
4. Loss of consciousness							0.67 (FE)
Yes	9	42.86	5	50.00	4	36.36	
No	12	57.14	5	50.00	7	63.64	
5. Initial BCVA							0.79 (FE)
NOLP	4	19.05	3	30.00	1	9.09	
LP	4	19.05	1	10.00	3	27.27	
HM	1	4.76	1	10.00	-	0	
< 6/60 to FC	5	23.81	2	20.00	3	27.27	
< 6/12 to ≥ 6/60	4	19.05	2	20.00	2	18.18	
≥ 6/12	3	14.28	1	10.00	2	18.18	
6. Injury to treatment interval							0.54 (FE)
Within 1 days	6	28.57	3	30.00	3	27.27	
2-3 days	4	19.05	3	30.00	1	9.09	
4-5 days	7	33.33	2	20.00	5	45.46	
6-7 days	4	19.05	2	20.00	2	18.18	

* 2 tailed student *t*-test
** 2 tailed Fisher's exact test

of the patients, respectively. There was no significant difference of cerebral concussion in either group.

The BCVA at 2 weeks and 2 months after treatment in the 5 subgroups, stratified by the initial BCVA, showed no significant difference between the patients in either group (Table 4).

At 2 weeks after treatment, 7 (70%) of the patients who received dexamethasone and 5 (45.45%) who received methylprednisolone had 3

Table 4. BCVA at 2 weeks and 2 months stratified by initial BCVA.

BCVA	2 Wk F/U		2 Mo F/U	
	Dexamethasone	Methylprednisolone	Dexamethasone	Methylprednisolone
1. Overall	n=10	n=11	n=9	n=6
NOLP	3	2	3	1
LP	0	0	0	0
HM	0	0	0	0
< 6/60 to FC	0	1	0	1
< 6/12 to ≥ 6/60	3	5	2	3
≥ 6/12	4	3	4	1
	P = 0.79(FE)*		P=0.40 (FE)	
2. Initial: NOLP	n=3	n=1	n=3	n=1
NOLP	3	1	3	1
3. Initial: LP or HM	n=2	n=3	n=2	n=1
LP or HM	0	1	0	0
< 6/60 to FC	0	1	0	1
< 6/12 to ≥ 6/60	2	1	1	0
≥ 6/12	0	0	1	0
	P=1.00(FE)		P=1.00(FE)	
4. Initial < 6/60 to FC	n=2	n=3	n=2	n=2
< 6/12 to ≥ 6/60	1	3	1	2
≥ 6/12	1	0	1	0
	P=0.40(FE)		P=1.00(FE)	
5. Initial < 6/12 to ≥ 6/60	n=2	n=2	n=2	n=1
< 6/12 to ≥ 6/60	0	1	0	1
≥ 6/12	2	1	2	0
	P=1.00(FE)		P=0.33(FE)	
6. Initial ≥ 6/12	n=1	n=2	n=0	n=1
≥ 6/12	1	2	0	1

* Fisher's exact test

or more lines of improvement in their BCVA. Fifteen patients, 9 in the first group and 6 in the second group, came for follow-up visits within 2 months. Six (66.67%) patients in the first group and 2 (33.33%) in the second group had 3 or more lines of improvement in their BCVA. Despite having more not-followed-up patients in the methylprednisolone group, no significant differences were recorded between the 2-week and 2-month follow-up (Table 5).

Two of the 5 (40%) patients receiving dexamethasone and 1 of the 3 (33.3%) patients on methylprednisolone who had a BCVA for hand motion or worse had 3 or more lines of improvement at 2 weeks. At 2 months, 2 in 5 (40%) of the patients receiving dexamethasone showed 3 or more lines of improvement while 2 of the patients receiving methylprednisolone did not. At 2 weeks, all of the patients receiving dexamethasone and 4 in 7 (57.14%) on methylprednisolone who had a BCVA finger count or better showed 3 or more lines of improvement. At 2 months, all of the patients receiving dexamethasone and 2 in 4 (50%) on methylprednisolone had 3 or more lines of improvement. There was no significant difference in the visual improvement between the two groups at week two or month two (Table 5).

DISCUSSION

Traumatic optic neuropathy can occur with an injury to the head (3%) and/or to the maxillofacial region (2.5%)[1]. Our study reported associated head and maxillofacial injuries in 43 and 34 per cent, respectively, compared to a previous retrospective study in Srinagarind Hospital[3]. These significant associated injuries caused the patients to seek medical attention. Loss of consciousness was associated with traumatic optic neuropathy in 43 per cent of our cases, which is comparable to the 40 to 72 per cent reported by Steinsapir[4]. Motor vehicle injury accounted for 70 per cent of cases in our study compared to 17 to 63 per cent of cases depending on the study[4].

Rattanatam et al[5], Mauriello et al[6] and Kitthaweesin[3] reported the percentages

Table 5. Three or more lines improvement of BCVA at 2 weeks and 2 months stratified by initial BCVA.

Initial BCVA	2 Wk F/U		2 Mo F/U	
	Dexamethasone	Methylprednisolone	Dexamethasone	Methylprednisolone
Overall	10	11	9	6
≥ 3 lines improve	7	5	6	2
Not improve	3	6	3	4
	P=0.39 (FE)		P=0.32(FE)	
NOLP, LP, HM	5	4	5	2
≥ 3 lines improve	2	1	2	0
Not improve	3	3	3	2
	P =1.00 (FE)		P=1.00 (FE)	
FC or better	5	7	4	4
≥ 3 lines improve	5	4	4	2
Not improve	0	3	0	2
	P=0.21(PE)		P=0.43 (FE)	

* Fisher's exact test

of patients with NOLP following traumatic optic neuropathy to be 48, 56 and 61 per cent, respectively. Typically, patients with traumatic optic neuropathy will have vision which is 3/60 or less. However, patients with more subtle loss of visual acuity should be suspected until proven otherwise. Our study revealed 19 per cent of patients with NOLP and 14 per cent with vision which was 6/12 or better.

Despite spontaneous improvement reported by Seiff[7] and Lessell[8], which varied from 20 to 35 per cent, most cases of traumatic optic neuropathy often deteriorate or have no improvement without treatment.

Anderson et al[2] introduced the use of high dose corticosteroids (3 to 5 mg dexamethasone/kg/day). They reported improved VA in 3 patients but failure in 4 patients who needed optic canal decompression. Seiff[7] proposed a nonconsecutive nonrandomized retrospective study in 36 patients. He compared the outcome of 15 patients who had not received corticosteroid to 21 who had received 1 mg dexamethasone/kg/day. Therapy was started within 48 hours and stopped within 72 hours if no improvement was observed. Visual improvement was seen in 13 of 21 (62%) treated patients and 5 of 15 (33%) untreated patients but this difference was not significant. Spoor[9] presented a retrospective study of 21 patients (22 eyes) studied at two centers. Eight patients (9 eyes) at one center received dexamethasone (20 mg/kg q 6 hours, i.v.) and 13 patients (13 eyes) at the second center received methylprednisolone (30 mg/kg followed by 15 mg/kg q 6 hours, i.v.). Treatment was started on average 17 hours and 4.2 days following injury in the dexamethasone and methylprednisolone groups, respectively. Improvement was reported in 7 of 9 (77.78%) eyes of the dexamethasone group and 12 of 13 (92.31%) eyes in the methylprednisolone group. The methylprednisolone-treated patients appeared to do as well as the dexamethasone-treated patients despite their being treated later than the dexamethasone group. High doses of intravenous dexamethasone (4 mg followed by 3 mg/kg/day divided q 4-6 hours) was proposed by Boyd[10] for treatment of traumatic optic neuropathy.

Chen et al[11] conducted a retrospective study in 21 patients treated with methylprednisolone. Thirteen of the 21 (62%) patients experienced an improvement. Visual improvement was reported in 80 per cent of patients with initial vision better than LP but 20 per cent of patients with NOLP initially.

From our study, three or more lines of improvement were reported at 2 weeks and 2 months (70 and 67%, respectively) in patients treated with dexamethasone, and 45 and 33 per cent, respectively, in patients treated with methylprednisolone. Despite the limitations including a small sample size and more non-followed-up patients in the methylprednisolone group dexamethasone had comparably better efficiency than methylprednisolone in the treatment of traumatic optic neuropathy. Dexamethasone currently costs less and requires lower

maintenance doses than methylprednisolone. Dexamethasone possibly has fewer adverse effects than methylprednisolone although no adverse effects of either drug was observed during our study.

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Dexamethasone และ Methylprednisolone ในการรักษาการบาดเจ็บที่เส้น-ประสาทตาชนิด indirect

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การศึกษาครั้งนี้เป็นการศึกษาแบบ prospective, randomized, double blind study เพื่อศึกษาเปรียบเทียบประสิทธิภาพของยา dexamethasone และ methylprednisolone ในการรักษาการบาดเจ็บที่เส้นประสาทตาชนิด indirect ผู้ป่วยบาดเจ็บที่เส้นประสาทตาชนิด indirect จำนวน 21 ราย ซึ่งเข้ารับการรักษาภายใน 7 วันภายหลังประสบอุบัติเหตุ เป็นผู้ป่วยเพศชาย 20 ราย และเพศหญิง 1 ราย อายุเฉลี่ย 26.38 ± 11.89 ปี โดยร้อยละ 71.43 เกิดจากอุบัติเหตุรถยนต์หรือรถจักรยานยนต์ พบการบาดเจ็บร่วมที่ศีรษะและกระดูกใบหน้าร้อยละ 43.48 และ 34.78 ตามลำดับ ก่อนการรักษาร้อยละ 19.05 ไม่สามารถมองเห็นแสง ใช้วิธีการสุ่มตัวอย่างให้ได้รับการรักษาด้วยยา dexamethasone 10 รายและ methylprednisolone 11 ราย ทางเส้นเลือดดำเป็นระยะเวลา 72 ชั่วโมง ประเมินระดับสายตาของผู้ป่วยโดยใช้ Snellen chart ก่อนการรักษา และภายหลังเริ่มรักษาที่ระยะเวลา 1, 2, 3, 7, 14, 30 และ 60 วัน ภายหลังได้รับการรักษา ผู้ป่วยมีระดับสายตาดีขึ้นตั้งแต่ 3 แถว Snellen chart ร้อยละ 70 และร้อยละ 66.67 ในกลุ่ม dexamethasone และร้อยละ 45.45 และร้อยละ 33.33 ในกลุ่ม methylprednisolone ที่ระยะเวลา 2 สัปดาห์และ 2 เดือนตามลำดับ ไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติของอายุ สาเหตุการบาดเจ็บ ระยะเวลาและระดับสายตาก่อนการรักษารวมถึงผลการรักษาระหว่างผู้ป่วยทั้งสองกลุ่ม สรุปผลการศึกษานี้ ยา dexamethasone และ methylprednisolone มีประสิทธิภาพไม่แตกต่างกันในการรักษาการบาดเจ็บที่เส้นประสาทตาชนิด indirect

คำสำคัญ : Traumatic Optic Neuropathy, Dexamethasone, Methylprednisolone

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