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IMAGING OF NORMAL PRESSURE HYDROCEPHALUS

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ABSTRACT

Normal pressure hydrocephalus (NPH) is hydrocephalus without an increase in intracranial pressure. The term Idiopathic Normal Pressure Hydrocephalus (INPH) has been used to describe individuals presenting with ventriculomegaly of unexplained etiology, accompanied by the classic triad of symptoms (gait disturbance, urinary incontinence, and dementia). CT-scan is more practical, cheaper, widely available, and can assess the anatomical condition of the brain and ventricles, but MRI is the best modality and superior to CT. It can assess the anatomic conditions better, changes in white matter, and the presence of flow-void sign. Radiological signs of INPH are the presence of ventriculomegaly with Evan's index > 0.3, z-EI > 0.42, the presence of DESH (Disproportionately Enlarged Subarachnoid Space Hydrocephalus), cingulate sign, callosal angle <90°, widening of the temporal horn unrelated to hippocampal atrophy, no obvious obstruction to CSF flow, periventricular white matter changes, and flow-void sign in the aqueduct or 4th ventricle on MRI.

Keywords: CT-scan, imaging modality, MRI, normal pressure hydrocephalus, radiographic feature

INTRODUCTION

Normal pressure hydrocephalus (NPH) is hydrocephalus without an increase of intracranial pressure. The prevalence of NPH increases with age, which is about 3.3 per 100,000 people aged 50-59 years, 49.3 per 100,000 people aged 60-69 years, and 181.7 per 100,000 people aged 70-79 years (1). The classic clinical triad of NPH, also called as Hakim's triad, includes gait disturbance, urinary incontinence, and dementia, accompanied with ventricular dilation and normal cerebrospinal fluid pressure. NPH is classified into idiopathic NPH (INPH) of unknown etiology and secondary NPH (SNPH) of known etiology, such as meningitis, trauma, and subarachnoid bleeding (2). INPH is more common than SNPH (1).

For many years, the term INPH has been used to describe individuals presenting with ventriculomegaly of unexplained etiology, accompanied by the classic triad of symptoms. Ventriculomegaly can be detected through brain imaging including computed tomography (CT) or magnetic resonance imaging (MRI) (3). NPH is often misdiagnosed because it is similar to the picture of senile brain atrophy. This review will help in identifying the features of NPH based on the last criteria that are most often used, especially the radiological features that can be found on CT scans

or MRIs.

PATHOPHYSIOLOGY

NPH is estimated to occur in up to 10% of cases of dementia and can be treated with a ventriculoperitoneal shunt (4). NPH is often underdiagnosed, even though as many as 70%-90% of patients undergoing ventriculoperitoneal shunt procedures experience clinical improvement. This may be due to the difficulty of diagnosing NPH because its symptoms overlap with other neurodegenerative diseases, especially Alzheimer's disease (5). In addition, the pathophysiology of idiopathic NPH is still not clearly understood (1).

Although the pathophysiology of idiopathic NPH is not clearly known, there are several theories proposed as the pathophysiological mechanism for the occurrence of INPH, SNPH, pressure that remains normal in the dilated ventricle and the mechanism of the classic triad of symptoms. The pathophysiology of INPH involves decreased craniospinal compliance and impaired CSF pulsation, while the pathophysiology of SNPH involves a disproportion of CSF absorption secretion and chronic obstruction of CSF pathways which will then lead to ventricular dilatation. Normal pressure in NPH is caused by ventricular dilation leading to decreased subependymal resistance, efficient subependymal absorption to compensate for absorption in the sagittal sinus, increased capillary pulsation, and the presence of alternative connections in CSF pathways. Ventricular dilatation causes periventricular edema, compression of the periventricular brain parenchyma and decreased cerebral blood flow leading to lesions in the frontal and temporal lobes. These lesions cause the classic triad of symptoms of NPH in the form of gait disturbances, dementia, and urinary incontinence (1).

IMAGING MODALITY OF CHOICE

CT Scan

CT scan is a commonly used modality to evaluate hydrocephalus. The advantages of CT are relatively fast and simple examination and easy reformatting of data in various fields (multiplanar). Periventricular interstitial edema can be visible on CT, and calcifications are more pronounced on CT than on MRI (6). Head CT scan is a sensitive imaging modality for identifying NPH, but MRI can provide additional information such as aquaductal stenosis, white matter changes or the presence of an underlying etiology such as Alzheimer's disease (2). In addition, CT uses ionizing radiation with a significant dose of radiation (6).

Magnetic Resonance Imaging

MRI is the best modality for diagnosing hydrocephalus, looking for its causes, and its complications. The MRI approach to hydrocephalus can be seen from various aspects, namely specific morphological features, location of obstruction, effects of hydrocephalus on the brain, recognition of the cause of the disease with its specific impact on brain tissue, and CSF dynamics (2).

RADIOGRAPHIC FEATURE OF NORMAL PRESSURE HYDROCEPHALUS

The most frequently used radiological diagnostic criteria for hydrocephalus include ventriculomegaly (Evan index > 0.3), enlargement of the third ventricular recess and lateral ventricular horns, decreased mamillopontine distance and frontal horn angle, thinning and elevation of the corpus callosum, narrowed cortical sulci, hyperintensity in periventricular (interstitial oedema), and “flow void” phenomenon in the sylvian aqueduct on T2WI sequences (7).

The diagnosis of INPH relies on the findings of hydrocephalus on brain imaging. Hydrocephalus is not synonymous with ventriculomegaly. Although ventriculomegaly is commonly found in the elderly population, this does not imply the presence of NPH. In NPH, ventriculomegaly is usually disproportionate to the amount of atrophy present, as seen in **Figure 1**(2). Head CT scan is a sensitive imaging modality for identifying NPH but MRI provides additional information such as aqueductal stenosis, white matter changes, or the presence of an underlying etiology (eg. Alzheimer's disease) (2).

There are two guidelines that are most often used to establish the diagnosis of INPH, namely the international guidelines and the Japanese guidelines. The aim of the INPH diagnostic guidelines is to identify patients who are most likely to benefit from shunt surgery. The two guidelines have some similarities but also some important differences. The terms 'possible' and 'probable' INPH are used in the respective guidelines, with diagnostic criteria based

on clinical and imaging features. However, Japanese guidelines use the term 'probable INPH' for those who improve after removal of CSF. Japanese guidelines also refer to cases that respond well after shunt surgery as 'definite INPH' (8). International guidelines do not mention cases that have a good response after CSF shunting in their diagnostic criteria. The neuroimaging criteria are also different. **Table 1** shows a comparison of the diagnostic neuroimaging features used in these two guidelines (2).

Other radiological features that can support the diagnosis of INPH but are not required to determine probable criteria based on international guidelines are the ventricular size before symptom onset appears smaller and there are no signs of

Table 1. Comparison of international and Japanese guidelines for the diagnosis of INPH (2)

Features	International guidelines	Japanese guideline
Size of Ventricles	Ventricular enlargement not entirely attributable to cerebral atrophy or congenital hydrocephalus (Evan's ratio >0,3 or equivalent)	Evan's ratio >0,3
Additional imaging features	• No obvious obstruction to CSF flow • And at least one of the following: 1. Enlargement of temporal horns not solely due to hippocampal atrophy 2. Callosal angle of 40° or more 3. Evidence of altered brain water content, including periventricular signal changes on CT and MRI not attributable to microvascular ischemic changes or demyelination 4. An aquaductal or fourth ventricle flow void on MRI	• Dilated subarachnoid spaces in the Sylvian fissures and narrowed spaces over the high cerebral convexity and medial surface (DESH) • One or more elliptically dilated sulci over the medial surface and convexity in isolation • A callosal angle of less than 90° on coronal section perpendicular to anterior commissure-posterior commissure plane
DESH = Disproportionately Enlarged Subarachnoid Space Hydrocephalus. These feature are supportive but not essential for a diagnosis of possible INPH		

hydrocephalus, radionuclide cisternogram shows delayed clearance of the radiotracer above the cerebral convexity after 48-72 hours, cine MRI examination showed an increase in ventricular flow rate (9).

Evan's Index

An objective way to assess whether the ventricles are enlarged is to use the Evan's Index or Evan's ratio. It is the ratio of the maximum width of the frontal horn of the lateral ventricle and the transverse diameter of the skull, measured at the same level on both axial CT and MRI images. Values above 0.30 are considered significant, and the higher the value, the more specific it is for NPH. Evan's index is a rough marker of hydrocephalus and can vary depending on the location and angle of the images (2). Measurement of Evan's Index can be seen in **Figure 2** (10).

Lateral ventricular enlargement in INPH is usually seen vertically on a coronal (z-axis) section as opposed to an axial (x-axis) view. The Evan's Index on the z-axis (z-EI) can be calculated by comparing the height of the lateral ventricular frontal horn on the coronal section divided by the midline

diameter of the skull, with a limit of 0.42. A value > 0.42 indicates ventriculomegaly and this assessment is said to be superior to the Evan's Index as measured on an axial section with a value > 0.3. In the same coronal section, the Brain per Ventricle Ratio (BVR) can be calculated. The coronal sections used to calculate z-EI and BVR are those that pass through the anterior commissure and are perpendicular to the line between the anterior and posterior commissures. Measurement of z-EI and BVR can be seen in **Figure 3**(8). In the section through AC, the BVR value for the diagnosis of INPH is <1.0 and in the section through the PC the value is <1.5 (8).

Disproportionately Enlarged Subarachnoid Space Hydrocephalus (DESH)

Findings of DESH (Disproportionately Enlarged Subarachnoid Space Hydrocephalus), such as ventriculomegaly, dilatation of the Sylvian fissure, and narrowing or increased convexity of the midline subarachnoid space are specific findings of INPH with high positive predictive value but low negative predictive value (8). In addition, the cingulate sulcus sign can be found, which is narrower of posterior part of the cingulate sulcus than the anterior part (10). The MRI images of DESH can be seen in **Figure 4** (12).

Callosal Angle

Sharpening of the callosal angle can be measured as an indirect sign of DESH and is very useful for diagnosing INPH and predicting the effect of shunt intervention (8). Using MPR, a coronal section was obtained at the level of the posterior commissure with the orientation of the section perpendicular to the anterior-posterior commissure line. At this level section, the callosal angle is measured as the angle between the superior border of the right and left lateral ventricles.11 CA < 90° is found in most cases of INPH. When combined with an Evan index > 0.3, INPH can be distinguished from AD with a sensitivity and specificity of 97 and 94%, respectively (2). Measurement of callosal angle can be seen in **Figure 5**(10).

Widening of Temporal Horns

One of the signs of hydrocephalus is dilatation of the temporal horn. International guidelines state that one of the signs of NPH on imaging examination is a widening of the temporal horn that is not caused by hippocampal atrophy (9).

There are no standard values in existing guidelines, but a diameter of more than 2 mm in adults is considered pathological. The temporal horn diameter limit of 4 mm showed a sensitivity of 0.92 and a specificity of 0.78 for the diagnosis of INPH, minimizing the risk of false negative cases. The temporal horn diameter limit of 6 mm shows a sensitivity of 0.32 and a specificity of 0.98, maximizing the ability to detect true positive cases (12). Widening of temporal horns in head CT scan can be seen in **Figure 6**(13).

White Matter Changes

MRI can detect changes in periventricular white matter that indicate changes in the water content of the brain. This can occur in communicating and non-communicating hydrocephalus. Changes in the deep periventricular white matter can also be seen in INPH. This is not an essential finding, but is associated with ischemic complications (9).

Periventricular white matter changes can be caused by transependymal extravasation of the CSF due to increased pressure, and can be seen on CT as hypodense lesions in the anterior and posterior horn regions. On MRI, these changes can be detected on T2 or FLAIR sequences. CSF extravasation must be distinguished from age-related white matter changes, which are less than 10 mm in diameter on axial section and decrease in thickness from anterior to posterior, as shown in **Figure 7**(14).

Leukoaraiosis (LA) and cerebral amyloid angiopathy (CAA) are common in the elderly and often accompany INPH. Because the clinical and MR imaging are very similar in that they can detect periventricular white matter changes, an accurate diagnosis of INPH is important to predict the patient's reaction and responsiveness to VP shunt surgery. INPH without LA and CAA will have good responsiveness to VP shunt surgery. To distinguish whether an INPH is accompanied by LA, CAA, or not, the SWI sequence on an MRI plays an important role (14). MRI images in INPH, LA, and CAA cases can be seen in **figure 8**(15).

CSF Flow Void

The advantage of MRI is that the T2WI sequence can show the CSF flow void sign which is related to the pulsation rate of the CSF flow. CSF flows back and

forth through the aqueducts during the cardiac cycle in response to arterial blood flow to the brain. This was observed as a flow void, ie decreased signal on MRI especially in the aqueduct on T2WI on MRI of patients with communicating hydrocephalus. These CSF flow voids can be seen in normal individuals, but are more prominent in patients with INPH. Initially this increased CSF flow void was thought to be predictive of patients responding well to shunting. In NPH that responds well to shunts, the CSF flow to the aqueduct is increased, but the significance of this finding is unclear and in further studies the correlation between the degree of CSF flow void and post-surgical outcome was low (2). Image of the flow void sign on the MRI can be seen in **Figure 9**(13)

Differential Diagnosis

Clinical signs and symptoms of INPH can be confused with normal aging processes or other neurodegenerative diseases such as Alzheimer's disease (AD) or Parkinson's disease (PD) or even vascular diseases such as vascular dementia (VD). In 2005, an international committee of hydrocephalus investigators published the extensive "Guidelines for the Diagnosis and Management of Idiopathic NPH," categorizing patients into 2 groups. (1) Probable: the age of onset was kept at more than 40 years, with a symptom duration of at least 3 to 6 months. A clinical diagnosis in the "probable" category requires gait or balance disturbance plus impairment in cognition or bladder control or both. (2) Possible: onset can occur at any age after childhood, with symptoms lasting less than three months. The patient presented with incontinence or cognitive impairment but no observable gait or balance disturbance (15).

Gait changes are the most prominent clinical feature in the early stages of INPH and are believed to be the most responsive to shunting. Dementia without gait disturbance can be safely excluded from the diagnosis. The INPH gait is described as "glued on the floor", magnetic gait, gait apraxia, or frontal ataxia, in which the steps are short, with decreased stride length and height, with outwardly rotated feet, diminished cadence, and a broadened base as opposed to a narrow base in PD. Patients tend to turn around, their posture is disturbed, and a history of falls can be reported. Sometimes, patients complain of vague pain in their legs after walking a moderate distance. Cognitive impairment NPH has prominent subcortical and frontal features with psychomotor slowing, decreased attention and concentration, and apathy, whereas other forms of dementia such as VD. Vascular dementia is a more likely diagnosis when there is a history of gradual cognitive decline with asymmetric signs. The lack of delusions or visual hallucinations or the presence of non-fluctuating cognitive status distinguishes NPH from Lewy-body dementia. Cortical features (aphasia, agnosia, and apraxia) are less prominent in NPH than in VD or AD. INPH can be distinguished from frontotemporal dementia (FTD) by the lack of personality changes, impulsivity, or aphasia. Urinary urgency may appear early in INPH, which may progress to urinary incontinence at a later stage (15).

Management

The management of INPH can be divided into conservative and surgery. As conservative management, diuretics and osmotic acetazolamide are sometimes used in patients with INPH. Memantine has shown some positive effects in those with neuropsychiatric symptoms. However, prospective cohort studies comparing surgical treatment with surgical treatment in patients with INPH have shown moderate to marked improvements in cognition, balance, urinary function, or activities of daily living in the majority of the shunted population, while the majority of unshunted patients either had marked worsening of symptoms or had no change from their baseline levels (15).

Shunting is used as standard surgical management of normal pressure hydrocephalus. The VP shunt is the most popular, whereas the ventriculo-atrial (VA) shunt is rarely implanted because of its more frequent long-term complications. Lumbo-peritoneal (LP) shunts are also increasingly being tried. Gait disturbance is the symptom most responsive to shunting. Cognitive impairment may improve with surgery if it is not too severe at the time of intervention, while urinary incontinence improves in 36% to 90% of patients (8, 15).

Complication

According to the Japanese Guideline, several complications that can occur after shunt intervention in the management of NPH patients include shunt dysfunction due to shunt tube obstruction, headache,

shunt infection, and subdural hematoma, which are associated with excessive CSF drainage (8). This is in line with another study stated that the incidence associated with VP shunt interventions was quite high in the past. Failure, infection, obstruction, over- or under-drainage, or subdural hematoma are examples of complications (15). However, with the introduction of newer materials for shunts and valves, complications have decreased by 20%. Complications not related to shunts, such as seizures and intracerebral hemorrhage, have also decreased significantly in recent times. Meanwhile, the intervention with LP had a lower incidence of infection than the intervention with VP shunt (8).

Prognosis

Symptoms of INPH usually improve after surgical intervention. Outcomes after surgical intervention have been reported for various periods, from 3 months to 6 years. Short-term outcomes (at 1 year after shunt intervention) may be affected by complications associated with the surgical procedure. In addition, the outcome was also influenced by the duration and severity of the disease, the response to the knock test, and the status of typical imaging findings (DESH). Regarding the rate of symptom improvement after shunt intervention, gait disturbance showed the highest improvement rate. The long-term outcome of INPH is influenced by the presence of comorbidities. For example, stroke affects functional prognosis, cancer affects life prognosis, Alzheimer's disease affects cognitive function, and Parkinson's disease affects motor function (8).

CONCLUSION

The guidelines most often used for the diagnosis of INPH are the international guidelines and the Japanese guidelines, where radiological examination is one of the diagnostic criteria in addition to clinical symptoms and other supporting examinations.

Radiologic examinations that can be used for the diagnosis of INPH are CT scan and MRI of the head. CT scan is more practical, cheaper, more widely available, and can assess the anatomical condition of the patient's brain and ventricles, but MRI is the best radiological examination and is superior to CT scan because it can assess anatomic conditions better, assess changes in white matter, and assess the presence of a flow void sign.

Signs that can be found on radiological examination of INPH cases are the presence of ventriculomegaly with Evan's index >0.3, z-EI> 0.42, the presence of DESH (Disproportionately Enlarged Subarachnoid Space Hydrocephalus), Cingulate sign, Callosal angle <90°, widening of the temporal horn. unrelated to hippocampal atrophy, no obvious obstruction to CSF flow, the presence of periventricular white matter changes, and the presence of a flow void sign in the aqueduct or 4th ventricle on MRI.

STATEMENT OF ETHICS

All data and images used for the publication of this case were sourced from the literature review with the original source acknowledged and no written informed consent was obtained from the patient.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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DATA AVAILABILITY STATEMENT

No additional data than the one presented in this article was used.

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FIGURE LEGENDS

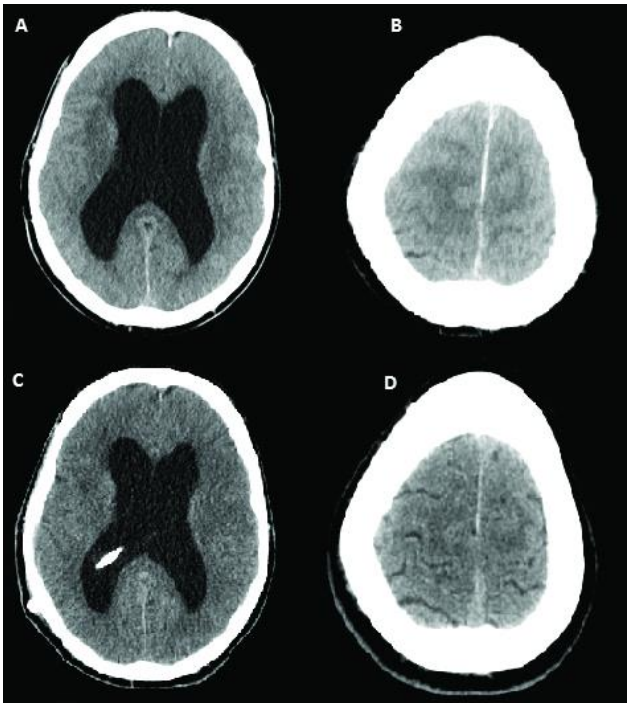

Figure 1. Head CT scan of a patient with INPH before and after surgery (2). A and B: Ventriculomegaly and narrowed sulci on the vertex of a patient with INPH;C and D: postoperative imaging showed improvement.

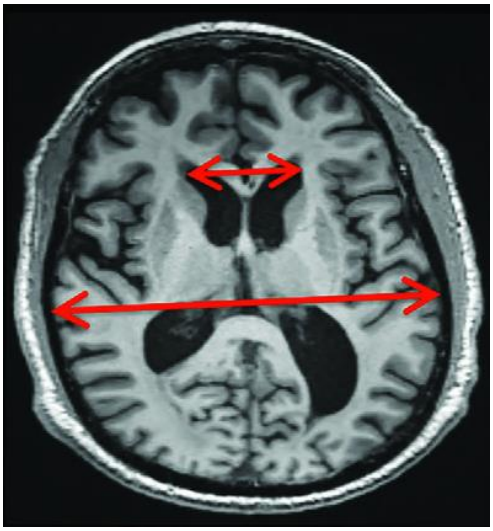

Figure 2. Measurement of Evan's Index (10). EI was determined on the axial view by measuring the greatest width of the right and left lateral ventricular frontal horn divided by the largest cranial width at the same level.

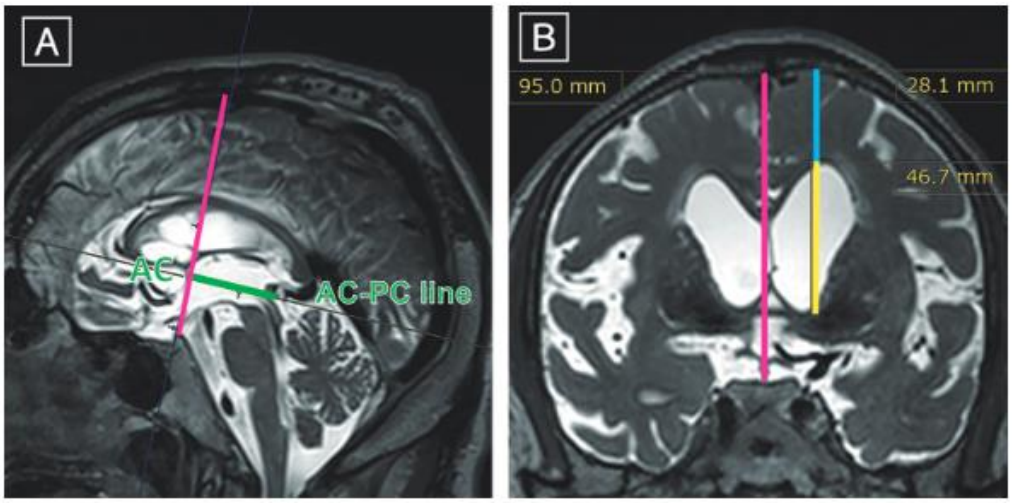

Figure 3. Evaluation of z-EI and BVR (8). (A) Evaluation of z-EI and BVR was performed on coronal sections obtained on sections that pass through the anterior commissure and are perpendicular to the AC-PC line (green line).(B) The height of the lateral ventricular frontal horn (yellow line) on the z-axis divided by the midline diameter of the skull (magenta line) is the z-EI, with a cut-off value of 0.42.The BVR at AC level is obtained by calculating the maximum length of the brain on the z-axis just above the lateral ventricle (yellow line) divided by the maximum length of the lateral ventricle (cyan line).In the slice through AC, the value is < 1.0 and in the piece through PC the value is < 1.5.This figure shows z-EI 0.49 (>0.42), BVR AC level 0.6 (<0.1).

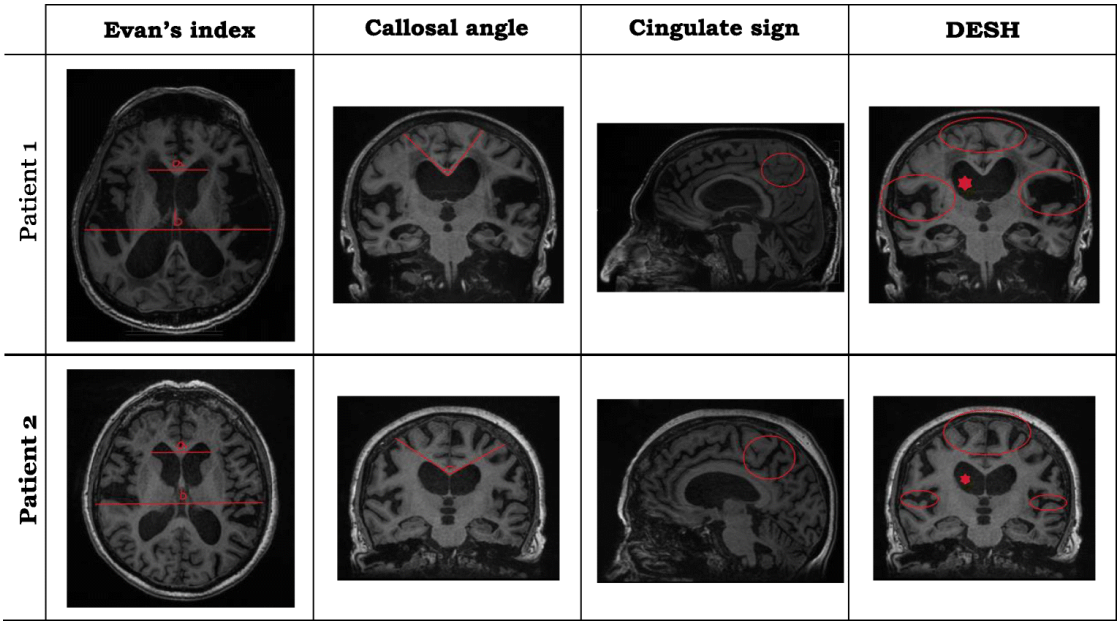

Figure 4. The MRI findings (T1WI) in two patients with Hakim's triad were positive (12). Both patients showed ventriculomegaly (Evan's index = 0.35). Patient 1, 75 years old male, had narrow callosal angle (85°), positive cingulate sign, and DESH. All of these signs indicate an INPH. Patient 2, a 77-year-old woman, had a blunt callosal angle (115°), negative cingulate sign, and no DESH. Patient 1 had positive results on the lumbar infusion test (LIT) and external lumbar drainage (ELD), and was treated with a VP shunt. Patient 2 was negative on both functional tests and a VP shunt was not indicated in this patient.

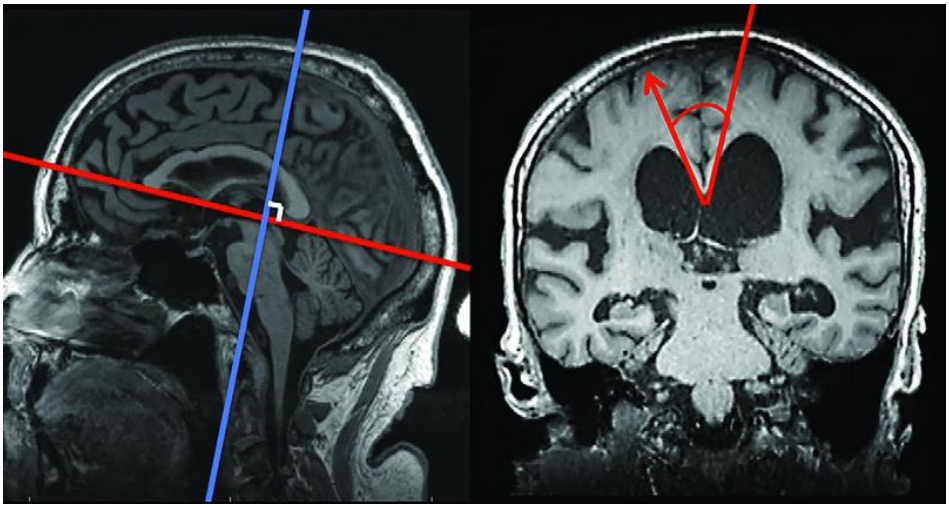

Figure 5. Callosal angle measurement (10).

Figure 6. Widening of temporal horns in head CT scan (13).

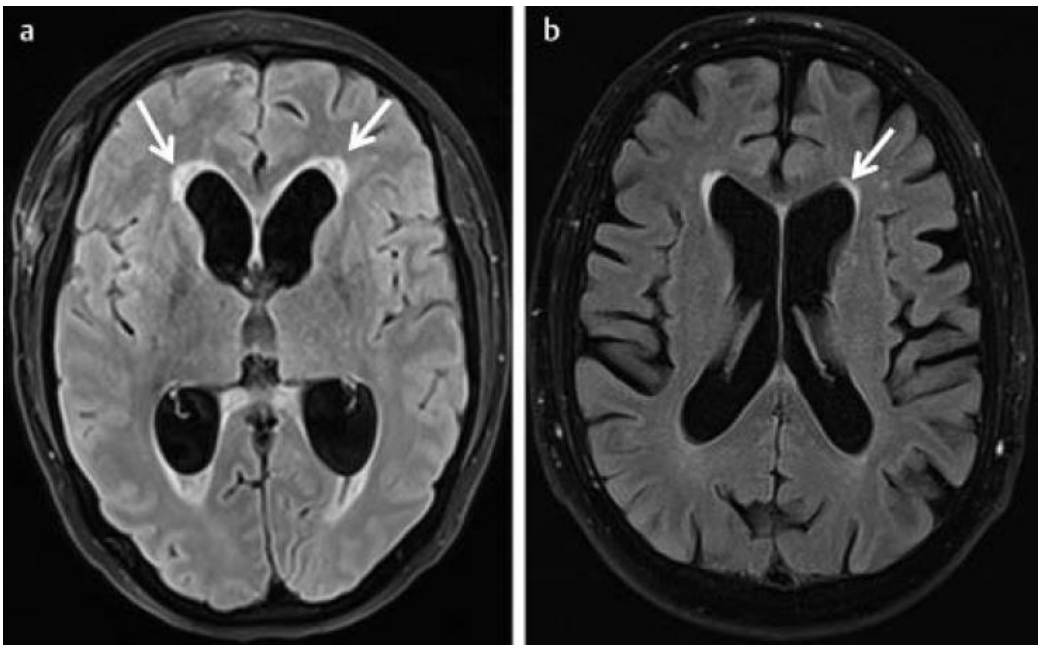

Figure 7. MRI appearance of periventricular white matter changes (14). (A) Periventricular white matter changes in hydrocephalus;(B) Age-associated periventricular white matter changes.

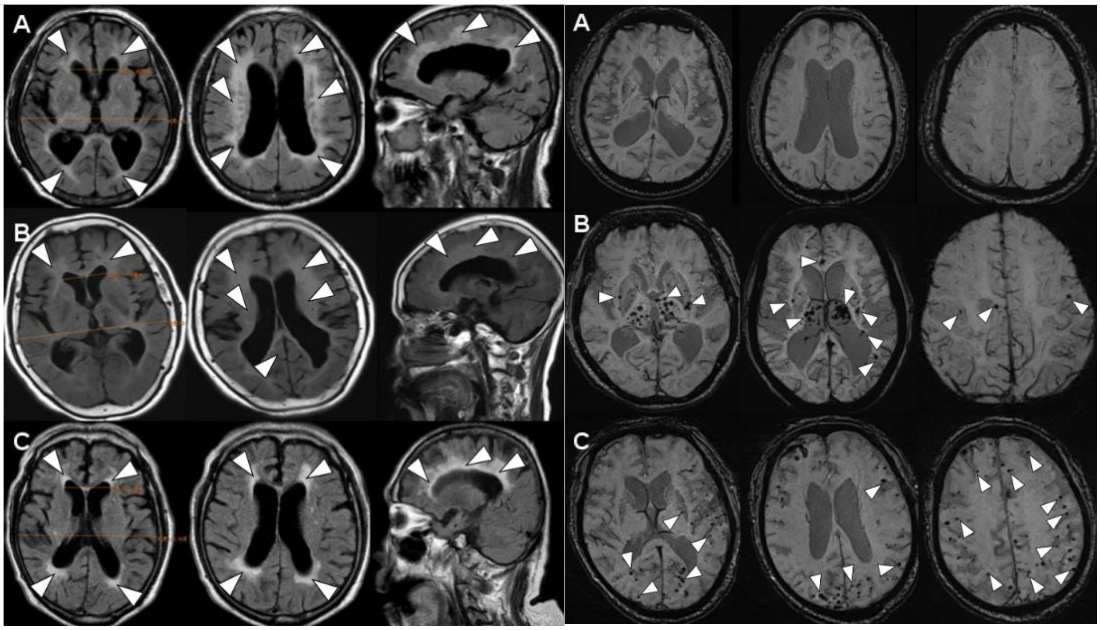

Figure 8. MRI images in INPH, LA, and CAA cases (15).Left: FLAIR Sequence.There is a similar picture, namely ventricular dilatation (Evan's index > 0.3, periventricular and deep white matter changes were seen in all three cases. (A) INPH case; (B) LA; (C) CAA.Right: SWI sequence. Threedifferent cerebral microbleed (CMB) phenomena (A) INPH, no CMB was seen (B) LA, CMB was seen with distribution in deep brain structures (basal ganglia, thalamus, corpus callosum, internal and external capsules); (C)CAA: multiple CMB seen in the lobar cerebral area (cortex and sub cortical white matter).

Figure 9. Image of the flow void sign on a sagittal T2WI MRI sequence (14).T2WI is a flow-sensitive sequence, and the sagittal section in the image shows a strong flow void in the aqueduct which is an indirect sign of INPH.

AN AORTOPULMONARY TUNNEL AS AN EXTRA-CARDIAC SYSTEMIC TO PULMONARY SHUNT

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ABSTRACT

Aortopulmonary window, one of the rarest congenital heart diseases, causes unrestricted left-to-right shunt and may lead to congestive heart failure, pulmonary vascular obstructive disease, and low cardiac output. Echocardiogram and CT angiography are important non-invasive diagnostic tools. Surgical closure is indicated in all patients diagnosed with APW and is usually performed at the time of diagnosis to reduce the risk of developing early pulmonary vascular disease. We report on a term baby girl with variant of aortopulmonary window which manifest as a tunnel on CT angiography.

Keywords: Aortopulmonary window; Aortopulmonary tunnel; Sytemic-pulmonary shunt

INTRODUCTION

Aortopulmonary window (APW) is one of the rarest congenital heart diseases with systemic to pulmonary shunt. This case report aims to highlight a variant of APW which has tubular communication rather than the conventional defect between the ascending aorta to the main pulmonary artery. To date, there has been no consensus in naming such anomaly.

CASE PRESENTATION

A term baby girl was delivered via emergency Caesarean-section due to foetal distress. She was treated for congenital pneumonia and physiological jaundice. Following an incidental detection of heart murmur at day 4 of life, she was then referred to Paediatric Cardiology Unit. During a follow-up visit at day 22 of life, she was mildly tachypnoeic with mild subcostal recessions. Respiratory rate was 44 breaths per minute, with oxygen saturation of 98% on room air. An ejection systolic murmur at left sternal edge was noted. She had lost weight at a rate of approximately 300 g/day at day 22 of life. The baby was started empirically on anti-failure treatment which consisted of furosemide and spironolactone.

Frontal chest radiograph showed cardiomegaly, while an echocardiography revealed mildly dilated left atrium and ventricle. A small persistent patent foramen ovale with left to right shunt was noted. There was also moderate tricuspid regurgitation. The ejection fraction was 68%. An abnormal aorto-pulmonary connection between ascending aorta and right pulmonary artery was demonstrated with left to right shunt.

CT angiography showed an abnormal tubular communication between the ascending aorta and the pulmonary trunk (**Figure 1**). This tubular communication was 6.6 mm in length with an entrance diameter of 5.4mm and exit diameter of 6.6 mm (**Figure 2**). She subsequently underwent surgical

repair at 2 months of age, which consisted of double ligations of the tubular connection through an open surgery.

Intraoperative findings showed an abnormal 'interconnecting vessel' between the aorta and main pulmonary trunk at the level of sinotubular junction which was then ligated. The aorta was found to be smaller than the main pulmonary trunk. A large patent ductus arteriosus (PDA) was ligated as well. The heart was moderately enlarged with moderate amount of pericardial effusion. The coronary vessels were unremarkable. The child was discharged well after 7 days in intensive care. Apart from several episodes of surgical wound infections which required antibiotics therapy, no major post-surgical complications were encountered.

Upon further follow-up at approximately two and a half years old, she was thriving well with no respiratory symptom. On auscultation, the lungs were clear with normal heart sounds and absent of any heart murmur. The ejection fraction remained stable at 67% on follow-up echocardiogram, without evidence of residual APW or PDA. There was no evidence of shunting, pulmonary arterial hypertension, or pericardial effusion.

DISCUSSION

Aortopulmonary window (APW) results from fusion failure of the conotruncal ridges (aorticopulmonary trunk) during the 5th to 8th week of gestation forming an abnormal communication between the proximal aorta and the main pulmonary artery (1). It usually begins just above the sinus of Valsalva with variable extensions to the aortic arch (2).

More than half of the APW cases may be found in isolation, while the remaining are found to be associated with other cardiac abnormalities. The most common associated cardiac anomalies are arch abnormalities, atrial septal defect, Tetralogy of Fallot and aortic origin of the right pulmonary artery. Other rare associations include tricuspid atresia, pulmonary or aortic atresia, ventricular septal defect and transposition of great arteries (2). In other literature, APW has been described as either simple or complex. Simple APW is associated with haemodynamically insignificant congenital cardiac anomalies, while Complex APW is associated with complex anomalies such as Tetralogy of Fallot, interrupted aortic arch, transposition of great arteries, or anomalous coronary arteries (3).

Patient with APW has unrestricted left-to-right shunt that worsens in post-natal period as the pulmonary vascular resistance falls dramatically. It results in congestive heart failure, pulmonary vascular obstructive disease and low cardiac output which may manifest as tachypnoea, diaphoresis, poor feeding, and inadequate weight gain. As the pulmonary vascular resistance increases rapidly, these patients are particularly susceptible to Eisenmenger's syndrome at an early age (3,4).

Mori's classification has been used in classifying APW. Type I APW occurs in the proximal part of aortopulmonary septum while type II defect occurs in the distal part of aortopulmonary septum, adjacent to the right pulmonary artery. Type III defect is a combination of both type I and II involving the entire length of the pulmonary trunk from immediately above the semilunar valves to the level of pulmonary bifurcation and the proximal portion of the right pulmonary artery (5).

Rather than having a typical window between the ascending aorta and pulmonary trunk, our case demonstrates a connecting tubular channel. Such tunnel-like configuration was reported by Ho et al. (6). The authors found a tunnel-like APW in 1 of the 25 patients who underwent transcatheter APW closure. The tunnel-shaped communication connected the right aortic sinus and the pulmonary sinus with the origin of the right coronary artery within the aortic origin (6).

Another resemblance to our findings was documented in a case reported by Chidambarathanu et al. (7). A 7mm tubular channel connected the proximal ascending aorta and the pulmonary trunk was described as tubular APW. Rather than a tubular APW, we propose the term aorto-pulmonary tunnel due to its simplicity and aptness.

An early and accurate diagnosis are of utmost importance. Imaging plays an important role in diagnosis as it is difficult to diagnose APW especially when it co-exists with VSD (3). APW should be suspected when there is a 'T-sign' in the presence of two normal semilunar valves, downward flow through the right side of main pulmonary artery and diastolic flow reversal in both aortic arch and descending aorta on echocardiography (4). Although 2-dimensional echocardiography is important in diagnosis, angiogram is considered the gold standard

for confirmation (3). Meanwhile, CT angiography provides precise anatomical details such as the location of the defect and may reveal other associated coronary origin anomalies (4). Furthermore, CT angiography is fast, safer, and less invasive compared to the transcatheter angiography.

Surgical closure is indicated in all patients diagnosed with APW except for asymptomatic patient with small APW. Surgical closure is usually performed at the time of diagnosis to reduce the risk of early pulmonary vascular disease (3). Due to the tubular nature of the APW communication, double ligations technique was able to be performed, rather than the conventional patches technique which required division of the defect prior to the patch repair.

CONCLUSION

Aortopulmonary window develops due to fusion failure of the conotruncal ridges. However, tubular structure or channel that connects proximal aorta with pulmonary trunk does not fit the typical APW. Early diagnosis and surgical closure are essential to prevent congestive heart failure and pulmonary vascular obstructive disease. CT angiography provides excellent visualization of the defect location and the origin of coronary arteries which enables appropriate surgical planning.

STATEMENT OF ETHICS

Written informed consent was obtained from the patients for publication of this case and any accompanying images.

ACKNOWLEDGEMENTS

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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DATA AVAILABILITY STATEMENT

No additional data than the one presented in this article was used

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FIGURE LEGENDS

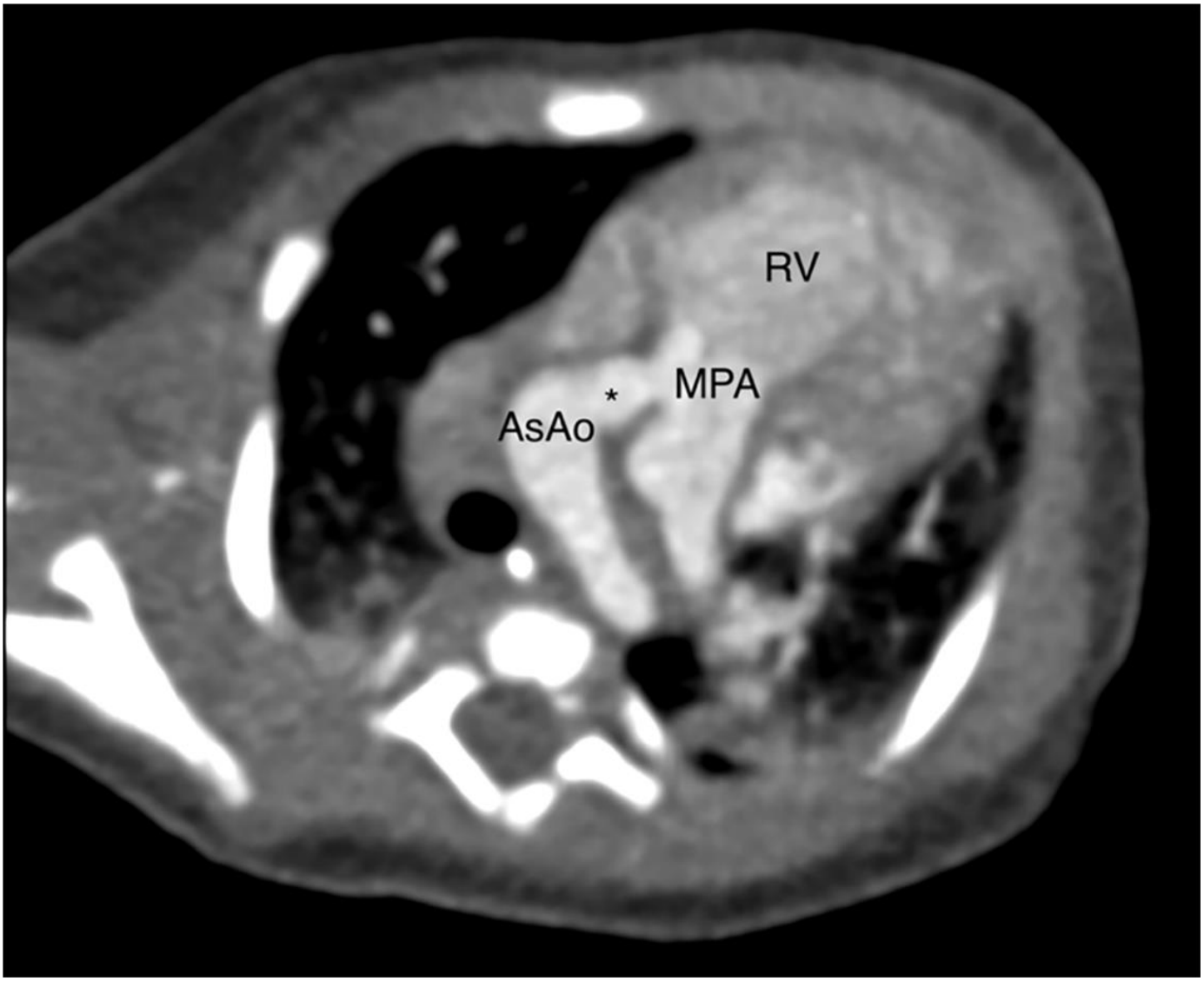

Figure 1: CT Pulmonary Angiogram in axial view showing an aortopulmonary window (*) that connects the main pulmonary artery (MPA) and ascending aorta (AsAo). Note that this communication appears as a tubular structure. RV: right ventricle.

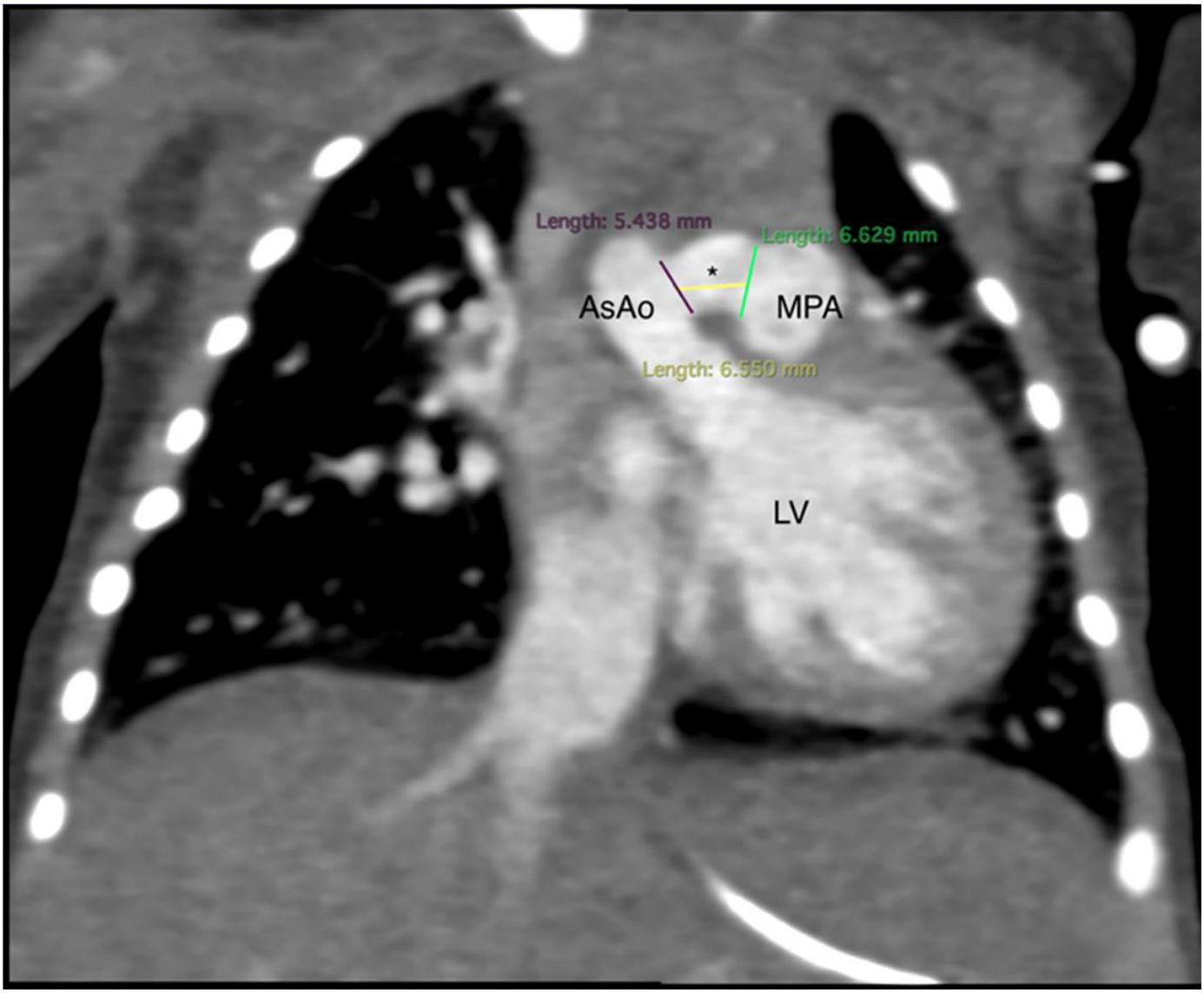

Figure 2: CT Pulmonary Angiogram in coronal view demonstrating an aortopulmonary window (*) that connects the main pulmonary artery (MPA) and ascending aorta (AsAo). Note the length of this tubular channel measures 6.6mm in length (yellow line). Its entry point (purple line) measures 5.4mm in diameter while the exit point (green line) measures 6.6mm in diameter. LV: left ventricle.

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A REVIEW ON THE IMPACT OF ENDOGENOUS AND EXOGENOUS TESTOSTERONE ON ACUTE ISCHEMIC STROKE IN MEN

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ABSTRACT

Introduction: The role of testosterone in atherosclerosis have been the topic of interest in the past few decades. Several studies have suggested that both low and high level of endogenous testosterone are a potential risk factors to atherosclerosis and cerebrovascular events in men. **Objectives:** To provide a summary on all the studies related to the impact of endogenous and exogenous testosterone to the risk of ischemic stroke. **Methodology:** A comprehensive search of scientific publications on the association between testosterone level and therapy to the risk of ischemic stroke were performed in PubMed, Scopus, and Web of Science. Based on the predetermined inclusion and exclusion criteria, 12 articles on the impact of serum testosterone level to the risk of ischemic stroke and nine articles related to the effect of testosterone supplementation to ischemic stroke were selected. **Results:** In this review, there were 12 research articles on the association between the serum testosterone level and risk of ischemic stroke, which consist of seven longitudinal observational studies, three case-controls and two case cohort studies. Nine out of 12 (75%) studies reported a significant association between endogenous testosterone level and ischemic stroke. There were nine research articles on the impact of testosterone replacement therapy in elderly men with hypogonadism on the risk of ischemic stroke, which include five retrospective cohort studies and four case-control studies. Four (44%) studies found a positive result, two (22%) gain negative result, and three (33%) had a neutral finding. **Conclusions:** Both endogenous level and replacement therapy of testosterone may exhibit a dose-dependent and time-sensitive effects on the risk of ischemic stroke. These findings may have a significant clinical implication on the management and prevention of ischemic stroke. Therefore, more large-scale prospective studies are required to establish the link of temporal relationship and close the gap of current understanding.

CASE REPORT OF SUCCESSFUL THROMBOLYSIS IN YOUNG ADULT WITH ACUTE ISCHAEMIC STROKE SECONDARY TO HOMOCYSTEINEMIA

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ABSTRACT

Background: Young adults with acute hemispheric ischaemic stroke benefit from intravenous thrombolysis with good safety outcome. We are reporting a case of successful thrombolysis in young adult with right TACI secondary to homocysteinemia. **Case presentation:** A 16-year-old right hand-dominant gentleman presented with sudden onset of headache upon waking up associated with slurring of speech and body weakness. He denied any fitting, fever or altered consciousness. He was last seen well at 6am.Upon arrival to hospital, patient's GCS was 14/15(E3, V5, M6) with right gaze preference, left dense hemiplegia with left neglect. Initial NIHSS score was 15.A plain CT brain was done which showed right temporoparietal hypo density with ASPECT score of 7.CTA and CT perfusion brain was subsequently performed. CTA brain showed no large vessel occlusion with right middle cerebral artery infarct. CT perfusion showed mismatched deficit at right MCA region. A decision was made for reperfusion therapy using alteplase. NIHSS score improved to 10 at 1hour and subsequently 7 after 24 hours post thrombolysis. Further clinical examination revealed marfanoid features ie high arch palate, pectus carinatum, kyphoscoliosis, arachnodactyly and increased arm/height ratio. An extensive young stroke workout including lipid profile, renal and liver function test, thrombophilia screening, connective tissue screening, transthoracic echograph,24hours Holter monitoring was normal. However, the serum homocysteine level was elevated at 30micromol/L. In view of high index of suspicion of young stroke secondary to homocystinuria, a geneticist consultation was done. Further plasma amino acid and urine organic acid was sent which was normal. Patient was discharged well with aspirin, atorvastatin, and pyridoxine. Subsequent MRS score 3month post stroke was 1. **Conclusion:** In summary, young patient with atypical presentation of stroke can be challenging to clinicians especially during acute settings. Advanced imaging studies will definitely aid in decision for reperfusion therapy. However, bedside clinical acumen is crucial in the identifying aetiology of diseases especially in resource limited setting.

SPONTANEOUS CORONARY ARTERY DISSECTION AND POSTERIOR REVERSIBLE ENCEPHALOPATHY SYNDROME- A RARE STROKE MIMIC

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ABSTRACT

Background: The etiology of spontaneous coronary artery dissections(sCAD) in the majority of patients without risk factors is unclear. There is evidence that sCAD may be caused by a transient arteriopathy and possibly to arterial wall dysfunction that can be seen as well in posterior reversible encephalopathy syndrome (PRES). **Case presentation:** A 37-year-old woman with no medical illness presented to ED with cardiac arrest secondary to MI. Post resuscitations and coronary angiogram revealed spontaneous coronary artery dissection at distal right coronary artery (RCA), PCI to RCA done. In CCU, patient complain of bilateral eye blurring of vision subsequent appeared restless. The blood pressure 168/82mmHg. Head CT showed ill-defined hypodensities of bilateral occipitoparietal lobes in keeping with acute infarcts. Interval CT after 48hours shows slight improvement. Her symptoms resolved completely over a period of 48- 72 hours. Sedimentation rate and workup for connective tissue disorder was normal. A follow up MRI/MRA obtained 1 month after the event revealed complete resolution of bilateral occipital changes support PRES. **Discussion:** Microbleeds are found close to the tunica media/tunica adventitia junction, which implies that hemorrhage in sCAD is not the result of an intimal tear, but of hemorrhage in the wall itself from possibly the vasa vasorum. The pathophysiology of PRES is thought to be related to a leaky blood– brain barrier, which is the result of an alteration of vascular reactivity related to profound endothelial dysfunction. Endothelial health and function are dependent on signals from smooth muscle cells (SMC) in the arterial wall. **Conclusion:** Although the pathogenesis of sCAD and PRES is unclear, in this case it is logical to conclude that the development of a transient arteriopathy affecting the stability and function of the arterial wall predisposed this patient to sCAD and PRES.

DRIVING RISK AMONGST STROKE PATIENTS: A NOVEL DRIVING SCREENING TOOL

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ABSTRACT

Introduction: Retu to drive (RTD) is an important aspect of community reintegration, thus serving as an indicator of patient recovery and independence. A Screening for Fitness to Drive tool has been adopted by the Occupational Therapy (OCT) Unit of HSAJB to improve the delivery of services across Johor. **Objectives:** This article aims to describe the risk of driving in post stroke patients using this screening tool. **Methodology:** This retrospective study included stroke patients who were referred for driving assessment to the OCT HSAJB. Measures include demographics, medical history, physical, visual, and cognitive/perceptual abilities. Data analyzed using descriptive statistics for sample characteristics. **Results:** The sample included 15 subjects with a mean age of 49.5 years. 80% of the sample suffered an ischemic stroke and 20% had a hemorrhagic stroke. Using the Screening for Fitness to Drive tool, 33% had low driving risk while 67% had moderate driving risk. At the point of assessment, 67% of the sample had not RTD. However, 80% of the samples who had RTD were found to have moderate driving risk. Impairments hindering the ability to RTD were physical (40%) and cognitive/perceptual (60%) abilities. Approximately half reported anxiety about RTD with 71% from this group reporting very severe anxiety levels. **Conclusions:** Findings suggested stroke patients require a driving risk assessment before RTD. Identification of impairments limiting ability for RTD can lead to a targeted approach to treatment and improved outcomes. Other treatment centers can employ this tool to screen stroke patients.

THE TREND OF ONSET-TO-DOOR TIME AMONG ISCHEMIC STROKE PATIENTS IN SEBERANG JAYA HOSPITAL IN RELATIONSHIP TO THE NATIONAL NUMBER OF COVID-19 CASES

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ABSTRACT

Introduction: The onset-to-door time is important in determining the eligibility for reperfusion therapy among acute ischemic stroke (AIS) patients. The COVID-19 pandemic presents challenges to the public's health-seeking behaviours. This study was aimed to describe the relationship between the onset-to-door time (ODT) and the national number of COVID-19 cases. **Methodology:** The onset-to-door time is important in determining the eligibility for reperfusion therapy among acute ischemic stroke (AIS) patients. The COVID-19 pandemic presents challenges to the public's health-seeking behaviours. This study was aimed to describe the relationship between the onset-to-door time (ODT) and the national number of COVID-19 cases. **Result:** Among the 187 patients who presented to SJH and given hyperacute reperfusion therapy, 159 patients received thrombolytic therapy and 28 patients received mechanical thrombectomy. The ODT before the COVID-19 pandemic ranged from 74 minutes to 106.83 minutes. With the emergence of COVID-19 cases in Q1-2020, there was a rise in the ODT from 85.40 minutes(Q1-2020) to 129.68 minutes(Q3-2020). However, as the COVID-19 cases increased considerably from Q3-2020 to Q2-2021, the ODT dropped to 92.16 minutes(Q2-2021). In Q3-2021, when the number of COVID-19 cases surged and followed by a sharp decrease, the ODT increased steadily. There was an increase in the average ODT from the pre-COVID era (90.52 minutes) to COVID era (109.54 minutes). **Conclusions:** The ODT increased significantly in the COVID era compared to that of pre-COVID era. Hesitancy in health-seeking behaviour in AIS patients during the COVID-19 pandemic may have led to a delay in treatment and ineligibility for hyperacute stroke treatment.

THE TREND OF DOOR-TO-NEEDLE TIME AMONG ISCHEMIC STROKE PATIENTS IN SEBERANG JAYA HOSPITAL IN RELATIONSHIP TO THE NUMBER OF COVID-19 CASES

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ABSTRACT

Introduction: The COVID-19 pandemic presents challenges to the delivery of standard care for acute ischemic stroke. This study aims to describe the relationship between the door-to-needle time (DNT) and the number of COVID-19 cases in a primary stroke centre. **Methodology:** This is a retrospective cross-sectional study involving the AIS patients who presented to Seberang Jaya Hospital (SJH) and received intravenous thrombolysis therapy with recombinant tissue plasminogen activator (rt-PA) from January 2019 to March 2022. Data were extracted from the medical records and ongoing stroke registry. **Result:** A total of 154 patients presented to SJH and received thrombolysis therapy. Before the emergence of COVID-19 cases, the DNT fluctuated between 78.50 minutes and 92.20 minutes. When the COVID-19 cases increased gradually from 2020-Q1 to 2021-Q2, the DNT declined considerably before there was a steady rise. However, when there was a surge in the number of COVID-19 cases in Q3-2021, the DNT increased sharply to 120.11 minutes in the next quarter Q4-2021. In 2021-Q4, the COVID-19 cases dipped, and the DNT in 2022-Q1 improved to 64.70 minutes. The COVID-19 cases then peaked again in 2022-Q1. The average for door-to-imaging time was 33.00 minutes (pre-COVID era) and 29.07 minutes (COVID era) while the average for imaging-to-needle time was 50.96 minutes (pre-COVID era) and 55.26 minutes (COVID era). Overall, there was no significant difference in the DNT between these two periods, as shown by the DNT figures of 84.18 minutes (pre-COVID era) and 84.33 minutes (COVID era) respectively. **Conclusions:** When the number of COVID-19 cases rose rapidly, the DNT increased significantly. Fatigue among the health care providers, pre-admission COVID-19 screening, and increased workload during the COVID-19 pandemic are the possible causes of the delay in the care of AIS patients.

THE ASSOCIATION OF BODY MASS INDEX AND STROKE SEVERITY, STROKE TYPE AND STROKE SUBTYPE

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ABSTRACT

Introduction: Obesity is an established risk factor for stroke. However, many studies suggested that the outcome of stroke is better in obese patients ("Obesity paradox"). **Objectives:** To study the association between body mass index (BMI) and stroke severity, stroke type, and stroke subtype. **Methodology:** This is a retrospective cross-sectional study involving all hospitalised stroke patients in Seberang Jaya Hospital with self-reported information on BMI from July 2019 to December 2021. BMI was categorised into four groups: underweight (BMI<18.5), normal weight (BMI 18.5-24.9), overweight (BMI 25.0-29.9), and obese (BMI≥30.0). Stroke severity was classified based on the National Institute of Health Stroke Scale (NIHSS) into mild (0-4), moderate (5-15), moderate-severe (16-20), and severe (20-42). Stroke types were classified into ischemic, intracerebral haemorrhage (ICH), and transient ischemic attack (TIA). Ischemic strokes were further classified based on Oxfordshire Community Stroke Project (OCSP) into total anterior circulation infarct (TACI), partial anterior circulation infarct (PACI), lacunar circulation infarct, and posterior circulation infarct (POCI). Data were analysed using cross-tabulation analysis. **Result:** Out of 317 patients recruited, 171 patients (45.1%) were underweighted, 115 patients (30.3%) were normal, 65 patients (17.2%) were overweight, and 28 patients (7.4%) were obese. Most patients had mild strokes (72.8%), followed by moderate strokes (25.1%), moderate-severe strokes (1.6%), and severe strokes (0.5%). Ischemic stroke was the commonest stroke type (83.6%), followed by TIA (12.4%) and ICH (4.0%). Among patients with ischemic strokes, the majority have LACI (83.3%), followed by POCI (8.2%), PACI (6.0%), and TACI (2.5%). There were no significant associations between BMI and stroke severity (p-value=0.912), stroke type (p-value=0.654), and stroke subtype (p-value=0.558). **Conclusions:** BMI is not associated with stroke severity, stroke type, and subtypes. More studies are needed to address the corresponding risk factors that might affect the outcomes.

ASSOCIATION OF ADMISSION BLOOD PRESSURE WITH STROKE SEVERITY AND FUNCTIONAL OUTCOME IN ACUTE ISCHEMIC STROKE PATIENTS WHO RECEIVED INTRAVENOUS THROMBOLYSIS IN SEBERANG JAYA HOSPITAL

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ABSTRACT

Introduction: Hypertension is a known risk factor for ischemic stroke. It is crucial to understand whether admission blood pressure affects admission stroke severity and functional outcome. **Objectives:** To determine the association between the admission blood pressure (BP) with the admission stroke severity and functional outcome in acute ischemic stroke (AIS) patients treated with intravenous thrombolysis (IVT) in Seberang Jaya Hospital (SJH). **Methodology:** This retrospective cross-sectional study involved AIS patients who were given IVT from year 2012 to January 2022. Data was extracted from the medical records and analyzed with SPSS IBM Version 25. **Result:** A total of 141 stroke patients underwent thrombolysis from 2012 to January 2022. The admission BP was subdivided into high [SBP ≥211mmHg (n=15; 10.6%) or DBP ≥111mmHg (n=29; 20.6%)], medium [SBP 111-210mmHg (n=125; 88.7%) or DBP 71-110mmHg (n=99; 70.2%)], and low [SBP ≤110mmHg (n=1; 0.7%) or DBP ≤70mmHg (n=13; 9.2%)]. The mean admission SBP and DBP were 168.6mmHg (SD=33.6) and 94.1mmHg (SD=19.1) respectively. The admission NIHSS was categorized into mild [0-7 (n=24; 17.0%)], moderate [8-15 (n=77; 54.6%)], and severe [≥16 (n=40; 28.4%)]. MRS at three months was categorized as good prognosis, 0-2 (n=56; 39.7%), and poor prognosis, 3-6 (n=85; 60.3%). Admission SBP and DBP were not found to have significant association with admission NIHSS (p=0.598; p=0.818) and MRS at 3 months (p=0.126; p=0.208). **Conclusions:** Admission SBP and DBP are not associated with admission stroke severity and functional outcome in AIS patients treated with IVT.

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ASSOCIATION OF STROKE SEVERITY WITH HOSPITAL DISTANCE, ECONOMIC STATUS AND HOSPITAL ARRIVAL TIME AMONG STROKE PATIENTS IN HOSPITAL SEBERANG JAYA

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ABSTRACT

Introduction: Demographic variables and hospital arrival time are known to influence outcomes for stroke patients. However, the relation of these factors with stroke severity remains unclear. **Objectives:** This study aimed to determine the association of admission stroke severity with hospital distance, economic status, and hospital arrival time among stroke patients in Hospital Seberang Jaya. **Methodology:** This retrospective cross-sectional study involved both haemorrhagic and ischaemic stroke patients from July 2020 to December 2021. The severity of stroke patients during admission was based on the National Institutes of Health Stroke Scale (NIHSS). Hospital distance was categorized by quartiles. Economic status was based on the salary of the patients. Salary was categorized into B40 and M40, with income range of <RM4850, and RM4850-RM10959, respectively. Hospital arrival time was categorized into the early arrival group and the late arrival group, indicated by the onset-to-door time of ≤4.5h, and >4.5h, respectively. **Result:** There were 278 stroke patients. A majority of them had a hospital distance of 12.0km to 19.0km (n=71, 25.5%), among which, 81.7% of the patients had mild stroke. There were 272 patients in the B40 category and only 6 of them were in the M40 category. Most of the B40 patients had mild stroke (n=200, 73.5%) while all M40 patients had mild stroke. There were more stroke patients in the early arrival group compared to the late arrival group (64.7% versus 35.3%). Most of the patients from both groups had mild stroke, which was 73.9% and 74.5%, respectively. All variables, namely hospital distance, salary and onset-to-door time were not significantly associated with admission NIHSS (p=0.154, p=0.423, p=0.921). **Conclusions:** Hospital distance, economic status, and hospital arrival time may not be associated with admission stroke severity, but these factors warrant larger studies to confirm the findings.

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ISCHEMIC STROKE AND HYPERACUTE TREATMENT IN SEBERANG JAYA HOSPITAL: THE SEBERANG PRAI MODULE

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ABSTRACT

Introduction: Seberang Jaya Hospital (SJH) started its first thrombolysis service in year 2012. Throughout the past 10 years, the service was further expanded with the introduction of hyperacute MRI (hMRI) sequence for wake-up stroke (2019), public-private partnership in mechanical thrombectomy (2019), and hub and spoke stroke activation module for nearby peripheral district hospital (2020). **Objectives:** To describe the flow of stroke activation and hyperacute treatment in Seberang Prai. **Methodology:** This is an analysis of an ongoing stroke registry data that included acute ischemic stroke (AIS) patients who had received hyperacute treatment from 2012 to 2022. **Result:** Any adult patients who presented with stroke symptoms within 4.5 hours will be alerted to stroke team. The imaging of choice is plain CT brain, CT angiography of brain, or hMRI sequence depending on the clinical scenario. Patients in periphery hospitals will be attended by the local medical team and updated to neurologist via telemedicine. The patients would then be transferred to SJH for imaging, and subsequently given IVT in emergency department. MT would be offered to eligible patients, and those agreed would be transferred to nearby private comprehensive center for MT, due to non-availability of in-house interventionist. Post-MT patients would be transferred back to SJH for continuation of care. Patients with rehabilitation potential would be assessed by geriatrician for in-house rehabilitation programme. All post-IVT or MT patients would be reviewed back in Neurology clinic 3 months post-discharge for recovery progress and stroke data collection. **Conclusions:** AIS is an emergency. The effective treatment of acute stroke requires speed and TEAM: Together Everyone Achieves More.

ASSOCIATION OF ADMISSION BLOOD SUGAR LEVEL WITH ADMISSION NIHSS AND mRS 3 MONTHS POST ISCHEMIC STROKE THROMBOLYSIS - SEBERANG JAYA HOSPITAL

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ABSTRACT

Introduction: Diabetes mellitus is a risk factor for ischemic stroke, and hyperglycemia is a common observation during acute stroke. To date, there are not much data on the association of admission blood glucose with stroke severity and functional outcome post thrombolysis. **Objectives:** To determine the association of admission blood glucose with admission NIHSS and mRS 3-months post thrombolysis of acute ischemic stroke (AIS) patients. **Methodology:** This is a retrospective cross-sectional study involving all AIS patients who received IVT from year 2012 to January 2022 in Seberang Jaya Hospital. Data was collected from clinical case notes and analyzed with SPSS IBM Version 25. **Result:** A total of 141 AIS patients received IVT from 2012 to January 2022. The mean age of patients was 59.7 (SD=12.3). The mean admission blood glucose was 10.3 (SD=5.2). Admission blood glucose (mmol/L) were categorised into: ≤10.0 (n=89; 63.1%), 10.1-14.0 (n=23; 16.3%), 14.1-18.0 (n=15; 10.6%), and ≥18.1 (n=14; 9.9%). The mean NIHSS upon admission was 12.5 (SD=5.2). The admission NIHSS was categorized into mild [0-7 (n=24; 17.0%)], moderate [8-15 (n=77; 54.6%)] and severe [>16 (n=40; 28.4%)]. Modified Rankin Scale (mRS) score at three months was categorized as good prognosis, 0-2(n=56; 39.7%) and poor prognosis 3-6(n=85; 60.3%). Admission blood glucose was not found to have significant association with admission NIHSS (p=0.921) and mRS score at 3 months (p=0.805). **Conclusions:** Admission blood glucose is not associated with admission NIHSS and mRS 3 months post IVT.

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ASSOCIATION OF WEIGHT WITH ADMISSION STROKE SEVERITY AND FUNCTIONAL OUTCOME IN ACUTE ISCHEMIC STROKE PATIENTS WHO RECEIVED INTRAVENOUS THROMBOLYSIS IN SEBERANG JAYA HOSPITAL

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ABSTRACT

Introduction: Obesity is an established risk factor for stroke, but the association of weight with admission stroke severity and functional outcome are not well established. **Objectives:** To determine the association of weight with admission stroke severity and functional outcome in acute ischemic stroke (AIS) patients treated with intravenous thrombolysis (IVT) in Seberang Jaya Hospital (SJH). **Methodology:** This retrospective cross-sectional study involved AIS patients who were given IVT from July 2012 to December 2021. Data was extracted from the medical records and analyzed with SPSS IBM Version 25. The patients were categorized into three groups based on their body weight: 40-60kg, 60-80kg and >80kg. Admission stroke severity was graded with the National Institutes of Health Stroke Scale (NIHSS) score (0-7 mild; 8-15 moderate; ≥16 severe) and functional outcome was graded with modified Rankin Scale (mRS) score at 3 months post-IVT (0-2 good outcome; 3-6 poor outcome). **Result:** Among the 136 post-IVT AIS patients, the mean admission NIHSS was 12 (SD 5.09) and mean mRS at 3 months was 3 (SD 1.92). Majority of the patients in all three groups have moderate stroke severity, with highest percentage noted in >80kg group, followed by 61-80kg and 40-60kg groups [n=11(78.6%); n=46 (63.0%); n=60 (61.2%). As for the mRS at 3 months, more than half of the patients in all groups have poor outcome, of which the 40-60kg group has the highest percentage (n=33;67.3%), followed by the ≥80kg group (n=9;64.3%) and the 60-80kg group (n=39;53.4%). There was no statistical significance between the body weight of AIS patients with their admission stroke severity (p=0.739), and functional outcome post-IVT (p=0.297). **Conclusions:** Body weight is not associated with admission stroke severity and functional outcome in AIS patients treated with IVT.

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We thank the Director-General of Health Malaysia for the permission to present these findings.

ASSOCIATION OF SMOKING WITH ADMISSION STROKE SEVERITY, TYPES OF STROKE AND ISCHAEMIC STROKE SUBTYPES AMONG STROKE PATIENTS IN HOSPITAL SEBERANG JAYA

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ABSTRACT

Introduction: According to World Health Organization (WHO), smoking is a well-established risk factor for stroke due to its direct effect on the development of atherosclerosis and arterial damage. **Objectives:** This study aimed to determine the association of smoking with admission stroke severity, types of strokes and ischaemic stroke (IS) subtypes among stroke patients in Hospital Seberang Jaya. **Methodology:** We included 392 stroke patients from June 2020 to December 2021. Data was extracted from the medical records and analyzed with SPSS IBM Version 20. The patients were categorized into two groups: smoker and non-smoker. The primary outcome was admission stroke severity assessed using the National Institutes of Health Stroke Scale (NIHSS) score, whereas the secondary outcomes were types of strokes based on the WHO classification and ischaemic stroke subtypes based on the Oxfordshire Community Stroke Project (OCSP) classification. All variables were categorical and were compared using chi-square test or Fisher's Exact test when the assumptions were not met. **Result:** A total of 134(34.2%) smokers and 258(65.8%) non-smokers were included in this study. The median (IQR) for admission NIHSS was 3(4) for both groups. Most patients had mild stroke (NIHSS 0-4), but the percentage was higher in the smoker group [100(74.6%) versus 185(71.7%)]. There was no statistically significant association between smoking and admission stroke severity (P=0.180). The most common type of stroke was IS with a higher percentage in the smoker group than in the non-smoker group [116 (86.6%) versus 214 (82.9%)]. Among 329 IS cases, lacunar infarct was the most common subtype in both groups [99 (86.1%); 173 (80.8%)]. There was no statistically significant association between smoking and types of strokes or IS subtypes (P=0.463; P=0.483). **Conclusions:** Smoking may not be associated with admission stroke severity, types of strokes and IS subtypes. Future larger studies are warranted to confirm the findings.

OUTCOME OF ISCHEMIC STROKE THROMBOLYSIS TREATMENT IN SEBERANG JAYA HOSPITAL, A SINGLE CENTER 10 YEARS REVIEW: 2012- 2021

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ABSTRACT

Introduction: Stroke ranked the third most common mortality cause in Malaysia. Intravenous thrombolysis (IVT) is the standard reperfusion therapy for patients with acute ischemic stroke. **Objectives:** To study the treatment outcome of acute ischemic stroke (AIS) patients who had received IVT at Seberang Jaya Hospital (SJH). **Methodology:** This is an analysis of ongoing stroke registry data that included acute ischemic stroke patients who had received IVT at SJH from 2012 to 2021. **Result:** A total of 149 patients with AIS had received IVT in SJH from the year 2012 to 2021. The mean (SD) NIHSS upon admission was 12.66(5.23). 39.60% were partial anterior circulation infarct (PACI), 26.85% were lacunar cerebral infarct (LACI), 25.50% were total anterior circulation infarct (TACI), and 8.05% were posterior circulation infarct (POCI). Modified Rankin Scale (mRS) score at three months were: mRS 0 (13[8.70%]); mRS 1(24[16.10%]); mRS 2(25[16.80%]); mRS 3(23[15.40%]); mRS 4(26[17.40%]); mRS 5(8[5.40%]); and MRS 6(30 [20.1%]).28(18.80%) patients developed intracranial bleeding (ICB) post-IVT. 7(4.70%) patients developed other bleeding events such as gum bleeding and haematoma. 25 (16.78%) patients died in the same admission, and five (5.43%) patients died within 3 months post IVT. Massive infarct with cerebral oedema (40%) is the commonest cause of post IVT mortality. **Conclusions:** Compared to CASES cohort study, our centre has a lower percentage of patients who achieved favourable functional outcomes (mRS score of 0-1) at three months (25.00% vs 31.80%), lower rate of ICB post thrombolysis (18.80% vs 28.90%), and a lower rate of mortality within 3 months post IVT (20.10% vs 22.30%).

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A RARE COMPLICATION OF ACUTE ISCHEMIC STROKE DURING CARDIAC CATHETERIZATION: A CASE REPORT

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ABSTRACT

Background: Acute stroke during cardiac catheterization is rare with incidence rate ranging from 0.2% to 0.4%. We report the case of a 70-year-old lady with independent activities of daily living pre-morbidly who had acute ischemic stroke during her cardiac catheterization. **Case presentation:** She was admitted for an elective coronary angiogram following an acute episode of NSTEMI a month ago. Coronary angiogram was done under local anaesthesia without sedation via her right radial artery. During the procedure, tortuosity of right subclavian artery was noted. Her GCS dropped to E3V2M5 shortly after undergoing coronary angiography. An emergency computed tomography (CT) angiography of the cerebral arteries revealed right middle cerebral artery (MCA) infarct (ASPECTS score 7) with distal right MCA (M4) thrombosis. Intravenous thrombolysis using recombinant tissue plasminogen activator (Alteplase) was administered immediately. Upon reassessment 2 hours later, her NIHSS decreased from the initial score of 9 to 6. Her GCS also improved fully after the thrombolysis. Neurological examination revealed left seventh cranial nerve palsy (upper motor neuron type), mild dysarthria, reduced powers of her left-sided upper limb (MRC graded 4) and lower limb (MRC graded 4) with left-sided upgoing Babinski. After 24 hours of thrombolysis, contrasted CT brain showed evolving right MCA territory infarct, with no evidence of acute intracranial bleeds or haemorrhagic transformation. Otherwise, her left-sided weakness of upper limb and lower limb remained similar with no new neurological deficits. She had complete bed rest for a week in the ward after the acute ischemic stroke. However, she developed deconditioning subsequently. She was given single anti-platelet therapy in the first week of stroke and restarted with double anti-platelet therapy thereafter. **Conclusion:** Despite transradial approach has lower risk of neurovascular complication (as compared to transfemoral route), usage of correctly sized material and meticulous manipulation of guidewire are of utmost importance.

STROKE AWARENESS AMONGST HEALTHCARE PROVIDERS IN AN UPPER MIDDLE-INCOME COUNTRY

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ABSTRACT

Introduction: Stroke is a rapidly developing clinical signs of focal or global disturbance of cerebral function with symptoms lasting 24 hours or longer or leading to death. It affects one in four people across the globe and is the third highest cause of death in Malaysia. **Objectives:** To explore the level of awareness in stroke care amongst healthcare providers in the Kuala Pilah District, Malaysia. **Methodology:** A cross-sectional study was conducted during the World Stroke Day awareness campaign in Hospital Tuanku Ampuan Najihah (HTAN), Kuala Pilah, Negeri Sembilan, Malaysia from the 1st to 28th of October 2021. A Google Doc questionnaire comprising ten questions on stroke care was sent to all departments in HTAN via WhatsApp instant messaging. Participants were allowed multiple submissions. One point was given for each correct response. Responses were collated and analysed using Google Doc application. **Result:** A total of 463 responses were recorded from 432 participants. The mean and median scores were 7.46 and 7, respectively. Most respondents (87.9%) knew about the timing of acute stroke thrombolysis, secondary prevention of stroke (79.3%), signs of dysphagia (94.4%), dietary modifications (98.1%) and stroke rehabilitation (97.6%). Only 15.6% respondents knew that the Face-Arm-Speech-Time (FAST) acronym is not sensitive to detect posterior circulation infarct. **Conclusions:** Stroke awareness amongst healthcare providers in the Kuala Pilah District varies from acute stroke care to rehabilitation. Areas which need more emphasis are signs and symptoms of posterior circulation syndrome, sexual dysfunction after stroke and the timing to start antihypertensives after an acute stroke.

Keywords: World Stroke Day, stroke awareness, healthcare providers, developing country, upper middle-income country.

HYPERCOAGULABLE STATE LEADING TO THROMBOTIC COMPLICATIONS AND CEREBRAL ARTERY INFARCTION IN PATIENT WITH SEVERE COVID-19 INFECTION. A CASE REPORT

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ABSTRACT

Case presentation: We report a rare case of major deep vein thrombosis with Left anterior cerebral artery (ACA) and middle cerebral artery (MCA) infarction requiring emergency left decompressive craniectomy in a 40-year-old gentleman severe non-ICU COVID-19 infection with a no known risk factor for cerebrovascular disease or hypercoagulable state. Patient recovered one month later with a good GOS scoring, fully alert, able to follow command with right sided hemiplegia. The proposed mechanisms for hypercoagulable state among Covid-19 patients are through systemic inflammation and cytokine storm, postinfectious immune -mediated responses, and direct viral-induced endothelitis or endotheliopathy which potentially leading to angiopahic thrombosis. This complication is also associated with an increase rate of both arterial and venous thromboses in the pulmonary and systemic vasculature with the incidence rate of almost 2.8% to 3.8%. Therefore, we feel that it is crucial for all health personnel to have a high level of clinical suspicion and low threshold for diagnostic imaging for complications related to the hypercoagulable state among severe ICU and non-ICU COVID-19 patients.

LESSONS LEARNT FROM A POSTERIOR CIRCULATION STROKE IN A COVID-19 PATIENT: A CASE REPORT

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ABSTRACT

Background: Since the start of the COVID-19 pandemic, an increasing number of COVID-19 related strokes have been reported, especially in young, healthy patients. **Objectives:** The aims of this case report are to highlight in this pandemic era: (1) consider diagnosis of COVID-19 in young, healthy patients who present with stroke despite absent COVID-19 infective symptoms; (2) successful outcome of COVID-19 stroke patients will require multidisciplinary treatment. **Case presentation:** A 45-year-old male presented with acute onset of headache and vertiginous giddiness. He was afebrile and denied any infective symptoms. As several of his roommates had been diagnosed with COVID-19, he was promptly isolated while awaiting confirmation of his COVID-19 status, although his admission chest x-ray was clear. His findings included left-sided dysmetria, left-sided dysdiadochokinesis, and left-sided heel-shin in-coordination. His neuroimaging confirmed a massive infarct in the left cerebellar hemisphere, left middle cerebellar peduncle and left hemipons. He was commenced on intravenous mannitol and monitored in the intensive care unit. The following day, he was confirmed SARS COVID-19 positive. Next day, because of neurological deterioration, he required urgent posterior fossa decompression, and insertion of external ventricular drain. Three weeks later, he was de-isolated and transferred to inpatient rehabilitation unit. After 2 months of hospitalization, he was independent in his activities of daily living and discharged. **Conclusion:** It has been reported in almost half of the young patients, stroke was more likely to happen before onset of any COVID-19 infective symptoms. Hence, it is important to consider the diagnosis of COVID-19 in young, healthy patients who present with stroke during the pandemic. Due to high vigilance and a comprehensive screening protocol, none of the healthcare workers that the patient had contact with, were infected with COVID-19. A successful rehabilitation outcome requires multidisciplinary effort.

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STROKE IN SEVERE COVID-19 INFECTION: A CROSS-SECTIONAL STUDY

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ABSTRACT

Introduction: Stroke has been identified as a neurological sequel of COVID-19 infection but there is limited data in local setting. This study aims to identify the prevalence, characteristics and in-hospital outcomes of patients who developed stroke during their hospitalization for severe COVID-19 pneumonia. **Methodology:** Patients with severe COVID-19 infection who were transferred out of ICU or general medical wards to the subacute geriatric ward Kuala Lumpur Hospital from 1st January 2021 to 31st December 2021 were included. Severe COVID-19 infection was defined as COVID-19 infection Clinical Category 4 or 5. Patients' characteristics were investigated for their association with stroke. In-hospital outcomes studied were HAP, VTE, AKI, Delirium, GI bleed, Pressure injury. Acute urinary retention, UTI, Psychological disorder, Poor functional recovery (Modified Barthel Index <60 upon discharge), Dysphagia, Institutionalization and Death. **Result:** 282 patients were included with a mean age of 63 (SD 15.3) and 137(48.7%) were females. 35(12.4%) developed acute ischaemic stroke. Acute ischaemic stroke was not associated with increased age, individual comorbidities, and comorbidity burden. Acute ischaemic stroke was not more common with those who had COVID-19 related cardiovascular complications such as acute coronary syndrome, cardiac arrhythmia, heart failure or myocarditis. However, higher rate of dysphagia, delirium, poor functional recovery, and mortality were observed in acute ischaemic stroke patients hospitalized for severe COVID-19 infection. **Conclusions:** The lack of association between traditional cardiovascular risk factors with acute ischaemic stroke in patients with Severe COVID-19 infection may suggest presence of alternative pathogenesis. Nevertheless, acute ischemic stroke in COVID-19 infection was associated with poorer outcome and warrant comprehensive management.

THE PECULIAR STROKE SYNDROMES

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ABSTRACT

Background: Midbrain stroke syndrome is a rare cluster of symptoms accounting to as low as 0.9% of all cerebrovascular accidents recorded. It can be challenging to diagnose due to the great variability of symptom presentations and yet appear to be rarely in the literature. **Case presentation:** A 55 years old gentleman with no known comorbid presented with a history of unsteady gait and slurring of speech with hypertensive crisis episodes up to 220/110. On examination, unequal pupil, and left eye ptosis along with contralateral hemiparesis were apparent. Subsequent CTA reported a left PCA thrombosis with left occipital, midbrain, and left cerebral peduncle infarction with no evidence of PCOM. He was then diagnosed as Weber Syndrome and subsequently transferred to rehabilitation ward for intensive rehabilitation. Thereupon, it was striking during activities done that he struggled with his balance and coordination, adding ataxia into his list of impairments. Hence, the diagnosis of Benedikt Syndrome was completed and established. **Discussion:** Generally, this syndrome causes an ipsilateral cranial nerve palsy and contralateral hemiplegia or hemiparesis with a characteristic manifestation according to the specific involved area. Among the commonest midbrain stroke syndromes are Weber Syndrome and Benedikt Syndrome. The distinction between the two is the presence of cerebellar ataxia. Benedikt Syndrome characterised by ipsilateral oculomotor nerve palsy, contralateral hemiparesis, and contralateral cerebellar ataxia. Whereas Weber Syndrome causing ipsilateral third nerve palsy with contralateral hemiparesis. Thus, a thorough examination is crucial. **Conclusion:** This case highlights a dilemma in establishing the accurate diagnosis of a midbrain stroke syndrome. Considering the pronounced patent of CVA, the other subtle fragments of the disease were often bypassed. Therefore, the understanding of this disease including all its customary and rarity is pivotal to ensure the accurate diagnosis made and the best outcomes generated.

FIBROMUSCULAR DYSPLASIA IN A YOUNG STROKE

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ABSTRACT

Background: Fibromuscular Dysplasia (FMD) is an underrecognized but important cause of stroke in young female Asian populations. It manifests as a non-inflammatory arterial disease with beading, stenosis, aneurysm, dissection, and arterial tortuosity. **Objectives:** We report a case of young stroke with multiple arterial aneurysms. **Case presentation:** This is a 32-year-old lady with young hypertension who presented initially with unstable angina. Coronary angiogram revealed aneurysmal coronary arteries. A year later, she presented with isolated right cranial nerve sixth palsy. CT and MR angiography found fusiform aneurysm of left vertebral artery (V4), stenoses and beaded appearance of L3-level lumbar arteries and bilateral renal interlobar arteries. Her DSA additionally showed right internal carotid artery cavernous segment saccular aneurysm. She had 2 cerebrovascular events in 2022; left lacunar stroke and transient ischemic attack-right-sided weakness with aphasia. NCCT Brain noted old lacunar infarct. CTA brain showed recurrent aneurysmal disease and dissection of left VA and new fusiform aneurysms were at basilar artery and right VA. She recovered with no neurological deficit. She had no associated connective tissue disease features, hematological abnormality, systemic or constitutional symptoms to suggest vasculitis as alternative diagnosis. Correlating with radiological findings and manifestations of renovascular hypertension and cerebrovascular events, diagnosis of FMD was made. **Conclusion:** Prevalence of FMD remains unknown1; clinical research is rare in Asian populations. Mainstay of treatment includes controlling risk factors, optimising blood pressure, and preventing ischemic events with medical treatment or revascularization

EXTENSIVE CORPUS CALLOSUM INFARCT AS AN UNUSUAL PRESENTATION IN TOTAL ANTERIOR CIRCULATION INFARCT STROKE: A CASE REPORT

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ABSTRACT

Background: Corpus callosum is the largest commissural fibres which connects both the cerebral hemispheres cortex, and it is the largest white matter tract in the brain. Due to its abundant vascular supply, ischemic stroke at this site is relatively rare. We present a case of extensive corpus callosum infarction presenting as acute stroke. **Case presentation:** A 50-year-old gentleman, active smoker with underlying hypertension, diabetes mellitus, dyslipidaemia presented with sudden onset of right body weakness on 22/11/21, 6am. He was found lying on floor, unable to speak associated with right facial asymmetry. Upon presentation, he was aphasic with dense right hemiparesis (power 0/5), NIHSS:12. CT brain showed extensive corpus callosum, bilateral centrum semi vale and left head of caudate nucleus infarct, CTA brain, RI brain with MRA TOF showed long segment bilateral ICAs occlusion with acute infarct of the genu-body of bilateral corpus callosum, corona additament basal ganglia and bilateral internal watershed zone. Posterior circulation supplying the ACA-MCA. He was hence started on double antiplatelets medication for 3 months followed by single antiplatelet medication was normal sinus rhythm with heart rate of 81bpm. 24-hour HOLTER monitoring was rescheduled for him. During the follow up, his NIHSS remains static of 12 with MRS 5. **Conclusion:** Large artery atherosclerosis has been identified as common aetiology for genu and body of corpus callosum infarct; embolism is more frequent for splenium corpus callosum infarct. In this case, Moyamoya disease need to be considered in view of the neuroimaging showing cerebral infarction primarily involving subcortical regions and CTA brain findings as such above. However, the involvement of bilateral ICA stenosis in this case mainly involving the proximal ICA and there are not prominent basal or parenchymal collaterals seen. DSA scan of the brain is still the gold standard method for diagnosis of moyamoya disease.

THROMBOTIC THROMBOCYTOPENIA PURPURA CAUSING CONCURRENT CEREBRAL ISCHEMIA AND INTRACRANIAL BLEED: A CASE REPORT

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ABSTRACT

Background: Thrombotic thrombocytopenic purpura (TTP) is a rare, life-threatening disease which is often initially missed due to its extensive neurological and systemic presentation. **Case presentation:** A 55-year-old female presented with both acute ischemic and haemorrhagic stroke with normal initial laboratory investigations. However, in the ward, clinical and biochemical deterioration led to the diagnosis of TTP. With prompt diagnosis and extensive workup for both primary and secondary TTP, immediate treatment was delivered. We highlight the dilemma in managing concurrent ischemic and haemorrhagic strokes, which raises the possibility of worsening intracranial bleed should plasma exchange be instituted. Instead, we commenced plasma infusion and intravenous steroids, which led to biochemical and clinical improvement. **Conclusion:** Although plasma exchange is recommended for the treatment of TTP, plasma infusion is equally effective and thus should be considered as the first-line therapy, especially when plasma exchange is contraindicated or unavailable.

Keywords: ischemic stroke, haemorrhagic stroke, thrombotic thrombocytopenic purpura, plasma exchange, plasma infusion

STROKE CODE ACTIVATIONS IN HOSPITAL SEBERANG JAYA 3 YEARS EXPERIENCE

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ABSTRACT

Introduction: Stroke Code activation was introduced in Hospital Seberang Jaya, a government-based primary stroke centre in the state of Penang since 2019. **Objectives:** This abstract aim to provide an insight into the characteristics of stroke code activations in our hospital from year 2019 to 2021. **Methodology:** All Stroke Code activations from January 1, 2019, to December 31, 2021, were included in the study. Data were extracted from our local registry. **Result:** A total of 479 patients were recruited in this study: 292 males (61%) and 187 females (39%). Their ages range from 20 to 97 with a mean age of 59 years old. The number of stroke activations increased from 76 in 2019 to 192 in 2020 and 211 in 2021. Thrombolysis therapeutic yield were 34.2% (26/76) in 2019, 24.0% (46/192) in 2020 and 23.2% (49/211) in 2021. One third (32.2%, n=73) of the stroke activations turned out to be intracranial haemorrhage, which is an absolute contraindication for thrombolysis. The percentage of patients arriving to hospital via ambulances increased from 20% in 2019 to 41% in 2020 and 53% in 2021. The average time patients took from onset until reaching to hospital were 1 hour 40 minutes in 2019, 1 hour 56 minutes in 2020 and 1 hour 59 minutes in 2021, respectively. **Conclusions:** In the era of evidence-based medicine, stroke registry plays an important role in providing data-driven strategies to improve our stroke service and awareness, in order to improve clinical outcome.

IMPACT OF ATRIAL FIBRILLATION IN FUNCTIONAL OUTCOME FOR ACUTE STROKE

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ABSTRACT

Introduction: Stroke patients with Atrial Fibrillation (AF) had a poorer clinical outcome than stroke patients without AF. Reduced exercise tolerance in AF may be caused by a low VO2max and inadequate cardiac endurance. **Objectives:** To evaluate functional outcomes in post-stroke patients with AF with and without revascularization intervention among patients who received post-stroke rehabilitation. **Methodology:** This is a retrospective study of HPUPM patients admitted between January and December 2021. Stroke patients with AF, whether they had revascularization or not, will undergo a post-stroke rehabilitation program until they are discharged. Following discharge, outcome measures such as the Modified Rankin Scale (MRS) and the Modified Barthel Index (MBI) were assessed using an independent t-test. **Result:** A total of 29 stroke patients with AF, of whom 15 received interventions. The majority of them are Female (51.7%), and Malay (62.1%), with a mean age of 72 ± 10.2 and a mean NIHSS of 16 ± 7.1 upon admission. Stroke patients with AF who received intervention had better outcome (mean MRS, 3 versus 4; $p > 0.05$, mean MBI, 39.0 versus 18.3; $p > 0.05$). MBI results show patients were severe and total dependency levels, respectively. **Conclusions:** Despite revascularization, AF had a poorer functional result in our study. Low cardiac endurance can impair exercise tolerance and the progression of activities in normal post-stroke rehabilitation regimens. As a result, a more organized post-stroke rehabilitation program with a cardiopulmonary endurance regimen will be beneficial in recovering acute post-stroke patients with AF.

CHALLENGES AND OUTCOMES IN INTRAVENOUS THROMBOLYSIS IN POSTERIOR CIRCULATION INFART (POCI) IN HOSPITAL SULTANAH NUR ZAHIRAH A RETROSPECTIVE STUDY

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ABSTRACT

Introduction: Posterior Circulation Infarct (POCI) corresponds to any infarctions within vertebrobasillar artery territories. It comprises of approximately 20% of ischemic stroke spectrum and remains as one the most challenging diagnosis in stroke due to atypical presentations. This reduces the sensitivity of prehospital stroke screening and delay in activation of stroke thrombolysis. This is shown through the local Stroke Thrombolysis Registry data collected in HSNZ. **Objectives:** This study aims to identify the challenges and outcomes in patients with acute POCI who received intravenous thrombolysis in HSNZ. **Methodology:** All acute stroke patients seen in Emergency Department Hospital Sultanah Nur Zahirah with POCI within 4.5 to 6 hours of onset with no evidence of ICH in CT brain from 2014- May 2022 were included. Demographic, clinical data, door to needle time, CT to needle time, NIHSS score pre and 24 hours post thrombolysis and CT Brain findings were reviewed. The outcomes are quantified using NIHSS at 24 hours post thrombolysis and Modified Rankin Score upon discharge and 3 months post discharge. The complications encountered during, and post thrombolysis were recorded, respectively. **Result:** Of all 25 patients with POCI who were given IV Alteplase, 28% had failed thrombolysis and intubated with poor NIHSS recovery and high MRS. 4 patients who failed thrombolysis passed away due to progression of stroke. 18 patients had successful thrombolysis with lower NIHSS score and good MRS (0-3). All patients presented more than 1 hour of symptom onset with average of 90 minutes from onset to door time, and the average door to CT time was 1 hour which exceeded the recommended 20 minutes. **Conclusions:** Difficulty in recognition of POCI by the public and healthcare professionals causes delay in delivery of stroke thrombolysis to eligible patients. The outcomes of POCI are variable due to the nature of the occlusion.

BETTER LATE THAN NEVER

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ABSTRACT

Background: Heterotopic ossification (HO) is pathological process of lamellar bone formation in muscles and surrounding joints that may lead to swelling, pain, nerve entrapment, contractures, and limited range of motion in the affected area. HO mostly occurs around the hip joint; however, it is a rare clinical entity in the upper extremity after stroke. Treatment of HO is challenging; therefore, early diagnosis and rehabilitation may improve patient's quality of life. This report presents a case of HO developed on the left elbow 3 months after a haemorrhagic stroke. **Case presentation:** A 59-year-old man, presented to our clinic with left hemiplegia due to basal ganglia haemorrhage after 3 months post stroke. The patient had not seen rehabilitation before. Motor recovery in the left upper limb was Brunnstrom stage 1 and left lower limb was Brunnstrom stage 3. Patient was not ambulating yet. The left elbow was warm, erythematous, and swollen and there was focal tenderness. Left elbow flexion was limited to 20 degrees. Left elbow radiograph done showed calcified HO around the elbow joint. Serum calcium, C-Reactive protein and erythrocyte sedimentation rate were within the normal range except ALP was borderline high, 150 U/L. Indomethacin and Alendronate was started for the treatment of HO. Rehabilitation of patient was passive stretching, cryo-cuff therapy, pressure garment together with the lower limb strengthening and gait retraining. He was undergoing therapy for 5 weeks. Upon discharge patient was able to ambulate with aid and independent in his self-care. **Conclusion:** This case highlights favourable outcome in functional recovery despite delayed rehabilitation, however early diagnosis and rehabilitation can prevent further complication and permanent disability. There is no specific reliable investigation to aid in diagnosing HO early, but detail clinical examination is important. In addition, non-pharmacological and pharmacological approach can give a good outcome in managing HO.

THE DEMOGRAPHICS, DISEASE PATTERN, INTERVENTION AND OUTCOMES OF STROKE PATIENTS PRESENTING TO EMERGENCY DEPARTMENT AT INSTITUT JANTUNG NEGARA IN 2019

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ABSTRACT

Introduction: Institut Jantung Negara (IJN) is located adjacent to Hospital Kuala Lumpur Hospital (HKL), which is a stroke center. We embarked on a study to look into the demographics, disease pattern and outcomes of stroke patients presenting to IJN Emergency Department (ED) in 2019. **Methodology:** This retrospective observational study was carried out between 1st January until 31st December 2019. All patients referred to HKL from IJN ED with the provisional diagnosis of stroke were included in the analysis. Data collected were analyzed using Excel software for age, gender, ethnicity, duration of symptoms at presentation, type of stroke, time to CT Brain, turn-around time before transfer and outcomes. **Result:** There were 25 patients diagnosed with stroke, where 72% were males, and majority were Malays (44%). The mean age was 70 years. Ischemic stroke was the most common type (48%) of stroke. 60% of cases presented more than 4.5 hours from symptom onset. 60% of patients had their CT brain performed more than the recommended 45 minutes. 96% of cases took more than 1 hour before referral to HKL. Of the 12 patients diagnosed with ischemic stroke, none of them received thrombolytic therapy, and majority (66%) had poor functional outcome. **Discussion:** Early recognition of stroke in the community is still lacking, as most patients delayed seeking medical assistance. The turn-around time for potential stroke patients in IJN is not optimal. Developing an efficient network with a stroke center can improve the management of stroke patients, thus leading to better patient outcomes.

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BALANCE TRAINING TO IMPROVE HAND FUNCTION IN STROKE: A SCOPING REVIEW

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ABSTRACT

Introduction: Stroke often results in impaired hand function while balance training is proven to be an effective intervention to improve mobility after stroke. However, limited evidence is available on the effects of balance training on upper limb function. A review on the effects of balance training to improve hand function after stroke needs to be explored to guide rehabilitation team in clinical decision making and practice. **Objectives:** The purpose of this review was to summarise recent scientific evidence on balance training to improve hand function among stroke survivors. **Methodology:** Literature search was performed via PubMed and Scopus with the following search terms: 'stroke' AND 'balance training' AND 'hand function'. All selected articles were published in English. Published randomised controlled trials between 2012 and 2021 that conducted balance training among adults aged 18 years and above with stroke were included. Review articles, case reports and dissertations were excluded. **Result:** The search yielded 232 results. From 27 eligible articles, nine were selected for the review. There were 141 and 139 participants in the intervention and control groups, respectively. Major types of balance training conducted included therapeutic core muscle exercises and adjunct interventions such as action observation, virtual reality, resistance training, as well as comparison with combination therapy (conventional and adjunct). Main outcome measures used for assessing hand function were FMA-UE and WFMT. Out of 9 selected studies, five studies showed significant improvement in hand function which used combination therapy. Between these studies, there were variations in training duration, intensity, and frequency with difficulties in standardising the interventions. **Conclusions:** Balance training in combination with adjunct intervention can improve hand function of stroke survivors. More methodological rigor studies should be implemented to evaluate accurately on the degree of improvements with various interventions as adjunct to balance training for enhancing upper limb outcomes after stroke.

CHALLENGES IN DELIVERING TELE-REHABILITATION FOR RURAL COMMUNITIES IN MALAYSIA

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ABSTRACT

Objectives: To describe the challenges in delivering tele-rehabilitation for rural communities in Negeri Sembilan, Malaysia. **Methodology:** An audit was performed on all patients who received tele-rehabilitation at the Rehabilitation Medicine clinic at Hospital Tuanku Ampuan Najihah, Kuala Pilah, Negeri Sembilan, Malaysia from March 2021 to December 2021. Tele-rehabilitation services comprised tele-consultation, tele-assessments, tele-therapy, and tele-education. Barriers and facilitators to tele-rehabilitation were documented and classified as: i) Patient factors ii) Healthcare provider factors iii) ICT issues. **Result:** Eighty-eight out of 366 patients (24%) received a spectrum of tele-rehabilitation services during the audit period. Barriers were poor network coverage, low smart phone and internet penetration, lack of awareness and/or expertise in telemedicine among healthcare providers and the community, preference for face-to-face consultation, lack of political will and competing health priorities. **Conclusions:** Healthcare providers need to adapt to the local culture and demands in order to improve uptake in tele-rehabilitation. More resources should be allocated to support ICT device ownership and training among clients and tele-rehabilitation providers.

Keywords: challenges, barriers, tele-rehabilitation, rural, communities, Malaysia

INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH AS PREDICTORS FOR PATIENT OUTCOME

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ABSTRACT

Introduction: The International Classification of Functioning, Disability and Health (ICF) is a conceptual framework introduced by the World Health Organisation (WHO) for goal setting and patient-management. Patients with co-morbidities face many challenges to participate in rehabilitation. **Objectives:** To identify factors contributing to patient mortality during intensive rehabilitation based on the ICF framework. **Methodology:** A cross-sectional study was conducted from 1st of July to the 30th of October 2021. All in-patients referred for intensive rehabilitation and died at Hospital Tuanku Ampuan Najihah, Kuala Pilah, Negeri Sembilan, Malaysia were included in the study. Patient demography, diagnoses, cause of death, outcome measures; barriers and facilitators to participate in rehabilitation were sub-categorised into the ICF framework. **Result:** Twenty (14.3%) out of the 140 patients died during the study period. The most common causes of death (body functions and structures) were aspiration pneumonia (35%), cardiac failure (30%) and septic shock (30%). All of them had required high level of nursing care for bladder and bowel care, and nasogastric tube feeding. None of them could participate in active rehabilitation or fulfil their previous roles in society. Personal factors include prolonged sick-role behaviour (100%), poor health-seeking behaviour (55%) and low motivation (75%). Environmental factors (barriers) were poor social support (66.7%), bariatric patients (25%) and communication difficulties (8.3%). **Conclusions:** Aspiration pneumonia and cardiac failure are the most common causes of death. Patients who are dependent and incontinent, have dysphagia and poor social support have higher mortality. The ICF can be used to predict patient outcomes.

PREDICTORS OF POST STROKE UNFAVORABLE FUNCTIONAL OUTCOMES AMONG PATIENTS WITH HYPERGLYCEMIA DURING ACUTE ISCHEMIC STROKE

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ABSTRACT

Introduction: Hyperglycaemia (HG) during acute ischemic stroke (AIS) has been associated with worse outcomes including unfavourable functional outcomes. Early stratification of the potentially risk factors of HG and poor outcomes associated with it during AIS would help to provide guidance for acute stroke management. This study assessed HG patte within 72hr after stroke, determined the predictors of HG during AIS and its impact on post stroke unfavourable functional outcomes (modified Rankin Scale (mRS) >2). **Methodology:** This was a retrospective cohort study included patients with AIS admitted to Hospital Sultanah Nur Zahirah, Kuala Terengganu, Malaysia, from January 2017 to December 2020. HG was defined as blood glucose level > 140 mg/dl within 72 hr after admission. Patients with HG were subdivided into early, late, and persistent HG. Logistic regression and Cox regression were performed by using SPSS version 22. **Result:** Of total 412, 169 (41.02%) patients had persistent normoglycemia, 243 (58.98%) had HG within 72hr of admission. Pre-stroke diabetes and leucocytosis upon admission were significantly associated with HG during AIS with aOR of 22.94 (95%CI; 12.35-42.61), and 2.71 (95%CI 1.47-4.97), respectively. The persistent HG during AIS significantly predict post stroke unfavourable functional outcome with HR of 1.89 (95%CI; 1.06-3.39) as compared to the peers with early HG during AIS. **Conclusions:** Pre-stroke diabetes is a significant independent predictor of HG during AIS while persistent HG during AIS increase risk of unfavourable functional outcome after discharge. Future study is required to personalise an optimal insulin dosing during AIS depending on pre-stroke DM status.

THERAPIST'S ROLE IN THERAPEUTIC ALLIANCE FOR THE PATIENTS' ENGAGEMENT IN STROKE REHABILITATION

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ABSTRACT

Introduction: There is growing acknowledgment of stroke rehabilitation for stroke survivors. Stroke rehabilitation services aim to be person-centered care where patients play a central role in their rehabilitation plan. However, there is still limited knowledge of factors that affect patients' engagement in stroke rehabilitation including the therapist's role in the therapeutic alliance. **Objectives:** To explore the therapist's role in the therapeutic alliance which influences the patients' engagement in stroke rehabilitation. **Methodology:** A literature search was conducted in MEDLINE, CINAHL, Embase, PsychINFO, and AMED databases for the articles published from January 2000 to December 2021 with the search term; stroke rehabilitation, patients' engagement, therapist's role, and therapeutic alliance. Included articles were in English with qualitative study. The quantitative studies, review articles, case reports, and dissertations were excluded. **Result:** The electronic search resulted in 49 articles. Eight studies met the inclusion and exclusion criteria. Patients experienced that the therapeutic alliance between them with health professionals could influence their stroke rehabilitation engagement. This included health professionals' communication skills, staff's voice tone, behaviors and attentiveness, support and feedback given by the therapists, continuity of care, and collaboration among staff and patients. **Conclusions:** The therapist's role in therapeutic alliance strongly influences the patients' engagement in stroke rehabilitation. It is crucial for the therapists to use their personal attributes therapeutically and professional skills flexibly to establish a therapeutic alliance throughout the rehabilitation program for patients' engagement in stroke rehabilitation.

COVID-19 VACCINATION, INFECTION, AND RISK OF STROKE IN MALAYSIA

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ABSTRACT

Objectives: To determine the risk of stroke among recipients of COVID-19 vaccines and people infected with COVID-19 in Malaysia. **Methodology:** Observational cohort study was conducted using secondary data for the period between 1 February 2021 and 28 February 2022. Individual-level data on COVID-19 vaccination records and confirmed cases of COVID-19 were linked to admission data from public hospitals. Exposure was defined as receiving at least one dose of COVID-19 vaccine or testing positive for COVID-19. Outcome was hospital admission for stroke. **Result:** During the observation period, we identified 3883 ischaemic strokes (IS) and 819 haemorrhagic strokes (HS) that occurred within 28-day of exposure. After the first and second doses of BNT162b2, the absolute risk of IS were 5.42 (95% CI 5.04-5.83) and 6.96 (6.52-7.42) per 100,000 persons vaccinated. The risk of IS following CoronaVac vaccination were 5.26 (4.82-5.73) and 6.46 (5.96-6.98) after the first and second dose, respectively. The risk of IS after first dose of ChAdOx1 was 3.77 (2.98-4.72) and 3.36 (2.61-4.26) after the second dose. For HS, the risk following vaccination with BNT162b2 were 1.44 (1.24-1.65) (first dose) and 1.51 (1.31-1.73) (second dose) per 100,000 persons vaccinated. Among CoronaVac recipients, the risk of HS after the first and second doses were 1.28 (1.06-1.52) and 1.59 (1.35-1.86). The risk of HS was 1.13 (0.71-1.69) and 0.98 (0.60-1.53) after the first and second dose of ChAdOx1 vaccine. In the COVID-19 infection cohort, the risk of IS and HS was 33.16 (31.09-35.38) and 3.50 (2.87-4.28) per 100,00 persons infected. **Conclusions:** Our data showed that the absolute risk of stroke after vaccination in Malaysia was low, whereas the risk of stroke after COVID-19 infection was higher compared with postvaccination.

EFFECTIVENESS OF VOCATIONAL REHABILITATION AUGMENTED WITH COGNITIVE REMEDIATION THERAPY FOR STROKE SURVIVORS WITH COGNITIVE IMPAIRMENTS IN IMPROVING WORK READINESS: A RANDOMISED CONTROLLED TRIAL

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ABSTRACT

Introduction: Finding a job is a top priority for most people but this goal remains unattainable for most post-stroke survivors with cognitive impairments who are still receiving benefits or are unemployed. Vocational rehabilitation aims to successfully retu people with any conditions or limitations to retu to work; however, they still have a significant amount of post-stroke survivors with cognitive impairment who are still unemployed. Cognitive impairments are common in stroke and may have a strong association with poor outcomes. Fortunately, the impairments are manageable to rehabilitation approach with cognitive remediation therapy (CRT) significantly improves cognition for people with mental illness. Vocational rehabilitation (VR) combined with cognitive remediation therapy significantly increases the chances of people with mental illness getting work and retaining work. However, in Malaysia, the availability of CRT is still limited in many cases and setting. **Objectives:** To explore the efficacy and how vocational rehabilitation augmented with cognitive remediation therapy can improve the work readiness among post-stroke survivors with cognitive impairments. **Methodology:** This research will be conducted at SOCSO Rehabilitation Centre, Malacca and two other rehabilitation centres in Klang Valley. This study design will be an experimental study and the participants (SOCSO contributors) will go through a procedure of randomized control trials (RCT) in the division of participants into an experimental group (vocational rehabilitation augmented group) or control group (best standard intervention) with a 1:1 ratio. Consolidated Standards of Reporting Trials (CONSORT) guidelines will be followed. **Result:** Results will include demographic data, a comparison of the level of work readiness and the level of psychosocial functioning before and after VR, the relationship between work readiness and level of psychosocial functioning, the functional relationship of the variables, and the predictors influencing the level of work readiness.

DEVELOPING A MALAY LANGUAGE EXECUTIVE FUNCTION ASSESSMENT: A SURVEY WITH SPEECH-LANGUAGE PATHOLOGISTS IN MALAYSIA

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ABSTRACT

Introduction: Recent robust evidence indicates that executive function (EF) is an important cognitive process in mediating language function and as an effective prognostic indicator of treatment gains in people with aphasia (PWA) (Murray 2017; Mohapatra & Marshall, 2020). While there is a need to measure EF in PWA, linguistic and cultural diversity has become a major challenge faced by speech-language pathologists (SLPs) when conducting assessment for PWA in Malaysia. (Hassan et al., 2020; Noorsham et al., 2020). Studies have also reported that the lack of appropriate, standardised Malay assessment tools and resources for the diagnosis and management of aphasia is a big obstacle faced by clinicians (Ahmad et al., 2013; Hassan et al., 2020). Together, (a) the need to assess EF in aphasia management and (b) the growing need for lingua-culturally standardised assessment tools set the stage for the current research. **Objectives:** The present study was designed to (i) identify current practices among SLPs in conducting EF assessment for PWA (ii) obtain professional opinions on using a Malay EF test battery and (iii) understand the need for remote EF assessment in Malaysia's clinical settings. **Methodology:** An online questionnaire was designed to gather information on the current practices in evaluating EF assessment for PWA and distributed to SLPs involved in the management of aphasia. **Result:** SLPs (n=10) expressed the need for a standardised Malay EF Test Battery. Furthermore, the responses indicated several factors to be considered for the development of a Malay EF test battery such as culturally appropriate items and sensitivity to dialectal variation. Additionally, it was revealed that telehealth practices surrounding aphasia management are novel and not widely used across Malaysia. These professional perspectives will form part of the evidence in the development of a linguistically and culturally appropriate EF test battery for Malay speakers in Malaysia.

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