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Early Endoscopic Sinus Surgery Versus Antibiotics Alone for Orbital Cellulitis from Acute Rhinosinusitis – A Retrospective Cohort Study

Panuchporn Pluksa[1] and Patorn Piromchai[2]*

[1]Department of Otolaryngology, Khon Kaen Hospital, Khon Kaen, Thailand.
[2]Department of Otorhinolaryngology, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand.
*Corresponding Author E-mail: patorn@gmail.com

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Orbital cellulitis is a common complication of sinusitis that can cause blindness, intracranial infection, or even death. The standard treatment of orbital cellulitis from acute rhinosinusitis is to administer antibiotics and closely monitor the visual acuity. In this study, we explored the benefit of early endoscopic sinus surgery to improve the clinical outcome of the patients. The objective of this study was to study the clinical outcomes of orbital cellulitis from acute rhinosinusitis patients who were treated with early endoscopic sinus surgery (within 48 hours after admission) versus antibiotics alone. We retrospectively reviewed the patients who were admitted to the Otolaryngology Department, Khon Kaen Hospital, Thailand with orbital cellulitis from acute rhinosinusitis from January 2013 to May 2023. The demographic data, treatment received, and clinical outcomes were collected. This study included 77 patients. All patients were treated with empirical intravenous antibiotics. The mean age for all patients was 43.7 years. The most common underlying diseases were diabetes and hypertension. The most common symptoms and signs were periorbital swelling and chemosis. The early endoscopic sinus surgery was performed in 44 patients while 33 patients received antibiotics only. At 48 hours after admission, one patient in the early endoscopic sinus surgery group (2.27%) and 12 patients in the antibiotics-only group (36.36%) had no clinical improvement. The odds ratio of improvement after early endoscopic sinus surgery was 24.57 (95% CI 2.99 to 201.80, p = 0.003). The intravenous antibiotics duration and length of stay were also shorter in the early endoscopic sinus surgery group (p = 0.020 and 0.065, respectively). Early endoscopic sinus surgery in orbital cellulitis from acute rhinosinusitis patients may improve clinical outcomes, shorter intravenous antibiotics duration, and hospital stay.

Keywords: Antibiotics, orbital cellulitis, rhinosinusitis, sinusitis, surgery, sinus surgery.

Orbital cellulitis is a common complication of acute rhinosinusitis caused by the spreading of the organism from the sinus to the orbit.[1] 74-85% of orbital cellulitis was arising from acute rhinosinusitis. Other etiologies were lacrimal sac infection, eye foreign body, eye trauma, dental infection, endophthalmitis, previous eye surgery, eye tumors, and local skin inflammation.[2,3]

The ethmoid sinus is a common site of infection that spreads into the eye socket due to the ethmoid sinus and the orbit is only separated by a thin layer of bone i.e., lamina papyracea.[4] Infection

from other sinuses may spread to the orbit by local thrombophlebitis. Although orbital cellulitis has a relatively low incidence, it can cause serious complications such as vision loss, intracranial infection, and even death.[5]

In the past when antibiotics were not widely used, morbidity and mortality of orbital cellulitis from acute rhinosinusitis were 20.5% and 17% respectively.[6] At present, the morbidity and mortality were reduced to 3-11% and 1-2.5% respectively.[7] The common bacterial pathogens found included *Streptococcus spp*., *Staphylococcus aureus*, anaerobic/facultative gram-negative rods, and anaerobic gram-positive cocci.[8]

The current standard treatment for orbital cellulitis from acute rhinosinusitis is to administer intravenous antibiotics and closely monitor the visual acuity. Surgery will be considered in the patients who had been given intravenous antibiotics, and whose condition worsens or does not improve within 24-48 hours.[9] Surgery is performed to drain pus and correct inflammation, including widening of sinus obstruction.[1,4] The surgery can be performed by external approach or endoscopic approach.

The intravenous antibiotics had a treatment failure rate of up to 40 percent.[10] Due to this reason, a recent study advocated early surgical intervention when the patients present with some markers for severe orbital cellulitis.[11] Another study also found that from 2008 to 2013, the trend of surgical intervention was increasing.[12]

In this study, we explored the benefit of early endoscopic sinus surgery to improve the clinical outcome of the patients. The objective of this study was to study the clinical outcomes of orbital cellulitis from acute rhinosinusitis patients who were treated with early endoscopic sinus surgery (within 48 hours after admission) versus antibiotics alone.

METHODS

Study design and setting

We conducted the retrospective Cohort study comparing early endoscopic sinus surgery (within 48 hours after admission) versus antibiotics alone in orbital cellulitis from acute rhinosinusitis patients. We collected the data from the Otorhinolaryngology Department, Khon Kaen Hospital, Thailand from January 2013 to May 2023.

Inclusion and exclusion criteria

The inclusion criteria were orbital cellulitis from acute rhinosinusitis patients. The exclusion criteria were the patients who cannot trace medical records, diagnosed with sinonasal or nasopharyngeal carcinoma, and existing eye diseases.

Data Collection

Information retrieved from the patient's admission records included gender, age, underlying diseases, symptoms and signs, eye symptoms, white blood cell count, finding in CT paranasal sinus and orbit, treatment modality, antibiotics received, duration of hospital stay, duration of intravenous antibiotic administration, signs, and symptoms improvement at 48 hours after admission.

All patients are given intravenous antibiotics. Pre-operative CT scan of the paranasal sinus was performed. All patients were closely monitored for eye symptoms. If the symptoms worsen or do not improve 48 hours after admission, they will be treated with endoscopic sinus surgery.

Definition of improvement

The definition of improvement at 48 hours after admission was defined as no fever at 48 hours after admission and improvement of clinical signs such as proptosis, chemosis, visual impairment, and ophthalmoplegia.

Statistical Analysis

The analysis was done using Stata software (version 9, StataCorp LP, Texas, USA). Continuous. For the continuous outcomes, we test the hypothesis using the unpaired t-test or Mann-Whitney U test. For the categorical outcomes, we test the hypothesis using Pearson's $\chi 2$-test.

The odds ratio was used to evaluate the clinical efficacy of endoscopic sinus surgery compared to intravenous antibiotics alone. The p-value of < 0.05 was considered statistically significant.

Ethics

Approval was sought from the Khon Kaen Hospital Ethics Committee for Human Research before initiating the study (ID: KEXP66047). The need for informed consent was waived by the ethics review board according to the nature of a retrospective study.

RESULTS

There was a total of 77 patients with orbital cellulitis secondary to acute rhinosinusitis. Of these 32 were males (41.56%), and 45 were females (58.44%). The mean age for all patients was 43.7 years (range 1-82 years). The most common underlying diseases were diabetes and hypertension. The most common symptoms and signs were periorbital swelling and chemosis.

The side of orbital cellulitis between group and sinus involvement were comparable between groups ($p > 0.05$). However, the early endoscopic sinus surgery group had a significantly higher white blood cell count ($p = 0.004$) (Table 1)

All patients were given the initial empirical antibiotic treatment to cover common pathogens consisting of ceftriaxone and clindamycin, ceftazidime and clindamycin, amoxicillin-clavulanic acid, ampicillin-sulbactam or piperacillin-tazobactam. Within 48 hours surgery was performed in the early endoscopic sinus surgery group.

At 48 hours, 43 of 44 patients (97.73%) in the early endoscopic sinus surgery group improved. However, only 21 of 33 patients (63.64%) in antibiotics alone improved (Odds ratio 24.57, 95% CI 2.99 to 201.80, $p = 0.003$). (Table 2)

For the average duration of intravenous antibiotic administration, the early endoscopic sinus surgery group had significantly lesser use of intravenous antibiotics ($p = 0.020$). However, there was no statistically significant difference in length of stay ($p = 0.065$). (Table 3)

Table 1. Demographic data

	Early sinus surgery (n=44)	Antibiotics alone (n=33)	p-value
Sex (n, percent)			
- Male	18 (40.91)	14 (42.42)	0.894
- Female	26 (59.09)	19 (57.58)	
Age (mean, SD)	45.82 (23.32)	40.88 (23.64)	0.363
Underlying disease (n, percent)			
- DM	16 (36.36)	9 (27.27)	0.276
- AIDS	0 (0.00)	2 (6.06)	0.387
- CKD	2 (4.55)	2 (6.06)	0.762
- Others	6 (13.64)	5 (15.15)	0.839
Symptoms and signs (n, percent)			
- Periorbital swelling	42 (95.45)	32 (96.97)	0.734
- Chemosis	42 (95.45)	31 (93.94)	0.767
- Ophthalmoplegia	24 (54.55)	15 (45.45)	0.430
- Proptosis	19 (43.18)	10 (30.30)	0.248
- Visual impairment	9 (20.45)	6 (18.18)	0.803
Side of eye (n, percent)			
- Left	23 (52.27)	19 (57.58)	0.644
- Right	21 (47.73)	14 (42.42)	
Sinus involvement (n, percent)			
- Frontal	19 (43.18)	10 (30.30)	0.248
- Maxillary	36 (81.82)	27 (81.82)	0.999
- Ethmoid	38 (86.36)	24 (72.73)	0.135
- Sphenoid	22 (50.00)	14 (42.42)	0.510
- Pansinusitis	9 (20.45)	7 (21.21)	0.935
White blood cell count (n, percent)			
- < 4,000 cell/cm	0 (0.00)	2 (6.06)	0.395
- 4,000 – 10,000	11 (25.00)	17 (51.52)	0.017*
- > 10,000	33 (75.00)	14 (42.42)	0.004*

* - Statistically significant difference

Table 2. Clinical outcome at 48 hours

	Early sinus surgery (N= 44)	Antibiotics alone (N = 33)	Odds ratio (95% CI)	p-value
Improved	43 (97.73)	21 (63.64)	24.57 (2.99 to 201.80)	0.003*
Not improved /required surgery	1 (2.27)	12 (36.36)		

* - Statistically significant difference

Table 3. Intravenous antibiotics duration and length of stay

	Early sinus surgery (N= 44)	Antibiotics alone (N = 33)	Mean difference (95% CI)	p-value
Intravenous antibiotics duration (mean, SD)	6.83 (2.99)	9.27 (5.88)	2.44 (0.39 to 4.49)	0.020*
Length of stay (mean, SD)	7.50 (3.64)	9.94 (7.55)	2.44 (-0.15 to 5.03)	0.065

* - Statistically significant difference

The pus culture was positive in 16 of 37 specimens (43.24%). The most common pathogens were *Staphylococcus spp*., *Streptococcus spp*., and *Klebsiella spp*.

DISCUSSION

Orbital cellulitis can cause high morbidity and mortality. A careful examination of signs and symptoms of orbital cellulitis is important.[13] In this study, the most common symptoms and signs were periorbital swelling and chemosis. The results are consistent with other studies that found that all patients with orbital cellulitis would come with periorbital edema and redness. Other symptoms and signs included proptosis, reduced vision, and ophthalmoplegia.[9, 14]

We found that the orbital cellulitis from acute rhinosinusitis commonly occurred in males. This finding was inconsistent among the literature which one study found this condition more in females.[15] while another study found this condition more common in males.[16]

In this study, the origin of infection was found to be commonly from the ethmoid sinus and maxillary sinus which is comparable with another study.[17] Orbital cellulitis was more prone to infect the left eye than the right eye.

Empirical antibiotics are the standard treatment.[18] The antibiotic should cover common pathogens such as *Staphylococcus spp*., *Streptococcus spp*., and anaerobes.[19, 20] The antibiotic should be adjusted afterward according to culture and sensitivity results. The most common pathogens in this study were *Staphylococcus spp*., *Streptococcus spp*., and *Klebsiella spp*.

There was no standard recommendation for surgical intervention in orbital cellulitis from acute rhinosinusitis. This study found that 43 of 44 patients (97.73%) in the early endoscopic sinus surgery group improved. However, only 21 of 33 patients (63.64%) in antibiotics alone improved (Odds ratio 24.57, 95% CI 2.99 to 201.80, $p = 0.003$).

In this study, surgery within 48 hours significantly reduced the intravenous antibiotics used ($p = 0.020$) and could reduce the length of stay ($p = 0.065$). These will reduce the cost of medical treatment and the expenses of patients.

A recent review of the management options for orbital complications from rhinosinusitis found that the decision to choose surgery and conservation approaches is controversial, especially in subperiosteal abscesses. In orbital cellulitis, broad-spectrum antibiotics can improve the symptoms of the patients ranging from 77 to 100

percent which is comparable to this study which had an antibiotics response rate of 63.64 percent.[21]

In this study, the early endoscopic sinus surgery group had a significantly higher white blood cell count representing a more severe feature ($p < 0.05$). We inferred that the benefit (odds ratio) of early sinus surgery will be increased if all clinical features are comparable.

Surgical treatment requires the knowledge and expertise of the surgeon. Complications from surgery are also possible including blindness and brain damage. The best approach to treatment for this condition is therefore a joint decision of the physician and the patient.

The limitation of this study included the nature of the retrospective studies which may result in a lack of completeness of the data. In future studies, we suggest collecting data on a forward basis in order to make concrete evidence on early surgical intervention in the future. Moreover, exploring the possibility of using tools such as artificial intelligence for clinical diagnosis and decision-making processes may be useful.[22]

CONCLUSIONS

The early endoscopic sinus surgery in orbital cellulitis from acute rhinosinusitis patients may improve clinical outcomes, shorter intravenous antibiotics duration, and hospital stay. More robust studies are needed to confirm the benefit of early endoscopic sinus surgery such as a larger sample size study or a randomized controlled trial.

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