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Research Article

**ROLE OF THERAPEUTIC INTERVENTIONAL RADIOLOGY
IN CEREBROVASCULAR STROKE MANAGEMENT**Maged Ali Hegazy Shoukeer ¹, Malek Yahya Mohammed Alshahrani ², Saleh Salem Hussain Al Qahtani ², Fahad Aedh Alghamdi ², Omar Abdullah S. Alshahrani ²¹ Consultant of Radiology, Armed Forces Hospitals, Southern Region, Saudi Arabia.² Medical intern, King Khalid University, Abha, Saudi Arabia.**Article Received:** February 2020 **Accepted:** March 2020 **Published:** April 2020**Abstract:**

Background: Imaging the brain and the vasculature that supplies it is therefore a vital first step in treating patients with acute stroke. A computed tomographic (CT) scan of the brain is needed in such patients to rule out hemorrhage before intravenous tPA can be given. Non-contrast CT (NCCT) is the most widely used first-line imaging tool in patients with acute stroke. NCCT is quick to acquire, widely available, and discriminates reliably between ischemia and hemorrhage. **Objective:** In this review, we looked into the cerebrovascular stroke and the role of interventional radiology in diagnosis, and management of stroke patients.

Methodology: Simple Review article. The review is comprehensive research of Medline, Google scholar, EMBASE and PubMed databases since the year 2000 to 2018.

Conclusion: Because of its high vulnerability, brain tissue may be already irreversibly injured at the onset of ischemic stroke. A specific intervention could then rescue brain tissue, restore function, and prevent disability and death. Moreover, endovascular interventions can decrease the risk of stroke in patients with arterial stenosis or malformations. Cerebrovascular interventional radiology treatments expand the treatment options for acute ischemic stroke victims. In addition, Endovascular Thrombectomy (EVT) is proven to provide better clinical outcomes in patients with ischemic strokes caused by large-vessel occlusion compared with best medical therapy alone

Key words: Cerebrovascular stroke, interventional radiology, treatment options, acute ischemic stroke victims.

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INTRODUCTION:

Cerebrovascular disease (CVD) is one of the most common reasons for neurological emergencies and constitutes a serious public health problem. A stroke is an acute compromise of the cerebral perfusion or vasculature or cerebrovascular accident (CVA) [1]. It is a neurologic event related to diseases of the cerebral circulation. Worldwide, cerebrovascular accidents (stroke) are the second leading cause of death and the third leading cause of disability [2]. Stroke, the sudden death of some brain cells due to lack of oxygen when the blood flow to the brain is lost by blockage or rupture of an artery to the brain, is also a leading cause of dementia and depression [3]. It is a major public health problem, affecting millions of people in both developed and developing countries [4]. In the past several decades in developed countries, a greater reduction in the age standardized stroke incidence has taken place because of good health services and effective strategies for cerebrovascular risk factor prevention. However, the converse has been shown for developing countries [5].

The terms CVD and stroke refer to a disturbance in the cerebral blood flow that results in a transient or permanent change in the function of 1 or more regions of the brain [6]. According to the definition proposed by the World Health Organization in 1970, "stroke is rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer, or leading to death, with no apparent cause other than of vascular origin" [7]. A new definition of stroke that includes clinical and tissue criteria has been proposed by the American Stroke Association for the 21st century. This definition is much broader and includes any objective evidence of permanent brain, spinal cord, or retinal cell death attributed to a vascular etiology based on pathological or imaging evidence with or without the presence of clinical symptoms [8].

Strokes mainly affect individuals at the peak of their productive life. Most strokes occur in individuals >65 years of age; in the <40 years of age demographic, stroke prevalence is only 0.5%, in the 60- to 79-year age group, prevalence rises to more than 6%, in persons ≥80 years of age, 12.4% of women and 14.8% of men have suffered a stroke [9]. Previous studies have shown that the risk of stroke is doubled after the age of 55 [10]. Although stroke often is considered a disease of elderly persons, one third of strokes occur in persons younger than 65 years [11]. Stroke is the leading cause of adult disability worldwide. It is thus critical to recognize stroke early and treat it rapidly to prevent or minimize morbidity and mortality [1].

Besides coronary heart disease and cancer, stroke is the commonest cause of death in most industrialized countries [12]. Cerebrovascular accidents (CVAs) are the fifth leading cause of mortality and the leading cause of serious, long-term disability in the United States. Recent statistics on European cardiovascular diseases indicate that stroke is responsible for 4 million deaths, with over 1.9 million deaths recorded in the European Union [13]. In 2001 it was estimated that cerebrovascular diseases (stroke) accounted for 5.5 million deaths worldwide, equivalent to 9.6 % of all deaths [14]. Two-thirds of these deaths occurred in people living in developing countries and 40% of the subjects were aged less than 70 years. In addition to this, cerebrovascular disease cause disability in adults and each year millions of stroke survivors have to adapt to a life with restrictions in activities of daily living as a consequence of cerebrovascular disease [15].

Study objective:

In this review, we looked into the cerebrovascular stroke and the role of interventional radiology in diagnosis, and management of stroke patients.

METHODOLOGY:

Study Design: Simple Review article. The review is comprehensive research of Medline, Google scholar, EMBASE and PubMed databases since the year 2000 to 2018.

Study duration: Data was collected during the period from 1–31 December, 2019.

Data collection: Medline, Google scholar, EMBASE and PubMed databases searches was performed for articles about the most important recent developments in the cerebrovascular stroke and the role of interventional radiology in diagnosis, and management of stroke patients, published in English around the world. The keyword search headings included "Cerebrovascular stroke, interventional radiology, treatment options, acute ischemic stroke victims", and a combination of these was used. References list of each included study was searched for further supportive data.

Epidemiology:

The incidence of stroke is around 800,000 people annually [16]. Each year, approximately 795,000 people in the United States experience new (610,000 people) or recurrent (185,000 people) stroke [17]. According to the World Health Organization (WHO), 15 million people suffer stroke worldwide each year. Of these, 5 million die, and another 5 million are left permanently disabled [18]. On average, every 40 seconds, a person suffers from a stroke, and every 4 minutes, there is one death caused by a stroke [19]. Women have 60,000 more strokes each year than men, which

may be partly attributable to their longer life span, and this disparity between the sexes is growing [9]. In the past several decades, the incidence of stroke has decreased because of effective strategies for preventing cerebrovascular risk factor and good health services in developed countries. However, the converse has been revealed for developing countries [20].

Pathophysiology:

Stroke is caused by ischemia to a brain area. The Na⁺/K⁺ ATPase pumps fail due mainly to low ATP production and an aerobic mechanism failure. Ischemia contributes to cell depolarization resulting in the release of calcium into the cells, elevated lactic acid, acidosis and free radicals. The death of cells raises glutamate and contributes to a chemical reaction (excitotoxicity) [21]. The brain tissue suffers ischemia when a reduction in blood flow lasting seconds occurs, or inadequate blood supply [22]. If the interruption of blood flow is not restored in minutes, the tissue suffers infarction followed by tissue death [23].

Classification:

Generally, strokes can be classified into two major categories, namely, ischemic stroke and hemorrhagic stroke. Ischemic stroke is caused by interruption of the blood supply to a part of the brain resulting in sudden loss of function, while hemorrhagic stroke is attributed to rupture of a blood vessel or an abnormal vascular structure [24]. According to the American Stroke Association, approximately 87% of strokes are ischemic and the other 13% are hemorrhagic [9, 25]. Hemorrhagic strokes are associated with a higher mortality rate, which suggests that an even greater proportion of recurrent strokes likely have ischemic etiology [26]. In ischemic stroke, disruption of blood flows to the brain for a few minutes' causes hypoxia and hypoglycemia, which leads to infarction of brain tissues [27]. In hemorrhagic stroke, the hematoma causes compression of tissue resulting in tissue injury [28].

Causes and risk factors:

Stroke is considered as a disease which can be developed by long-lasting exposure to risk factors related to lifestyle. Modification of such risk factors should greatly affect the incidence of stroke and even mortality rates [29]. The risk factors for stroke are similar to those for coronary heart disease and other vascular diseases. Different modifiable and non-modifiable risk factors have been recognized for stroke. Non-modifiable risk factors are gender, age, ethnicity, heredity, and race. Modifiable risk factors include, but are not limited to, hypertension, dyslipidemia, diabetes mellitus, atrial fibrillation, smoking, drug abuse,

and alcoholic intake [30]. Hypertension is the strongest risk factor after age and people with hypertension are about 3 or 4 times more likely to have a stroke [31]. This attributed to the powerful effects of hypertension on the cerebral circulation [32].

Management:

Stroke is a medical emergency that requires immediate intervention. Cerebral infarction is progressively established over several hours, and the size of the infarct can be minimized if we act within that therapeutic window. General care has been shown to be effective in improving the prognosis in stroke patients [6]. The monitoring of vital signs and the treatment and early detection of complications, as well as early mobilization, are all measures included in the guidelines and recommendations for stroke care [33]. The application of diagnostic and therapeutic measures according to existing protocols within the first 6 hours of the onset of symptoms significantly reduces disability and shortens the hospital stay [34].

Imaging the brain and the vasculature that supplies it is therefore a vital first step in treating patients with acute stroke [35]. Until recently, intravenous tissue-type plasminogen activator (tPA) has been the only reperfusion therapy proven to reduce disability after acute ischemic stroke [36]. A computed tomographic (CT) scan of the brain is needed in such patients to rule out hemorrhage before intravenous tPA can be given. Non-contrast CT (NCCT) is the most widely used first-line imaging tool in patients with acute stroke. NCCT is quick to acquire, widely available, and discriminates reliably between ischemia and hemorrhage [37]. The National Institute for Health and Care Excellence (NICE) recommends that patients eligible for I.V. thrombolysis should have an urgent non-contrast CT head scan [38].

Magnetic resonance imaging (MRI) as an imaging selection tool for use in patients with acute ischemic stroke has some practical drawbacks. Diffusion MRI provides the most accurate assessment of ischemic core, and short 6-minute stroke protocols have been described [39]. Magnetic resonance imaging (MRI), particularly diffusion-weighted imaging (DWI), is more sensitive, but its practicality in terms of cost and scanning times are hindrances in its universal utilization [40]. There is a strong consensus in the stroke community that time is brain. Any imaging strategy that produces significant delays in the stroke workflow should therefore be avoided.

Interventional Radiology:

Because of its high vulnerability, brain tissue may be already irreversibly injured at the onset of ischemic stroke. A specific intervention could then rescue brain tissue, restore function, and prevent disability and death. Moreover, endovascular interventions can decrease the risk of stroke in patients with arterial stenosis or malformations [41]. Cerebrovascular interventional radiology treatments expand the treatment options for acute ischemic stroke victims.

Approved in 2004, the Mechanical Embolus Removal in Cerebral Ischemia (MERCi) Retriever is the first mechanical device for use in endovascular procedures in stroke patients. With a treatment window of up to 8 hours from symptom onset, the MERCi Retriever is most successful when used in larger cerebral vessels, such as the vertebral arteries, basilar artery, internal carotid arteries, and middle cerebral artery [42].

Another innovation, approved in 2008, is a thrombo-aspiration device called the Penumbra System. It has been 82% successful in recanalization. Introduced through percutaneous angiography, the system is threaded into the cerebral circulation to the area of the clot; the interventional radiologist deploys a separator to break up the clot and the Penumbra device then sucks the clot out [42].

Recent data show that intra-arterial therapy in ischemic stroke provides both benefit in outcomes and potential for further advancements in care. Intervention in hemorrhagic stroke remains limited to reversal of coagulopathy and hypertension; however, surgical techniques are underway and may prove beneficial in some cases. These techniques are altering current management and broadening the therapeutic alternatives for patients who present with acute cerebrovascular insufficiency and stroke in evolution. As wider experience is gained in these techniques, the clinical indications for their use will also broaden [43].

Another important consideration in the control of stroke is the prevention of secondary vascular events. For both ischemic and hemorrhagic stroke, appropriate control of blood pressure reduces the risk of subsequent strokes [44]. For patients who have suffered an ischemic stroke, antiplatelet therapy and cholesterol reduction are also important for secondary prevention [45]. WHO will develop guidelines for the management of acute stroke in low- and middle-income countries, and aims to expand training programs in stroke prevention, treatment and rehabilitation through its partners [46].

On the other hand, Endovascular Thrombectomy (EVT) is proven to provide better clinical outcomes in patients with ischemic strokes caused by large-vessel occlusion compared with best medical therapy alone (47). Furthermore, endovascular Thrombectomy has proven to be cost-effective (48). The American Heart Association (AHA) and multiple international stroke organizations recommend EVT as standard of care for selected patients (49). Based on 2015 AHA guidelines, it is estimated that approximately 10–20 patients per 100,000 per year are eligible for EVT in the United States (50). However, only a fraction of these patients are currently being treated (51). In addition, the most recent AHA guidelines now include patients with symptom duration as long as 24 hours and consider the treatment of vessel occlusions in locations other than the internal carotid artery and M1 segments, such as the anterior cerebral artery and M2 branches (52). With these expanded indications, it is now estimated that as many as 31 patients per 100,000 per year may be eligible for EVT in the United States (53).

CONCLUSION:

Because of its high vulnerability, brain tissue may be already irreversibly injured at the onset of ischemic stroke. A specific intervention could then rescue brain tissue, restore function, and prevent disability and death. Moreover, endovascular interventions can decrease the risk of stroke in patients with arterial stenosis or malformations. Cerebrovascular interventional radiology treatments expand the treatment options for acute ischemic stroke victims. In addition, Endovascular Thrombectomy (EVT) is proven to provide better clinical outcomes in patients with ischemic strokes caused by large-vessel occlusion compared with best medical therapy alone

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