Assessment & Outcomes of Paediatric Optic Neuritis in a Tertiary Children's Hospital in the United Kingdom: A 10-year Retrospective Review

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Background

Due to its rarity, there is limited long-term data available on Paediatric Optic Neuritis (PON) such as clinical features, diagnosis & management practices.

In PON, it is important to consider demyelinating conditions such as Multiple Sclerosis (MS), Neuromyelitis Optica Spectrum Disorder (NMOSD) & myelin-oligodendrocyte glycoprotein associated disease (MOGAD) – which may have significant implications on patient care. Due to lack of data about treatment practices, management is often extrapolated from the Optic Neuritis Treatment Trial (ONTT), that showed intravenous corticosteroids accelerate recovery but did not affect final visual outcomes in adults. To address this gap, the Pediatric Optic Neuritis Prospective Outcomes Study (PONPOS) was initiated, & recently published data on 2-year visual outcomes, recurrence rates, & final diagnoses in PON cases in USA.

Our review aims to further define clinical presentations, visual outcomes & treatment practices in PON, within a tertiary paediatric hospital in the United Kingdom.

Methodology

Alder Hey Children's Hospital: 1st May 2014-31st April 2024

- 0-16 years old
- First episode of ON

Unilateral (n=13/16)	Bilateral Simultaneous* (n=3/16)	Bilateral Sequential** (n=0/16)

Data Collection

- Demographic data
- Clinical presentation
- Examination findings*** including optic nerve function & evidence of disc swelling
- MRI findings
- Further investigations e.g. bloods/LP/VEP
- Treatment regime

Follow -Up Data

Recorded at 2 weeks, 3 months, 6 months, 1 year & 3 years post-presentation.

Minimum follow up: 2 weeks

*As defined by PONPOS: second eye presenting within 1 month of first eye
** As defined by PONPOS: second eye presenting >1 months after first eye
*** LogMAR visual acuity was documented. Low vision categories were converted as follows:

- No Light Perception (NPL) = 3.0 LogMAR
- Light Perception (LP) = 2.7 LogMAR
- H& Movement (HM) = 2.3 LogMAR
- Counting Fingers (CF) = 1.9 LogMAR.

Results

Baseline Characteristics at Presentation	Total (n=16)
Sex	Female = 9 (56%), Male = 4 (44%)
Mean Age	11 years (median=10.5, range 3-16) Over 10 years = 14/19 (74%)
Laterality of ON	Unilateral = 13 (81%) Right eye = 7/13 (54%) Left eye = 6/13 46(%)
History of demyelination	None = 14 (88%) Relapsing Remitting MS= 2 (13%)

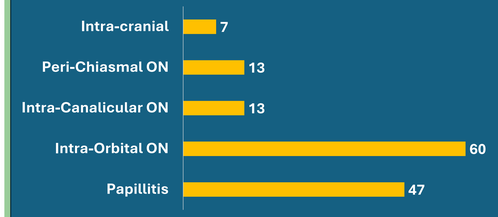
Ocular Examination

- **Unilateral**: 46% presented with optic disc swelling.
- **Unilateral**: 50% of swelling resolved within 2 weeks, & 83% by 3 months
- **Bilateral** : 67% presented with disc swelling. One resolved at 3 months, & the other had prominent discs at 3 years.

Visual Acuity

- Data available for 15/16 patient, one patient (3 years) was un-cooperative
- 78% presented with VA<0.3LogMAR, which fell to 14% at 3 months *(McNemar's, p=0.002)*
- Majority of improvements occurred within the first 3 months; however, improvement of 0.48LogMAR (Mean) was seen from 3 months to 1 year.

MRI: Sites of Optic Nerve Inflammation (%)



Two bilateral optic neuritis (ON) patients had multi-focal high signal across the supratentorial brain – of which, one demonstrated longitudinal high signal at C1/C2 & T12. This patient was Aquaporin-4 & MOG-Ab negative, & responded poorly to steroids, thus required PLEX

Symptomatology

- 100% visual blurring or vision loss
- 37% headaches
- 25% pain on eye movements
- 19% dizziness

Recurrence

- No recurrences (via Paediatric Emergency, Neurology or Ophthalmology attendance).
- No patients diagnosed with MS were commenced on immunomodulators/biologics

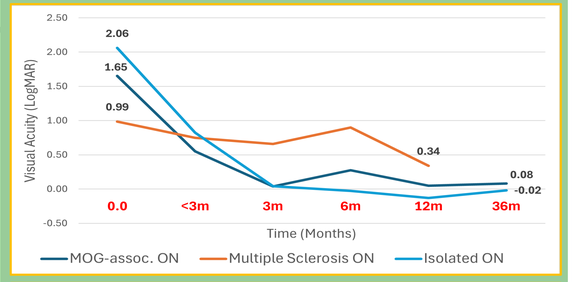
Management of Bilateral ON (n=3)

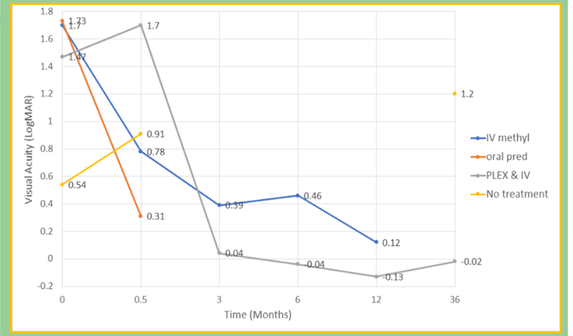
- All received 5-days IVMP (20-30mg/kg once a day, maximum dose 1g/day) then 6-week tapering oral prednisolone (initial dose 1-2mg/kg/day).
- One bilateral simultaneous ON did not respond to IVMP. Commenced on plasma exchange (PLEX) on day 11. VA prior to PLEX was 1.5 LogMAR in both eyes, & improved to RE 0.8, LE 0.9 LogMAR nine days post-PLEX. 1-month post-PLEX, VA RE 0.02, LE 0.1

Management of Unilateral ON (n=13)

- Nine patients received IVMP (see dose above) followed by tapered oral prednisolone (see dose above). Eight had a 5-day IVMP course, one had a 3-day course. .
- Two patients had 400-500mg oral methylprednisolone followed by a prednisolone tapering course (one with known MS had 5 days, & one with MOG-associated ON had 3 days)
- Two patients had no steroid treatment – one self-resolved, & one was treated for meningococcal septicaemia.

Final Diagnosis		
Bilateral	MOG-Positive Optic Neuritis	67% (n=2/3)
	Isolated Optic Neuritis	33% (n=1/3)
Unilateral	MOG-Positive Optic Neuritis	39% (n=5/13)
	Isolated Optic Neuritis	15% (n=2/13)
	Relapsing-Remitting MS-associated Optic Neuritis	23% (n=3/13)
	Optic Neuritis secondary to Viral Infection	15% (n=2/13)
	Optic Neuritis secondary to Meningococcal Septicaemia	8% (n=1/13)





Progression of Visual Acuity over 3-years

LogMAR in Affected Eye	Presentation (n=18)	2 weeks (n=18)	3 months (n=14)	6 months (n=9)	1 year (n=8)	3 years (n=5)
1.00 or worse	12 (67%)	7 (39%)	2 (14%)	0 (0%)	0 (0%)	0 (0%)
0.31 - 0.99	2 (11%)	7 (39%)	0 (0%)	3 (33%)	1 (13%)	1
0.3 - 0.01	4 (22%)	4 (22%)	12 (86%)	5 (56%)	5 (62%)	3
≤0.00	0 (0%)	(0%)	(0%)	1 (11%)	2 (25%)	1
Mean VA (LogMAR)	1.63	0.75	0.32	0.3	0.04	0.2
Mean change from previous review (Paired t-test)	-	Improvement by 0.92 LogMAR (p=0.003)	Improvement by 0.45 LogMAR (p=0.01)	Improvement by 0.23 LogMAR (p=0.43)	Improvement by 0.25 LogMAR (p=0.03)	Worsened by 0.1 LogMAR (p=0.12)

Discussion

Whilst majority presented with VA ≤ LogMAR 1.0 (63%), most improved to ≤0.3 LogMAR (86%). The deterioration in VA between 1 & 3 years was not significant & likely due to small sample size & bias from only following up patients with limited recovery. Although recovery was greatest in the first 3 months, improvement can continue up to a year. This is important for counselling & underscores the need for continued monitoring in cases of partial recovery.

Pain on eye movements was reported in 25% of cases. This is lower than adult ON & previous PON reports (50-60%), possibly due to symptomatology reporting or anatomical distribution of inflammation. MRI findings confirmed the intra-orbital optic nerve (60%) & papilla (47%) were the most affected sites– similar to the ONTT. ON was mainly unilateral, with only 20% bilateral simultaneous, & no bilateral sequential cases. These rates are higher than in adults, but lower than previous PON studies. Majority of our patients were over 10 years over – Waldman et al. noted lower rates of bilateral disease in those over 10 years (30% vs 70%). No recurrences were identified, though this may reflect loss to follow up or transition to adult care.

MOGAD was the most common diagnosis (47%), followed by isolated ON (31% & MS-associated ON (19%). No statistically significant difference in final VA was noted between MOG-positive ON, MS-associated ON & isolated ON (ANOVA: MOG vs MS p=0.14; MOG vs isolated ON p=0.14; MS vs isolated ON p=0.59; Bonferroni-adjusted significance threshold = 0.017) .MS was diagnosed only in older adolescents, reinforcing its lower prevalence in PON compared to adults. The association of PON with MOGAD over MS highlights a key distinction from adult ON.

Initial treatment regimes varied, reflecting lack of consensus on PON. IVMP is the most utilized, likely due to familiarity adult practice, & the need for rapid intervention as PON presents with profound vision loss, & bilateral disease. NICE guidelines for an acute relapse in MS in adults recommend high dose oral methylprednisolone, which may result in a growing trend of oral methylprednisolone in demyelinating PON – as seen in two cases in our cohort. PLEX is increasingly used for steroid-resistant cases, with previous studies advocating optimal initiation to be within 2-3 weeks. Steroid use in children warrants caution due to side effects such as mood changes, hypertension & growth issues. A tailored & closely monitored approach is essential.

Conclusion

These findings provide valuable insight into the presentation, management & outcomes of PON. Our findings highlight significant variation in treatment trends, with a predominance of intravenous corticosteroid therapy. The study also confirms a relatively lower risk of MS compared to adults, with a high prevalence of MOG-associated optic neuritis. Despite poor initial visual acuity in many cases, outcomes were generally favourable, with significant recovery possible up to one-year post-presentation. These results underscore the need for individualized management strategies & long-term follow-up to optimize outcomes for paediatric patients with optic neuritis.

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