

Neuroimaging Findings in Acquired Esotropia Patients at Siriraj Hospital from 2009–2020

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ABSTRACT

Objective: To analyze the neuroimaging findings in patients with acquired esotropia at Siriraj Hospital from 2009 to 2020.

Materials and Methods: A retrospective review of the medical records of all patients aged above 6 months old who presented with acquired esotropia was done. All the patients had an angle of deviation ≥ 10 prism diopters (PD), refraction $< +3.0$ diopters (D), and had neuroimaging performed. The patients with restrictive myopathy and extraocular neurological abnormalities were excluded from the study.

Results: In total, 177 subjects aged between 8 months old to 81 years old (mean age 32.35 ± 24.40 years old) were included in the study. The patients' demographic data, ocular findings, and neuroimaging findings were collected. The mean angle of deviation at near and distance were 26.88 ± 18.90 PD and 29.81 ± 17.25 PD, respectively. Of the 177 cases, 113 cases (63.8%) had no neuroimaging abnormalities, while 64 cases (36.2%) had abnormal neuroimaging findings. In those 64 cases with abnormal findings, there were 16 intracranial tumors, 6 inflammations, 4 vascular lesions, 7 degenerations, and 31 other lesions. Sixth nerve palsy was found to be significantly different between the positive and negative neuroimaging group from both the uni- and multivariate analysis.

Conclusion: Although more than half of acquired esotropia patients had no abnormalities in neuroimaging, but 14.7% of those with abnormal neuroimaging findings had underlying serious conditions, which consisted of intracranial tumors, inflammation, and vascular lesions. Special attention should be concentrated to patients with sixth nerve palsy as it was the significant factor found to be associated with positive neuroimaging findings in acquired esotropia.

Keywords: Acquired Esotropia; neuroimaging (Siriraj Med J 2023; 75: 508-512)

INTRODUCTION

Esotropia is a type of strabismus characterized by the inward deviation of the eye. It can be classified based on its onset as either infantile esotropia, which occurs within the first 6 months of life, and acquired esotropia, which occurs after this period.¹ Acquired esotropia had been initially classified as accommodative and non-accommodative types.^{2,3} Burain and Miller⁴ further subdivided acute acquired non-accommodative esotropia (AACE) into Swan type, Burian–Franceschetti type, and Bielschowsky type.^{5,6} Although acquired esotropia is less common than its congenital counterpart, it can be

associated with life-threatening conditions.^{5,7} In a study by Cruysberg JR. et al., neurological risk was reported to be equal in comitant and incomitant acquired esotropia.⁸ Dotan G. et al suggested that neuroimaging is suggested in young patients presented with isolated sixth nerve palsy to detect intracranial tumor early.⁹ Nevertheless, the decision to perform neuroimaging in patients is still complex as previous reports have provided conflicting recommendations.¹⁰⁻¹⁸ Furthermore, most studies have focused solely on acute acquired comitant esotropia (AACE) type^{18,19} or patients with sixth nerve palsy. In Thailand, neuroimaging is commonly performed in all

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patients with acquired esotropia, but the incidence and prevalence of life-threatening conditions associated with this acquired esotropia are not well documented. Therefore, the aim of this study is to determine the prevalence and factors associated with abnormal neuroimaging findings in all types of acquired esotropia, excluding the accommodative type, in Thai patients receiving treatments at Siriraj Hospital between 2009 and 2020. The goal is to provide additional information to support the appropriate use of neuroimaging in patients with acquired esotropia.

MATERIALS AND METHODS

The medical records of all patients diagnosed with esotropia at Siriraj Hospital from January 2009 to December 2020 were reviewed. The inclusion criteria were an onset of esotropia ≥ 6 months of age, angle of deviation ≥ 10 PD, refraction $< +3.0$ D, and had imaging of the brain and/or orbit performed. The exclusion criteria were restrictive myopathy and having extraocular neurological signs. This study was approved by Siriraj Institutional Review Board Certificate of Approval (COA no. Si 497/2021).

The collected data included the patients' demographic characteristics, ophthalmological examination (visual acuity, anterior segment examination, posterior segment examination, and angle of deviation at near and distance) and neuroimaging findings. The analysis was performed using descriptive statistics (numbers and percentages, Chi-square test, and Fisher's exact test) and analytic statistics (univariate and multivariate logistic regression).

RESULTS

In total, 177 cases that presented with acquired esotropia at 8 months to 81 years of age (mean 32.35 ± 24.40 years old) were included in the study. The duration of acquired esotropia ranged from 1 day to 520 weeks (mean 58.83 ± 91.98 weeks). All the demographic data and ocular findings are summarized in Table 1. There were 93 male cases (52.5%) and 84 female cases (47.5%). The mean angle of deviation at distance and near were 29.81 ± 17.25 PD and 26.88 ± 18.90 PD, respectively. The study identified various abnormal ocular findings. Sixth nerve palsy was the most frequently observed condition, with a total of 54 cases, while nystagmus and ptosis were each observed in 2 and 1 cases, respectively. Additionally, decreased vision was reported in 6 cases, and abnormalities of the anterior segment were detected in 2 cases. Optic disc atrophy was found in 5 cases, while optic disc edema and optic disc anomaly were identified in 2 and 3 cases, respectively.

Table 2 provides a comprehensive list of the

neuroimaging modalities used in the study, which included both CT and MRI scans. The neuroimaging results revealed various pathologies, including 16 cases of tumors, 6 cases of inflammation, 4 cases of vascular conditions, 7 cases of degeneration, and 31 cases of other conditions (Fig 1). Types of tumors observed in this study are listed in supplement 1. The study identified older age, hypertension, diabetes mellitus, dyslipidemia, sequelae of stroke, coronary artery disease and sixth nerve palsy as factors that differed significantly between patients with positive neuroimaging results and those with negative results, with a p-value of less than 0.001. However, only sixth nerve palsy remained statistically significant in the multivariate analysis. Other ocular abnormalities revealed no significant differences between the two groups.

The authors conducted a subgroup analysis (Supplement 2) to investigate the association factors of patients in different age groups: under 18 years old, aged 19-60 years old, and over 60 years old. The analysis showed that the proportion of patients with abnormal imaging findings was significantly higher in older age group (p-value < 0.001). Among the different age groups, positive findings were significantly associated with decreased visual acuity in patients under 18 years of age, sixth nerve palsy and early onset of less than 6 months in patients aged 19-60 years old, and hypertension in patients over 60 years old.

As the study by Buch H. et al.¹⁶ identified age over 6 years as a factor related to intracranial lesions, subgroup analysis of patients with early onset (< 6 months) and those with onset over 6 months was further done. Patients with positive findings had a higher incidence of older age, hypertension, and sixth nerve palsy in both groups.

DISCUSSION

A total of 177 cases with a diagnosis of acquired esotropia were identified over a 12-year study period. Interestingly, the majority of patients belonged to the age group of 19-60 years. This finding contrasts with previous studies in the Thai population, such as the study by Montriwet M. et al.¹⁹, which found over 70% of patients in age group below 18 years (mean age 10.8 ± 8.6 years) among 41 patients with AACE. Another study by Lekskul A. et al.¹⁸, which investigated 30 patients with AACE, reported a higher mean age but still much lower than our studies (mean of age 22.9 ± 16.1 years and 32.35 ± 24.40 years, respectively). This difference could be related to the varied types of acquired esotropia in this study. The mean angle of esodeviation at distance and near were comparable with many precedent studies^{18,20}, but lower with several studies.^{19,21} The differences could be related to the older age of patients in this study, as

TABLE 1. Demographic data and ocular findings.

Characteristics & signs	Total N (%)	Negative findings N (%)	Positive findings N (%)	P value
Gender (n=177)				
Male	93 (52.5)	58 (51.3)	35 (54.7)	0.667
Female	84 (47.5)	55 (48.7)	29 (45.3)	
Age group (n=177)				
0-18 years	70 (39.5)	53 (46.9)	17 (26.6)	<0.001*
19-60 years	75 (42.4)	49 (43.4)	26 (40.6)	
More than 60 years	32 (18.1)	11 (9.7)	21 (32.8)	
Comorbidities (n=167)				
No	111 (66.5)	84 (76.4)	27 (47.4)	<0.001*
Yes	56 (33.5)	26 (23.6)	30 (59.6)	
Hypertension	24 (14.4)	7 (6.4)	17 (29.8)	<0.001*
Diabetes Mellitus	18 (10.8)	7 (6.4)	11 (19.3)	0.016*
Dyslipidemia	15 (9.0)	5 (4.6)	10 (17.5)	0.009*
Sequalae of stroke	5 (3.0)	1 (0.9)	4 (7.0)	0.047*
Coronary artery disease	5 (3.0)	0 (0.0)	5 (8.8)	0.004*
Malignancy	3 (1.8)	1 (0.9)	2 (3.5)	0.269
Previous brain injury	4 (2.4)	3 (2.7)	1 (1.8)	1.000
Ocular neurological signs (n=164)				
Normal	106 (64.6)	82 (79.6)	24 (39.3)	<0.001*
Abnormal	58 (35.4)	21 (20.4)	37 (60.7)	
CN VI palsy	54 (32.9)	19 (18.5)	35 (57.4)	<0.001*
Nystagmus	2 (1.2)	1 (1.0)	1 (1.6)	1.000
Ptosis	1 (0.6)	0 (0.0)	1 (1.6)	0.372
Visual acuity (n=159)				
Normal	153 (96.2)	99 (98.0)	54 (93.1)	0.192
Decreased	6 (3.8)	2 (2.0)	4 (6.9)	
Anterior segment (n=148)				
Normal	146 (98.6)	94 (99.0)	52 (98.1)	1.000
Abnormal	2 (1.4)	1 (1.0)	1 (1.9)	
Mean angle of esodeviation				
At distance (n=119)	29.81 ± 17.25	30.74 ± 17.65	28.04 ± 16.48	0.362
At near (n=111)	26.88 ± 18.90	27.03 ± 18.20	26.57 ± 20.43	0.893
Optic disc (n=150)				
Normal	130 (86.7)	83 (86.5)	47 (87.0)	1.000
Abnormal	20 (13.3)	13 (13.5)	7 (13.0)	
Disc pallor	5 (3.3)	3 (3.1)	2 (3.7)	1.000
Disc edema	2 (1.3)	1 (1.0)	1 (1.9)	1.000
Disc anomaly	3 (2.0)	2 (2.1)	1 (1.9)	1.000

P-values were obtained by Chi-square or Fisher's exact test. Values with asterisk are results that are statistically significant.

TABLE 2. Neuroimaging modalities.

	N (%)
CT brain with contrast	68 (38.4)
CT brain and orbit with contrast	21 (11.9)
MRI brain and orbit	20 (11.3)
MRI brain	20 (11.3)
MRI and MRA brain	12 (6.8)
CT brain and orbit	12 (6.8)
CT brain without contrast	11 (6.2)
CTA brain	4 (2.3)
CT orbit	4 (2.3)
MRI and MRV brain	2 (1.1)
MRI orbit	1 (0.6)
CT and CTA brain and orbit	1 (0.6)
CT brain, orbit and neck with contrast	1 (0.6)

Abbreviations: CT = computed tomography, CTA = computed tomography angiography, MRI = magnetic resonance imaging, MRA = magnetic resonance angiography, MRV = magnetic resonance venogram.

the mean of deviation decrease with age.²¹ Furthermore, although papilledema and optic disc pallor have been reported to be associated with intracranial neoplasms^{22,23}, our study did not find a significant difference in the prevalence of these features between the groups with positive and negative neuroimaging findings.

Despite the commonly held belief that acquired esotropia is a benign condition, recent research has revealed the potential for serious neurological pathologies even in patients with normal neurological examination.^{5,24-27} In this

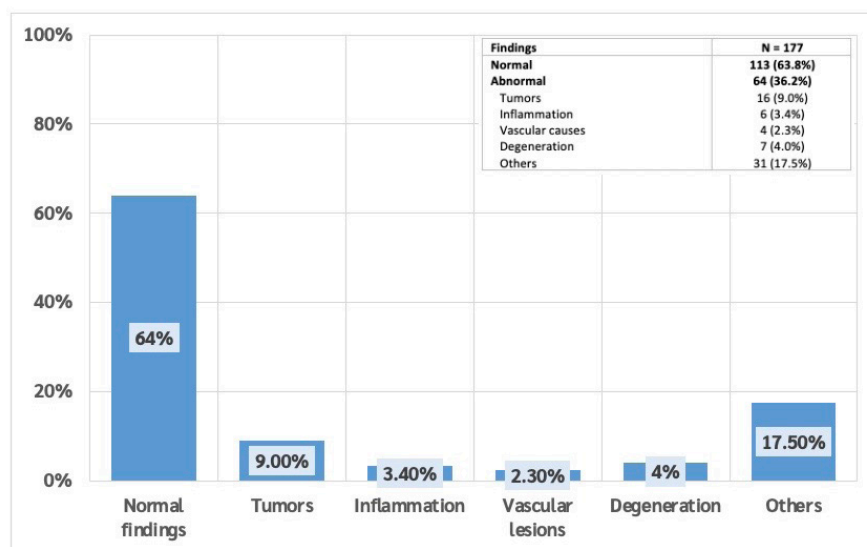
study, 113 cases (63.8%) displayed normal neurological findings, while 26 cases (14.7%) were diagnosed with life-threatening conditions such as tumors, inflammation, and vascular lesions. Additionally, degeneration and other pathologies were observed in 38 cases (21.5%). Among the 26 cases with serious conditions, intracranial tumors were the most frequently observed, accounting for 9% of the cases. This proportion was found to be lower than that reported in sixth nerve palsy patients^{9,13}, but higher than that observed in studies of AACE patients.¹⁶⁻¹⁸

The present study observed a higher prevalence of hypertension, history of cerebrovascular diseases, advanced age, and sixth nerve palsy among patients with positive and serious neuroimaging findings, which is consistent with previous reports.^{10,16,18} However, in the multivariate analysis, only sixth nerve palsy demonstrated a statistically association. These findings provide additional evidence supporting the recommendation to perform neuroimaging in patients presenting with sixth nerve palsy.^{9,12,13}

This study is the first study which investigation focused in all types of acquired esotropia except accommodative type in Thai population. Nevertheless, there are several limitations that must be acknowledged, including the retrospective design of the study and a small sample size. Further research using a randomized-controlled trial approach, larger sample size, and comparison each acquired esotropia type, ocular findings and imaging modalities may yield more definitive conclusions regarding of acquired esotropia patients.

CONCLUSION

In the current study, more than one-third (36.2%) of the patients diagnosed with acquired esotropia had abnormal neuroimaging results. Furthermore, among these cases, 14.7% had underlying serious central nervous

**Fig 1.** Neuroimaging findings.

system conditions, including tumors, inflammation, and vascular lesions. Sixth nerve palsy was revealed to be a significant factor associated with positive neuroimaging findings. Therefore, patients presenting with sixth nerve palsy should be carefully examined and closely monitored as it is an ocular sign that may relate with serious intracranial lesions.

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