**Title:**

**Peri-orbital and Orbital cellulitis in children - a survey of Emergency Physicians and analysis of clinical practice guidelines across the PERUKI network.**

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**ABSTRACT**

**Background**

Due to limited evidence to guide management of peri-orbital cellulitis (POC); we surveyed current practice and assessed quality and consistency of local clinical practice guidelines (CPGs) to highlight future research priorities.

**Methods**

A web-based survey was sent to a designated emergency physician (who clinically assess children), at Paediatric Emergency Research United Kingdom and Ireland (PERUKI) sites between 23rd November 2018 to 22nd January 2019. A nominated site lead offered one response as a department-wide perspective on admission, severity assessment, treatment, disposition and specialty consultation request. Sites shared their CPG. These were compared using a standardised data collection tool, and quality assessed using Standardised Reporting Practice Guidelines in Healthcare (RIGHT) criteria. Survey responses were also compared against CPG recommendations.

**Results**

83% (49/59) institutions invited submitted an individual survey response. 67% of responding sites had a CPG and 63% (31/49) submitted these. CPG quality was poor (mean 6.7/35 RIGHT criteria.) 21 different severity markers were identified across CPGs. Most CPGS recommend investigations for severe disease, yet 23% (7/31) advise blood culture universally. 90% of CPGs advise discharge with oral antibiotics for milder cases, yet 86% of respondents reported departmental admission of all POC patients. Nearly all respondents included proptosis, systemically unwell and visual disturbance as indications for admission; but differed regarding importance of other signs.

**Conclusions**

We demonstrated variation in practice across the PERUKI network in assessment of severity and management of POC. CPGs vary in recommendations, and clinical practice appears to differ from CPGs. Guidelines were generally of poor quality when compared against RIGHT standards.

**What is known on this subject?**

• Periorbital infection is relatively common in children although risks of the most serious complications have been reduced by successful vaccination programmes

• There has been no large-scale assessment of practice for management of this infection and no national or international guidelines exist.

**What this study adds?**

• In this survey of respondents from PERUKI sites, we found that the assessment of severity, the approach to investigation, management and follow up varies significantly between institutions. CPGs vary significantly, and no CPG reports if or how evidence from clinical research has been used in its development

• Respondents frequently reported practice inconsistent with the CPG.

• These findings suggest a need for periorbital and orbital cellulitis national consensus guidance

**INTRODUCTION**

Periorbital infection is a common paediatric presentation.1-3 Normally, infection remains anterior to the orbital septum (preseptal cellulitis). When infection extends further (orbital cellulitis) there is potential risk to sight, and of life-threatening intracranial sequelae, including meningitis, cerebral abscess or cavernous sinus thrombosis.1-4 The risk of these traditionally mandated cautious management with intravenous antibiotics. However, complications have decreased with *Haemophilus influenza* type B vaccination programmes,5 and changes in practice including ambulatory intravenous treatment, minimal investigations and first-line oral antibiotics have resulted. To date, only small-scale audit of this practice change has occurred.6

There is no national clinical practice guideline (CPG) in the UK or Ireland, nor established international guidelines. This likely reflects paucity of high-quality evidence with no multicentre randomised controlled trials in adult or paediatric populations. Therefore, uncertainty exists for clinicians who must weigh individual patient risk of complications due to undertreatment, against risks of admission, and responsible antibiotic stewardship.

This project analysed available local written guidance and contrasted current practice of UK clinicians. Aiming to identify both consensus and equipoise, enabling prioritisation of future research.

**METHODS**

An online survey (SurveyMonkey, www.surveymonkey.com) was undertaken 23rd November 2018 to 22nd January 2019. One response was sought from each Paediatric Emergency Research in the UK & Ireland (PERUKI) site lead across the research network. Respondents were emergency consultants (Adult or Paediatric) clinically assessing children. This study is reported in line with the CHERRIES statement.7

**Survey instrument**

Survey content was derived from existing literature (author MTC) and refined iteratively by the study team. The survey was piloted by the PERUKI Research Steering Committee before release (See supplementary 1). In the survey, a nominated site lead was asked to offer a department-wide perspective as opposed to answering based on individual practice alone. Respondents were asked about specialties on-site, frequency of cases, and proportion of patients admitted. The survey also included assessment, treatment and disposition of patients, and questions on four clinical scenarios.

In addition, respondents were asked to submit their local CPG.

Survey data was analysed using Microsoft Excel (Microsoft Corporation). CPGs were assessed using a standardised data collection tool (See supplementary 2) that was piloted and edited to ensure accurate data. Two assessors (MTC, JE) independently undertook data extraction, and a third assessor (TW) arbitrated to establish consensus. The quality of CPGs were judged against Standardised Reporting Practice Guidelines in Healthcare (RIGHT) criteria.8

Simple descriptive statistics were used to analyse data.

Ethics

This survey assessed reported practice. Formal ethics review was not required as per the Framework for Health and Social Care Research UK. Consent was implied by participation. There was no patient or public involvement in study design or implementation.

**RESULTS**

49/59 (83%) sites provided complete responses. 43% (21/49) were from district general hospitals and 57% (28/49) from tertiary hospitals. Of the 49 participating sites, 67% (33/49) had a local CPG of which 31 were obtained, representing 53% of eligible PERUKI sites.

**Quality of CPGs**

CPG quality was poor when judged using RIGHT criteria; mean score 6.7/35 (range 2-14) (22 criteria, 13 sub-sections; data supplement). The poorest scoring criteria involved evidence-base (e.g., what questions CPG was based on, how outcomes were selected, strength of recommendations, gaps in evidence and limitations). 58% (18/31) of CPGs reported a quality-assurance process.

**Assessing severity**

Across CPGs, 21 different features were listed in severity assessment including clinical findings, investigation results and age (Figure 1a). Most common were proptosis, ophthalmoplegia, systemic illness, visual disturbance and failure of oral antibiotics. The same features were identified by survey respondents as the most common indicators for admission (Figure 1b) and CT scan (Table 2). However, other than those listed above, the importance attached to these varied. (Figure 1b & supplementary Figure 2)

**Investigations**

Most CPGs recommend investigations only in severe disease, 77% (24/31) and 90% (28/21) for blood tests and CT head respectively (Table 1). 86% (42/49) of respondents stated they do blood tests on a systemically unwell child and only 4% (2/49) reported performing blood tests universally (Table 1).

**Treatment and Disposition**

90% of CPGs recommended oral antibiotics first-line for mild peri-orbital cellulitis. Site responses mirrored this; 78% (38/49) offer oral antibiotics to patients not requiring admission. 90% of CPGs recommend, and 96% of respondents stated they use co-amoxiclav as first-line oral antibiotic (Table 1).

Only 10% of CPGs advocate universal admission while 86% (42/49) of survey respondents reported that their department typically admitted all paediatric periorbital infections.

**Specialist Review**

If patients are admitted, 84% (26/31) of CPGs recommend ophthalmology review, and 68% (21/31) ENT review. Respondents always request inpatient review less frequently, (63% (31/49) and 37% (18/49) for Ophthalmology and ENT respectively) (Table 1).

**Follow-up**

74% (23/31) of CPGs lacked follow-up guidance. 26% (8/31) made discharge recommendations including follow-up 16% (5/31), safety netting advice 6% (2/31) and open access 3% (1/31).

However, individual responses indicated 78% (38/49) of clinicians follow-up cases. 45% (22/49) with ED or paediatrics and 24% (12/49) arrange speciality follow-up.

**DISCUSSION**

This study demonstrates practice variation in the management of paediatric peri-orbital cellulitis in the UK, with varying quality across 31 local CPGs. The lack of evidence-base in diagnosing and stratifying severity is the likely aetiology of this variance (no CPG reported any evidence-base to inform the guidance). The survey also mirrored this, demonstrating both variation between different sites and also against CPG recommendations.

A strength of this research is that it reflects reported departmental management, as well as reviewing CPGs and so provides wide coverage of current UK practice. Limitations included a single respondent from each site reporting perceived departmental practice. Inevitably this will introduce bias. Furthermore, all sites were members of a research collaborative, and survey respondents were PERUKI site leads and consultants. This population may not be representative of all sites and clinical decision makers. Further limitations were that not all sites responded and 2 CPGs were unobtainable and therefore not assessed.

The heterogeneity demonstrated suggests need for national, evidence-based guidance that addresses the following:

* Which criteria or investigations should be used to define severity of disease?
* Which patients require admission and specialist input?
* Which antibiotics should be used, by which route, and for how long?

Improved understanding may decrease admissions or parenteral antibiotic usage, whilst maintaining safety.

**Declarations**

**Ethics Approval and Consent to Participate**

Under current United Kingdom health research authority guidance this work did not require research ethics committee review as was determined to be service evaluation.

**Consent for Publication**

Not Applicable

**Availability of Data and Materials**

The datasets analysed during the current study are available from the corresponding author on reasonable request.

**Competing Interests**

The authors declare that they have no competing interests.

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**Author’s Contributions**

Conceptualised and led study: MT-C

Contributed to the design of the study: All authors (MT-C, JE, TW, RM, JA, DR, ML)

Developed the survey: MT-C, JE

Analysed the survey data: MT-C

Analysed the clinical practice guidelines: MT-C, JE, TW

Drafted the manuscript: MT-C, JE, TW, RM, JA

Critically reviewed the manuscript and contributed to its revision: DR, ML

Supervised all aspects of the work: TW, DR, ML

All authors approved the final manuscript and share accountability for the study as a whole.

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**Table 1 – Results of CPG review and Survey Responses**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **CPG Recommendations**  **N=31** | **Survey Responses**  **N=49** | | |
| **Number of severity variables** | 21 | 23  *(indicators for admission used as surrogate marker for severity)* | | |
| **Investigations** |  | **Discharged** | | **Admitted** |
| **Blood tests** | † 77% (24/31) | 4% (2/49) on all patients  86% (42/49) on systemically unwell patient | | |
| **CT-Orbit/Brain** | † 90% (28/31) | \* | | |
| **Eye Swab** | † 55% (17/31) | 24% (12/49) | 53% (26/49) | |
| **Nasal Swab** | † 26% (8/31) | 71% (35/49) | 8% (4/49) | |
| **Specialty Referrals** | |  | | |
| **ENT** | ‘routine review’ 68% (21/31) | Always – 14% (7/49) | Always –37% (18/49) | |
| Sometimes – 57% (28/49) | Sometimes – 59% (29/49) | |
| Never – 29% (14/49) | Never – 4% (2/49) | |
| **Ophthalmology** | ‘routine review’ 84% (26/31) | Always – 29% (14/49) | Always – 63% (31/49) | |
| Sometimes –61% (30/49) | Sometimes –37% (18/49) | |
| Never – 10% (5/49) | Never = 0% (0/49) | |
| **Prescription of nasal decongestants** | 55% (17/31) | Always – 24% (10/49) | Always – 24% (12/49) | |
| Sometimes – 39% (19/49) | Sometimes – 49% (22/49) | |
| Never – 51% (25/49) | Never – 31% (15/49) | |
| **Follow-up** |  |  |  | |
| **Specialty** | 13% (4/31) | 24% (12/49) | N/A | |
| **Paediatric or ED** | 3% (1/31) | 45% (22/49) | N/A | |
| **GP** | 0% (0/31) | 4% (2/49) | N/A | |
| **Open access/ safety netting** | 10% (3/31) | 4% (2/49) | N/A | |
| **Nil specified/ arranged** | 74% (23/31) | 12% (6/49) | N/A | |
| **Other** | 0% (0/31) | 10% (5/49) | N/A | |
| **Oral antibiotics for mild disease** | 90% (28/31) | 78% (39/49) | | |
| **1st line oral antibiotic** | | | | |
| Co-amoxiclav | 90% (28/31) | 96% (47/49) | | |
| Not applicable | 10% (3/31) | 4% (2/49) | | |
| **Recommended minimum duration of oral antibiotics (days)** | | | | |
| 5-7 days | 23% (7/31) | 67% (33/49) | | |
| 8-10 days | 26% (8/31) | 18% (9/49) | | |
| 11-14 days | 10% (3/31) | 6% (3/49) | | |
| Not stated | 32% (10/31) | 4% (2/49) | | |
| Not applicable/ other | 10% (3/31) | 4% (2/49) | | |
| **1st line intravenous antibiotic if required** | | | | |
| Ceftriaxone | 55% (17/31) | 51% (25/49) | | |
| Co-amoxiclav | 29% (9/31) | 39% (19/49) | | |
| Cefotaxime | 13% (4/31) | 6% (3/49) | | |
| Cefuroxime | 3% (1/31) | 2% (1/49) | | |
| Unknown | \* | 2% (1/49) | | |
| **Additional antimicrobial advised first line in addition to 3rd generation cephalosporin** | | | | |
| Metronidazole | 29% (9/31) | 24% (12/49) | | |
| Flucloxacillin | 19% (6/31) | 18% (9/49) | | |
| **Recommended minimum duration before changing to oral antibiotics (days)** | | | | |
| 24 hours | 6% (2/31) | 31% (15/49) | | |
| 48 hours | 16% (5/31) | 35% (17/49) | | |
| >7 days | 0% | 2% (1/49) | | |
| Other | 24% (7/31) | 36% (18/49) | | |
| Not Stated | 55% (17/31) |  | | |

\*In table refers to data not available. † Specified for severe disease

**Table 2. A. Survey responses to case vignettes. B. Management indicated by clinical variables**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. **Case Vignettes** | | | | | | | | | | | | | |
| **Case** | **Antibiotic Therapy** | | | | | | | | **Disposition** | | | | |
|  | **None** | | | **Oral** | | **IV~** | | | **Admit** | | | **Discharge with f/u~** | **Discharge without f/u** |
| ***Case 1: 4-year-old, systemically well, no visual disturbance, mild erythema of the lower lid only with no swelling.*** | 22%  (11/49) | | | 76% (37/49) | | 0% (0) | | | 4%  (2/49) | | | 55%  (27/49) | 37%  (18/49) |
| ***Case 2: More severe 2-year-old, very oedematous eye, clingy and unsettled, not febrile. No visual disturbance or ophthalmoplegia.*** | 0%  (0) | | | 37% (18/49) | | 63% (31/49) | | | 72%  (35/49) | | | 20%  (10/49) | 6%  (3/49) |
| ***Case 3: Afebrile, systemically well, 6-year-old with moderate oedema and redness of the eye but no visual disturbance or other eye signs*** | 6%  (3/49) | | | 72% (35/49) | | 22% (11/49) | | | 18%  (9/49) | | | 65%  (32/49) | 12%  (6/49) |
| ***Case 4:*** ***Systemically well, 6-year-old with moderate oedema and eye redness, no visual disturbance or other eye signs***, ***fever 38.0C*** | 0%  (0) | | | 49% (24/49) | | 51% (25/49) | | | 59%  (29/49) | | | 35%  (17/49) | 4%  (2/49) |
| 1. **Management indicated by clinical variables** | % Of respondents | | | | | | | | | | |  | |
|  | **Admission indicated** | | | | | **CT indicated** | | | | | | **Blood test indicated** | |
| **Likert Scale** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** | | **4** | **5** |  | |
| **Young age** | 2 | 12 | 37 | 29 | 20 | 8 | 45 | 33 | | 0 | 4 | 24% | |
| **Systemically unwell** | 0 | 0 | 4 | 16 | 80 | 0 | 16 | 39 | | 24 | 12 | 86% | |
| **Fever** | 2 | 10 | 25 | 47 | 16 | 12 | 33 | 31 | | 6 | 4 | 51% | |
| **Proptosis** | 0 | 0 | 0 | 2 | 98 | 0 | 2 | 6 | | 27 | 65 | 65% | |
| **Ophthalmoplegia** | 0 | 0 | 0 | 2 | 98 | 0 | 0 | 6 | | 20 | 67 | 65% | |
| **Chemosis** | 6 | 10 | 30 | 29 | 25 | 10 | 45 | 20 | | 12 | 4 | 14% | |
| **Conjunctival Injection** | 8 | 25 | 42 | 21 | 4 | 20 | 47 | 14 | | 6 | 2 | 10% | |
| **Upper & lower lid involvement** | 2 | 4 | 58 | 23 | 13 | 10 | 37 | 39 | | 6 | 0 | 16% | |
| **Severity of erythema + oedema** | 0 | 0 | 23 | 52 | 25 | 2 | 14 | 47 | | 22 | 8 | 43% | |
| **Tenderness** | 2 | 13 | 33 | 38 | 14 | 10 | 22 | 37 | | 20 | 2 | 20% | |
| **Inability to examine eye** | 0 | 2 | 8 | 26 | 64 | 4 | 8 | 24 | | 31 | 27 | 49% | |
| **Pain on eye movement** | 0 | 0 | 4 | 20 | 76 | 0 | 6 | 14 | | 39 | 39 | 63% | |
| **Speed of spread** | 0 | 2 | 9 | 49 | 41 | 0 | 16 | 43 | | 39 | 8 | 52% | |
| **Failure to tolerate oral antibiotics** | 0 | 2 | 25 | 27 | 46 | \* | | | | | | \* | |
| **Failure of oral antibiotics** | 0 | 2 | 6 | 16 | 74 | \* | | | | | | \* | |

\*In table refers to data not available. ~ f/u = follow-up. **Likert scale** 1 = Never, 2 = Rarely 3 = Sometimes, 4 = Frequently, 5 = Always