

Monsoon and Primary Acute Angle Closure in Malaysia

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SUMMARY

Introduction: Acute angle closure (AAC) without prompt treatment may lead to optic neuropathy. Environmental factor such as climate change may precipitate pupillary block, the possible mechanism of AAC.

Objective: To determine the association of northeast monsoon and incidence of AAC in Malaysia.

Materials and methods: A retrospective study was conducted on AAC patients admitted to two main tertiary hospitals in Kelantan, Malaysia between January 2001 and December 2011. The cumulative number of rainy day, amount of rain, mean cloud cover and 24 hours mean humidity at the estimated day of attack were obtained from the Department of Meteorology, Malaysia.

Results: A total 73 cases of AAC were admitted with mean duration of 4.1SD 2.0 days. More than half have previous history of possibility of AAC. There was higher incidence of AAC during the northeast monsoon (October to March). There was also significant correlation of number of rainy day ($r=0.718$, $p<0.001$), amount of rain ($r=0.587$, $p<0.001$), cloud cover ($r=0.637$, $p<0.001$), mean daily global radiation ($r=-0.596$, $P<0.001$), 24 hours mean temperature ($r=-0.298$, $p=0.015$) and 24 hours mean humidity ($r=0.508$, $p<0.001$) with cumulative number of admission for AAC for 12 calendar months.

Conclusion: Higher incidence of AAC during northeast monsoon suggested the effect of climate as the potential risk factor. Prompt treatment to arrest pupillary block and reduction of the intraocular pressure is important to prevent potential glaucomatous damage. Public awareness of AAC and accessibility to treatment should be part of preparation to face the effect of northeast monsoon.

KEY WORDS:

Acute angle closure, primary angle closure glaucoma, rainy day, meteorological data, northeast monsoon

INTRODUCTION

It is well established that the prevalence and severity of certain diseases is associated with the changes of season^{1,2}. The most common example is respiratory disease during winter season in temperate countries¹. Primary angle closure glaucoma (PACG) is one of the most common types of

glaucoma especially among Asians. It is believed that higher prevalence among Asians is due to the ocular biometric characteristic of Asians³. Shallow anterior chamber depth, thicker lens, anterior lens position, small corneal diameter, and short axial length lead to overcrowding the anterior structure and compromising the opening of trabecular meshwork^{4,5,6}. Asians has higher incidence of occludable angle on gonioscopic evaluation compared to African Americans and Caucasians⁶.

The course of disease of PACG may begins as primary acute angle closure (AAC) that subsequently progresses to primary angle closure (PAC) and later develops optic neuropathy; PACG^{7,8}. However, there are cases that developed PACG without AAC. AAC is characterised by sudden reduction of vision, painful red eye, haloes around the light, nausea and vomiting due to sudden increased in intraocular pressure induced by pupillary block. Pupillary block is induced by mid-dilated pupil in susceptible eye causing blockage of the aqueous flow from posterior chamber to anterior chamber^{4,5}. Anterior bowing of the iris occurs due to building pressure in the posterior chamber and physiological blockage of the trabecular meshwork⁴. Mydriatic drugs, low illumination especially during a gloomy day and emotional stress are believed to precipitate pupillary block⁹.

In temperate countries, number of day-light hours was found to associate with higher incidence of AAC^{10,11}. Higher incidence of AAC was found during winter and autumn in Finland and the United Kingdom^{10,11}. Malaysia is a tropical country with almost uniform temperature, high humidity and copious rainfall. There is two monsoon regime; southwest monsoon from late May to September, a drier weather and northeast monsoon from November to March that bring heavy rainfall to the east coast of Peninsular Malaysia and the western part of Sarawak¹². Kelantan is a north-eastern state of Peninsular Malaysia that is affected by annual flood during north east monsoon. The objective of this study was to determine the association of AAC and monsoon in Kelantan. The possible correlation between meteorological data and AAC was also studied.

MATERIALS AND METHODS

A retrospective record review study was conducted involving AAC patients admitted to two main public tertiary hospitals in Kelantan state of Malaysia; Hospital Universiti Sains Malaysia (HUSM) and Hospital Raja Perempuan Zainab II

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(HRPZ II). AAC patients presented between January 2001 and December 2011. This study received ethical approval from Ethical research board of School of Medical Sciences, Universiti Sains Malaysia and HRPZ II. AAC was diagnosed based on the criteria below:

- a. The presence of at least one of typical symptoms of AAC such as pain, blurred vision, seeing halos around the light, nausea or vomiting
- b. The presence of at least four of the important signs of AAC: corneal oedema, mid-dilated non reactive pupil, iris bombé, ciliary injection and intraocular pressure (IOP) more than 20mmHg
- c. Gonioscopic evidence of a completely occludable angle in the affected eye or narrow angle in the fellow eye with high possibility of occlusion. Occludable angle is when pigmented (posterior) trabecular meshwork is seen for less than 90° of angle circumference.

Those with incomplete data, suspicious of AAC due to other causes e.g. plateau iris syndrome and secondary causes of acute angle closure e.g. neovascular glaucoma and phacomorphic glaucoma were excluded.

The patients were identified from the hospital admission record to the eye ward of both hospitals. Demographic data and ocular data during the presentation were obtained from patients' medical record. Ocular data at presentation such as visual acuity, IOP, anterior segment findings and optic nerve changes were documented. Gonioscopic evaluation at presentation and post laser peripheral iridotomy was documented. Optic nerve findings were documented once the assessment was possible. In this study, patient with acute on chronic primary angle closure glaucoma (PACG) was also included.

We contacted the Department of Meteorology, Ministry of Science, Technology and Information, Malaysia to obtain the information on monthly mean amount of rainfall, rain days, and mean cloud cover, air pollution index (API) and daily global radiation. The meteorological data was obtained based on the estimated month of the presentation of AAC. Other data such as 24 hours mean humidity pressure, 24 hours mean temperature and 24 hours mean sea level (MSL) pressure were also included. The data was obtained based on the estimated day of the onset of AAC presentation instead of the day of admission. For example, a 48 years old lady presented with history of AAC 3 days prior to admission. The 24 hours mean temperature was based on the date of the initial symptoms.

Spearman's correlation test was conducted to determine the correlation between AAC cases and meteorological data. The meteorological parameters were based on the cumulative mean of total number of cases per month for 10 years. P-value of less than 0.05 is considered statistically significant.

RESULTS

A total of 73 cases of AAC involving 73 eyes were included in this study. There is higher predilection in female to develop AAC than male (ratio of 1:3) (Table I). The distribution of ethnicity is almost reflective of ethnicity distribution of Kelantan state. Majority of our AAC patients presented with

Table I: Demographic and clinical characteristics of AAC

Demographic and clinical characteristics	N=73
Race (n, %)	
Malays	65 (89.0)
Chinese	8 (11.0)
Sex (n, %)	
Male	17 (23.3)
Female	56 (76.7)
Age at presentation(years)	
Mean (SD)	61.6 (7.0)
Range	40-85
Days of admission (days)	
Mean (SD)	4.1 (2.0)
Range	1-8
IOP at presentation (mmHg)	
Mean IOP (SD)	55.1 (11.7)
Range of IOP	34->70
Clinical presentation (n, %)	
Symptoms	
Ocular pain	65 (89.0)
Nausea and/or vomiting	61 (83.6)
History of pain	35 (47.9)
Signs	
Conjunctiva hyperaemia	71 (97.3)
Cornea oedema	71 (97.3)
Glaukomflecken	17 (27.3)
Visual acuity at presentation (n, %)	
6/6-6/18	14 (19.2)
6/24-6/60	20 (27.4)
>6/60	36 (49.3)
Perception to light (PL)	3 (4.1)
Diagnosis post acute treatment (n, %)	
PAC	12 (30.1)
PACG	51 (69.9)

IOP: intraocular pressure, PAC: primary angle closure, PACG: primary angle closure glaucoma

Table II: Number of AAC cases according to the year of admission

Year of admission	AAC case (N)
2001	4
2002	6
2003	5
2004	2
2005	8
2006	7
2007	10
2008	11
2009	9
2010	7
2011	4
Total	73

vision of 6/60 or worse (56.2%) with 3 patients presented with perception to light (PL) only. Nearly half of them (47.9%) presented with previous history of suggestive of intermittent attack. AAC was found more in the right eye (69.6%) than left eye (27.5%), and 2.9% has simultaneous attack on both eyes (only right eye was selected in these cases). The highest number of AAC cases was reported in 2008 and the lowest in 2004 (Table II).

The mean duration of admission for AAC was 4.1 SD 2.0 days (Table I). More than half (69.9%) were found to already develop glaucomatous optic neuropathy after appropriate treatment was given during AAC. Higher number of AAC

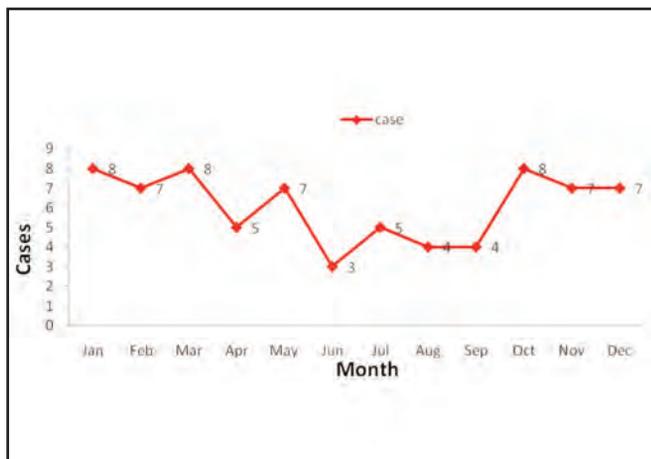


Fig. 1 : Cumulative number of cases of AAC according to 12 calendar months (2001-2011).

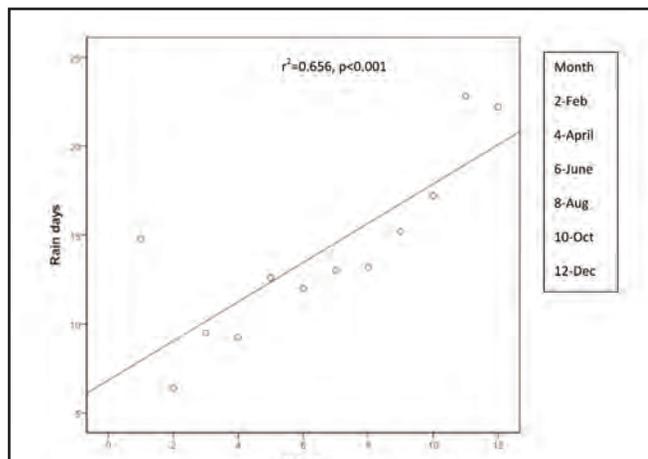


Fig. 2a : Correlation of mean number of rain days per month and cumulative number of AAC cases for 12 calendar months (2001-2011). P<0.05, Spearman correlation test.

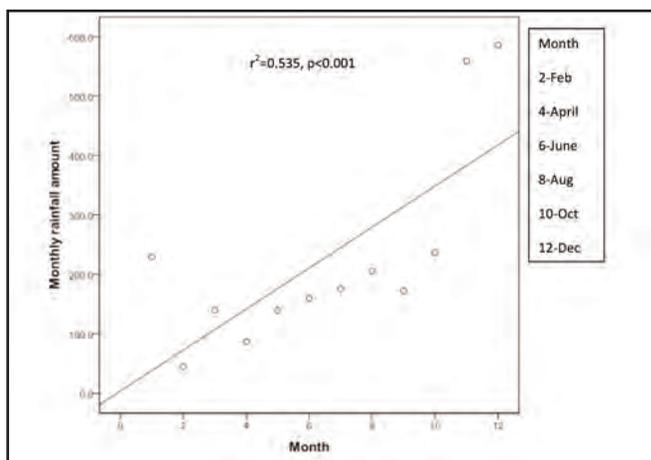


Fig. 2b : Correlation of mean monthly amount of rain fall (mm) and cumulative number of AAC cases for 12 calendar months (2001-2011). P<0.05, Spearman correlation test.

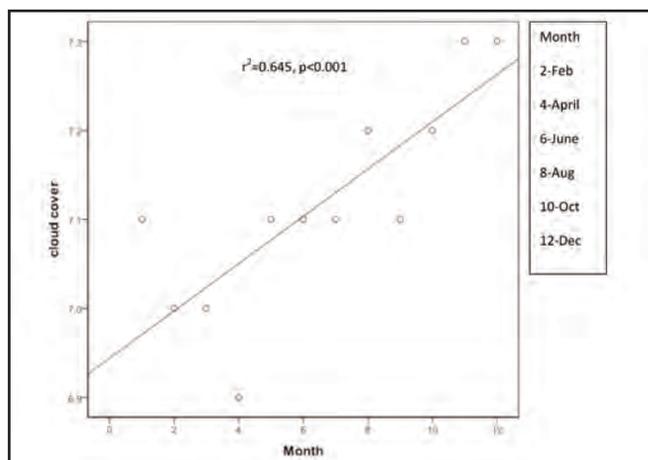


Fig. 2c : Correlation of mean cloud cover (oktas) and cumulative number of AAC cases for 12 calendar months (2001-2011). P<0.05, Spearman correlation test.

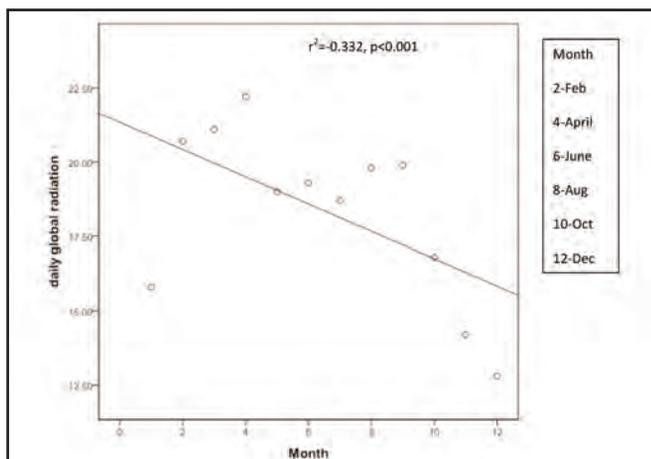


Fig. 2d : Correlation of mean daily global radiation (MJm²) and cumulative number of AAC cases for 12 calendar months (2001-2011). P<0.05, Spearman correlation test.

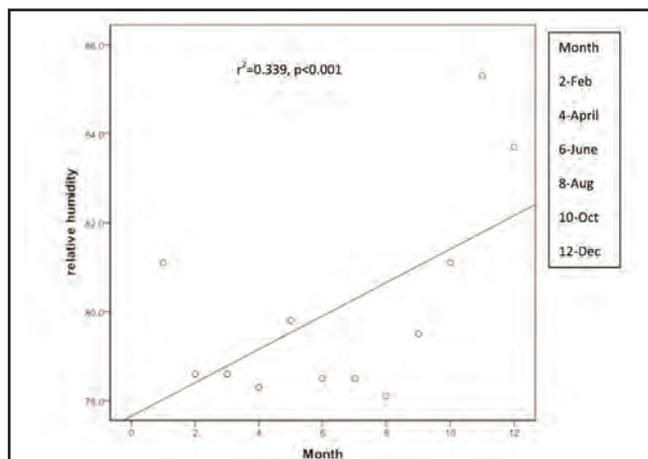


Fig. 2e : Correlation of mean relative humidity (%) and cumulative number of AAC cases for 12 calendar months (2001-2011). P<0.05, Spearman correlation test.

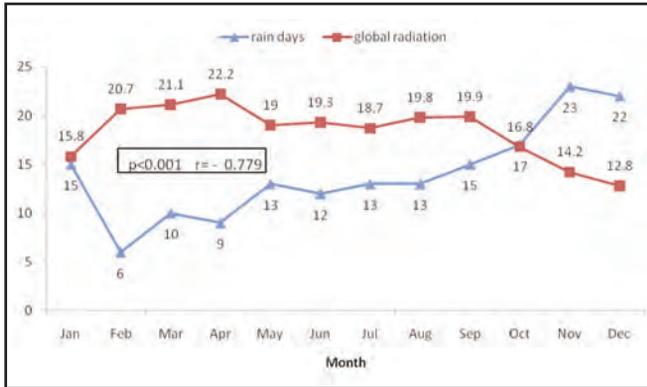


Fig. 3 : Correlation between mean daily global radiation (MJm-2) and mean rain days during AAC presentation.

cases was admitted between Octobers to March in this 10 years survey (Figure 1).

There was significant positive correlation of mean number of rainy day ($r=0.656$, $p<0.001$), amount of rain ($r=0.587$, $p<0.001$), cloud cover ($r=0.637$, $p<0.001$), and 24 hours mean humidity ($r=0.508$, $p<0.001$) with AAC (Figure 2a-e). A negative correlation was observed between mean daily global radiation ($r=-0.596$, $P<0.001$), 24 hours mean temperature ($r=-0.298$, $p=0.015$) and 24 hours mean atmospheric pressure ($r=-0.049$, $p=0.694$) with cumulative number of AAC cases per 12 calendar months. There was inverse correlation between mean daily global radiation and mean of rain days per month (Figure 3). There was no statistical significant correlation between air pollution index and cumulative number of AAC cases ($r^2=-0.207$, $p=0.145$).

DISCUSSION

Kelantan received large amount of rain all year round and exceptionally high during north east monsoon. North east monsoon occurs due to low temperature in Siberia during winter months causing high atmospheric pressure and anticyclone. The interaction of high pressure and low atmospheric pressure system and cyclonic vortices at the equator bring strong wind and high sea to east coast of Peninsular Malaysia. During this monsoon season, there is prolong period of rain that normally lead to flood. There is prolonged cloud cover and lack of sunlight for several days. Environmental changes have been postulated to induce pupillary block in susceptible individuals^{13,14}. However, evidence to this postulation is still inadequate.

Cumulatively, there was higher number of admission for AAC between October and March in this 10 years retrospective review. A significant positive correlation was also found between number admission for AAC and mean number of rainy days, mean amount of rain and mean cloud cover per month. This suggests the effect of monsoon on AAC in Malaysia. These findings also further strengthen the possible association of climate and AAC. However, the effect of climate and AAC remains elucidated.

There were evidences suggesting the effect of lack of sunshine during winter and autumn season on AAC in Finland and Croatia^{14,15,16}. A 2-year prospective study in Hong Kong found similar increased in emergency presentation of AAC in January and February¹⁷. Hong Kong receives higher amount of rain during this period. Lack of sunshine during winter in Taiwan, shown similar increased in incidence of AAC¹⁸. On contrary, higher incidence of AAC was observed during hotter weather in Singapore¹⁹. Singapore has similar climate as Malaysia but with lesser distinctive monsoon effect. Higher incidence of AAC was observed during higher temperature in summer and lower temperature in winter in Israel²⁰. It was postulated that extreme weather inadvertently forced people to be indoor, changed their way of clothing and involved with indoor activities such as reading books, sewing etc²¹. Extreme weather is also believed to cause emotional stress and behavioural changes²². Staying in evacuation centres with lack of basic amenities may cause emotional stress or reading in the dim surrounding during monsoon season may induce pupillary block.

There is strong inverse correlation between mean global radiation and number of rainy day. This is not surprising as global radiation can be easily extrapolated based on number of rainy day or cloud cover. Indirectly, incidence of AAC was inversely related with mean global radiation. On contrary, there was weak correlation between mean global radiation and incidence of AAC in the prospective observation among Chinese in Hong Kong¹⁷. Absent of distinct monsoon season in Hong Kong may be responsible for this contradictory finding.

In this study, we found almost half of our patients with AAC presented with history of intermittent AAC. Perhaps, due to large amount of rain all year round precipitated intermittent acute attack in susceptible individual. There is also high possibility of many of the patients who presented with AAC have already developed glaucomatous optic neuropathy but are not aware of the disease. Due to lack of public awareness, social deprivation and high illiteracy rate in Kelantan state, late presentation is quite common^{23,24}. Perhaps, combination of these factors is responsible for high percentage of our patients presented with glaucomatous optic neuropathy.

The retrospective nature of this study may not represent the incidence of the AAC in Kelantan state. There were patients who presented to other district hospitals in Kelantan state and were only referred to HRPZ II for laser peripheral iridectomy after the acute attack subsided. These patients were not included in this study. There were also patients who refused admission or not admitted but managed as outpatients in HUSM. In addition, recollection of the onset of AAC is a potential source of inaccuracy in estimating the mean of meteorological parameters. There is a possibility that by chance, the recollection of the day of AAC fall on the rainy day resulted in higher mean monthly rain fall and cloud cover. Moreover, higher percentage of patients with potential intermittent attack and acute on chronic PACG may lead to wrong recollection of the day of onset. Perhaps, in the future a prospective case control study will provide more conclusive evidence on the effect of monsoon on AAC in Malaysia.

Nevertheless, the present study provides important data for the improvement of prevention of blindness strategy especially to the east coast of Peninsular Malaysia. Late presentation during AAC may lead to optic nerve damage and lead to glaucoma²⁵. Prompt management of AAC is important to prevent or arrest optic nerve fibre damage especially in patients with chronic primary angle closure glaucoma. Apart from providing flood relief aids during the northeast monsoon, awareness regarding AAC is also important. The accessibility to tertiary centres with ophthalmological service should also be part of the preparation to face annual flooding. Effective awareness campaign on AAC for the public and primary eye care should be launched as part of prevention of blindness strategy.

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