

10 - COMPUTERIZED TOMOGRAPHY AND MAGNETIC RESONANCE IN VASCULAR ENCEPHALIC ACCIDENT

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INTRODUCTION

Encephalic Vascular Accident is the abrupt manifestation of a deficit in neurological activities whose symptoms remain for at least 24 hours, caused by two distinct mechanisms in the blood circulation, more frequent in the arterial, or in the venous circulation due to thrombus or embolism. cause cellular damage and alterations in cognitive, motor and sensory neurological functions. The EVA are of two types: Ischemic and hemorrhagic. Ischemic EVA is the result of the reduction or total restriction of blood supply to the brain. It can be of three subtypes: Ischemic Thrombotic or Atherothrombotic, Ischemic Embolic or Cardioembolic and Ischemic Lacunar (ANDRADE, 2010). Hemorrhagic EVA may result from blood leakage from cranial trauma, from hemorrhagic disorder, spontaneous rupture, or from arteriovenous malformation. They are of two types: Intracerebral and subarachnoid (CONTIN, 2011). Common signs and symptoms: mental confusion, difficulty speaking or understanding commands, loss of strength, and or sensitivity on one side or both sides of the body, lip rhythm deviation, visual loss in one or both eyes, balance, motor coordination and difficulty walking, sudden and intense headache and seizures.

EVA is one of the cerebrovascular diseases that has a major impact on global health and generates enormous social and economic costs (CONTIN, 2011). Worldwide, it affects 16 million people and is the second leading cause of death, around 6 million people a year (BARROS, et al, 2012). In Brazil, there are around 68 thousand deaths a year, being the first cause of death and incapacity in the country (PORTAL, 2012). The EVA has a therapeutic window of 3 hours for the treatment, period in which it is possible to intervene in the ischemic or hemorrhagic lesion to diminish the damages (RAFFIN, 2002). Early and accurate diagnosis is fundamental because it is a medical emergency and only clinical evaluation of patients with suspected stroke is insufficient and incapable of differentiating whether the lesion is hemorrhagic or ischemic (SILVA, OLIVEIRA, 2017).

Transient ischemic attack (TIA) precedes stroke from 9.4% to 26% of patients and the risk after TIA is 24% to 29% over the next 5 years. From 4% to 8% is the risk in the first month, and from 12% to 13% during the first year (GAGLIARDI, et al., 2001).

One of the major causes of neuronal damage during EVA is due to the ischemic process and the lack of oxygen where presynaptic neurons release large amounts of neurotransmitter glutamate that will excite the postsynaptic neurons by stimulating them to release nitric oxide in large quantity, being a free radical will cause extensive damage to surrounding cells (RANG, et al., 2012). Another event generated in the extracellular environment occurs due to the large amount of glutamate that produces the stimulation in the receptors of the nerve cells to release much calcium, damaging the action of the mitochondria that will release digestive enzymes causing cellular apoptosis around the lesion (FILHO, 2009; , 2006). The Na⁺ and K⁺ pump changes due to absence of blood flow, altering the oxygenation and depolarization of the neuronal cell membrane, increasing Na⁺ to the intracellular medium and the high amount of H₂O that will cause cell lysis (RANG, et al. , 2012).

The accepted imaging methods to initially evaluate are computed tomography (CT) and Magnetic Resonance (MRI) for examination of the skull. The validity of these methods is determined by sensitivity and specificity, sensitivity being the probability of the test to give positive in the presence of disease and specificity the probability of giving negative in the absence of disease. Noncontrast CT is the most widely used method because it has lower cost, greater availability, and a shorter time to perform. In the intracranial hemorrhage the two methods have a similar sensitivity in the detection of acute bleeding, but CT has a higher specificity in acute lesions (BRAZZELLI, et al., 2009), giving less false positive results and MRI is more sensitive to show chronic hemorrhages (SILVA, OLIVEIRA, 2017), presenting less false negatives.

In ischemic Encephalic Vascular Accident (IEVA), CT has a lower sensitivity for the detection of posterior fossa lesions and acute cortical or subcortical lesions. The use of MRI sequences, such as diffusion and perfusion, allows better visualization of the lesions not seen on the CT and diagnoses the ischemic lesion a few minutes after its initiation (SILVA, OLIVEIRA, 2017).

METHODOLOGY

This study will be carried out through non-systematic literature review in PUBMED, SCIELO, DOAJ and LILACS databases with the following keywords: "encephalic vascular accident", "tomography, X-Ray computed" and "magnetic resonance spectroscopy".

OBJECTIVES

Demonstrate the importance of Computed Tomography and Magnetic Resonance Imaging in characterization, identification, diagnostic confirmation of the EVA and the removal of hypotheses from other causes, facilitating the quick decision on the use or not of thrombolytic therapy.

DISCUSSION AND RESULTS

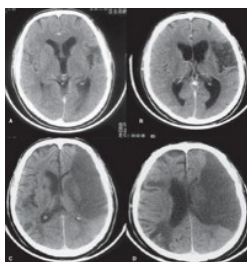
It is estimated that 85% of EVAs are ischemic and 15% hemorrhagic, of which 10% are intraparenchymal and 5% subarachnoid hemorrhages (LESSA, 1999). Systemic Arterial Hypertension is the main risk factor for EVA, but other comorbidities are also relevant, such as smoking, Diabetes Mellitus and hyperlipidemia. After 55 years the incidence doubles with a slight predominance for males, blacks and Asians (PEREIRA, et al., 2009). The therapeutic window that exists to intervene in the processes triggered by the AVE is 3 h and systematized ducts can minimize lesions to the encephalon (RAFFIN, 2002). This short period indicates that it is a medical emergency at all stages of care with this suspicion. The NINDS - National Institute of Neurological Disorders and Stroke shows the division of this time in minutes. From admission to medical evaluation 10 minutes and up to the tomography of skull 25 minutes. From the admission to the interpretation of CT 45 minutes and until the infusion of the recombinant plasminogen activator (r-PA) 60 minutes. And the time of patient admission to bed fully monitored 3 hours (RAFFIN, et al., 2006).

There are several types of prehospital scales used in the world to recognize symptoms: the Cincinnati Prehospital Stroke Scale (CPSS) (CAVALCANTI, 2006), the Glasgow Scale (ECGI) (KOIZSUMI and ARAÚJO, 2005) and the LAPSS Scale (Los Angeles Prehospital Stroke Screen). All are aimed at pre-treatment to limit the progression of the lesion, promote neuroprotection and prevent recurrence.

The CT should be performed as soon as possible and repeated after 24 h and 48 h, being recommended because it is not invasive, widely available in the emergency room in most hospitals, easy to use and with a relatively low cost and a valuable advantage in achieving distinguish between a hemorrhagic EVA and an early stage ischemic EVA, which is extremely important in prognosis and treatment. Thus CT is the first examination to be performed in a patient with symptoms of EVA. Contrast-enhanced CT allows the description of subtle signs in the supra-tentorial region suggestive of ischemia in the first 6 hours of evolution, such as groove erasure, cortical and subcortical density attenuation, but has a lower sensitivity for posterior fossa detection and acute cortical frames or subcortical. The use of MRI sequences such as diffusion and perfusion, allows better visualization of these lesions not seen by CT and diagnose ischemic lesion minutes after its initiation.

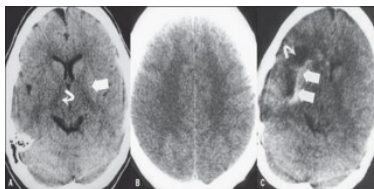
The CT image is based on X-ray, the tomograph has a series of detectors that transforms the radiation into electrical signal converted into digital image, and each slice examined will show the attenuation measured on a scale of grayscale, the Hounsfield Scale, corresponding the attenuation of the tissues in the image obtained in the CT scan (ABREU, 2002). Brain tissue has between 18 in 27 HU (Hounsfield unit), venous blood 55 HU and blood coagulated 80 HU, so CT can rapidly visualize with 98% sensitivity the hemorrhagic EVA by the high blood density compared to the density of the brain tissue (GARCIA and FERREIRA, 2015). But it will have low sensitivity in the ischemic alteration in the first hours.

Figure 1 - CT scan with ischemic EVA of the MCA territory. A, B: partial infarction, with involvement restricted to the left hemisphere. C, D: complete left infarction, with mass effect compressing the lateral ventricle. In the right hemisphere, lower left hypodensity is visualized. <http://dx.doi.org/10.1590/0100>



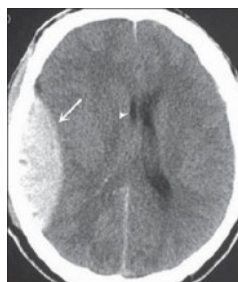
Source: GARCIA, L. H. C., FERREIRA B. C., 2015

Figure 2 A: Ischemic EVA CT six hours after the symptoms. The curved arrow denotes medial demarcation of the posterior portion of the right inner capsule. It is noted that the lateral margin of the right inner capsule is poorly defined, due to the decrease in the attenuation of the lentiform nucleus. The straight arrow shows the normal left internal capsule and lentiform nucleus. B: Decreased white-gray differentiation in the right cerebral hemisphere, corresponding to the distribution of ACM. C: Three days after - area of greater attenuation (straight arrows) corresponding to hemorrhage in a region of infarction. Non-hemorrhagic areas of infarction are seen as hypoattenuating (curved arrow)



Source: GARCIA, L. H. C., FERREIRA B. C., 2015

Figure 3: HEVA - EDH extradural or acute epidural hemorrhage demonstrated by the biconvex lens format (arrow). It is also noted a decrease in the right lateral ventricle lumen associated with midline deviation (arrowhead), suggesting subfalcine herniation.



Source: GARCIA, L. H. C., FERREIRA B. C., 2015

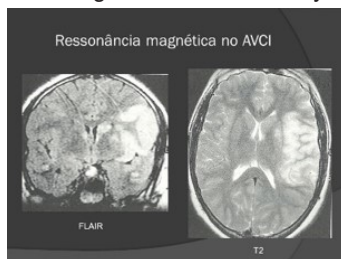
MRI is a method that has the ability to differentiate tissues and collect biochemical information and explore anatomical and functional aspects. Hydrogen cores that have loads and are in constant spinning motion produce small, randomly oriented magnetic fields, and when subjected to an external magnetic field of greater intensity, their magnetization vectors align in the same direction in rotational motion aligned to the external magnetic field, precession. The frequency of this rotational motion (Larmour frequency) is specific to the hydrogen core and varies according to the strength of the

magnetic field as measured in Tesla (T). The application of pulses of Radio Frequency (RF) causes it to absorb energy and deflect its magnetization vector from the initial position. The absorbed energy is released by the nucleus in the form of RF, as soon as the RF pulse is switched off, when its vector returns to the resting state, in line with the higher intensity external magnetic field (SILVA; OLIVEIRA, 2017). A Resonance equipment is therefore composed of the magneto, measured in Tesla, coils of the gradient, antenna coupled to the RF amplifier, to stimulate the patient, with the RF pulses and the receiver, to pick up the signal emanated by the patient. Through the diffusion and flare techniques of MRI, in the first 24 hours, ischemic zones can be detected and better localized in 80% of conventional MRI scans compared to CT (Silva et al., 2008).

Diffusion is a sequence that measures the movement of random water from the tissue. In tissues with high cellularity, the movement of free water is restricted. In tissues with low cellularity, it is elevated. The use of this method evaluates the capacity to identify the presence of ischemic lesions and visualizes its extension in the early stage of the AVE.

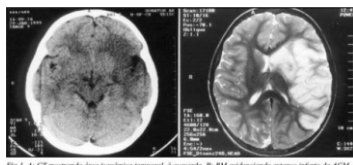
MRI using the Diffusion and Flair sequences is able to quickly identify the ischemic penumbra and the irreversible ischemic stroke zone.

Figure 4: Image of ischemic EVA by MRI



Source: LIMA et al., 2014. Available at <<https://slideplayer.com.br/slide/3170162/>>. Access on 3 sep. 2018

Figure 5: CT with ischemic EVA of the MCA territory. A, B: Partial infarction, with involvement restricted to the left hemisphere. C, D: Complete infarction on the left, with mass effect compressing the lateral ventricle. In the right hemisphere, the lower left hypodensity



Source: GARCIA, L. H. C., FERREIRA B. C., 2015

CONCLUSION:

Imaging evaluation in the suspicion of stroke by CT and / or MRI is a very important tool for diagnosis and also to elucidate the mechanisms of ischemia or intracranial hemorrhage.

CT is a consolidated diagnostic feature for the skull exam because it is a fast, highly effective, noninvasive method, more accessible compared to MRI, and because it presents a high image resolution that allows the safety characteristics of the ischemic stroke to be distinguished from the hemorrhagic. Both CT and MRI are able to provide information about the state of the brain of the patient with stroke or suspicion. The decision of the best method will be linked to the state of the patient and the time elapsed since the onset of symptoms. Diagnosis by CT and MRI in AVE reliably helps to identify differences between the irreversibly affected tissue of the brain and the reversible tissue that may benefit from early treatment such as reperfusion, preventing cell death and reestablishment of normal function (SILVA, OLIVEIRA, 2017).

Each technique has advantages and disadvantages, being suggestive more studies that can compare through measures of greater precision the point efficiency among the techniques.

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COMPUTERIZED TOMOGRAPHY AND MAGNETIC RESONANCE IN VASCULAR ENCEPHALIC ACCIDENT ABSTRACT

Encephalic Vascular Accident (EVA) is one of the cerebrovascular diseases that causes great impact on the world health and generates enormous social and economic costs (CONTIN, 2011). The EVA has a therapeutic window of 3 h for the treatment, period in which it is possible to intervene in the ischemic or hemorrhagic lesion to diminish the damages (RAFFIN, 2002). Early and accurate diagnosis is fundamental because it is a medical emergency and only clinical evaluation of patients with suspected stroke is insufficient and incapable of differentiating whether the lesion is hemorrhagic or ischemic (SILVA, OLIVEIRA, 2017). The accepted imaging methods to initially evaluate are computed tomography (CT) and Magnetic Resonance (MRI) for examination of the skull. Computed tomography and magnetic resonance imaging are important in the characterization, identification, diagnostic confirmation of stroke and the removal of hypotheses from other causes, facilitating the rapid decision making regarding the use or not of thrombolytic therapy. Diagnosis by CT and MRI in EVA reliably helps to identify differences between irreversibly affected brain tissue and reversible tissue that may benefit from early treatment such as reperfusion, preventing cell death and reestablishing normal function (Silva, 2017). Each technique has advantages and disadvantages, being suggestive more studies that can compare through measures of greater precision the point efficiency among the techniques.

Key words: "stroke"; "computed tomography"; "magnetic resonance".

TOMOGRAPHIE INFORMATISÉE ET RÉSONANCE MAGNÉTIQUE DANS UN ACCIDENT ENCEPHALIQUE VASCULAIRE

ABSTRACT

L'accident vasculaire encéphalique (AVE) est l'une des maladies cérébrovasculaires qui a un impact considérable sur la santé dans le monde et génère des coûts sociaux et économiques énormes (CONTIN, 2011). L'AVE a une fenêtre thérapeutique de 3 h pour le traitement, période dans laquelle il est possible d'intervenir dans la lésion ischémique ou hémorragique pour diminuer les dommages (RAFFIN, 2002). Un diagnostic précoce et précis est fondamental car il s'agit d'une urgence médicale et seule l'évaluation clinique des patients soupçonnés d'être victimes d'un AVE est insuffisante et ne permet pas de distinguer si la lésion est hémorragique ou ischémique (SILVA, OLIVEIRA, 2017). Les méthodes d'imagerie acceptées pour l'évaluation initiale sont la tomodensitométrie (TDM) et la résonance magnétique (RM) pour l'examen du crâne. La tomodensitométrie et l'imagerie par résonance magnétique jouent un rôle important dans la caractérisation, l'identification, la confirmation diagnostique de l'attaque cérébrale et le retrait des hypothèses de toute autre cause, facilitant la prise de décision rapide quant à l'utilisation ou non du traitement thrombolytique. Le diagnostic par tomodensitométrie et RM en AVE aide de manière fiable à identifier les différences entre un tissu cérébral atteint irréversiblement et un tissu réversible pouvant bénéficier d'un traitement précoce, tel que la reperfusion, la prévention de la mort cellulaire et le rétablissement de la fonction normale (Silva, 2017). Chaque technique présente des avantages et des inconvénients, en suggérant davantage d'études qui permettent de comparer, par des mesures plus précises, l'efficacité ponctuelle entre les techniques.

Mots-clés: "accident vasculaire cérébral"; "tomodensitométrie"; "résonance magnétique"

TOMOGRAFÍA COMPUTADORA Y RESONANCIA MAGNÉTICA EN EL ACCIDENTE VASCULAR ENCEFÁLICO

RESUMEN

El Accidente Vascular encefálico (AVE) es una de las enfermedades cerebrovasculares que causa gran impacto en la salud mundial y genera enormes costos sociales y económicos (CONTIN, 2011). El AVE posee una ventana terapéutica de 3 h para el tratamiento, período en que se puede intervenir en la lesión isquémica o hemorrágica para disminuir los daños (RAFFIN, 2002). El diagnóstico precoz y exacto es fundamental por ser una emergencia médica y sólo la evaluación clínica de los pacientes con sospechas de AVE es insuficiente e incapaz de diferenciar si la lesión es hemorrágica o isquémica (SILVA, OLIVEIRA, 2017). Los métodos de imagen aceptados para evaluar inicialmente son la tomografía computadorizada (TC) y la resonancia magnética (RM) para el examen de cráneo. La tomografía computadorizada y la resonancia magnética son importantes en la caracterización, identificación, confirmación diagnóstica del AVE y el alejamiento de hipótesis de otras causas, facilitando la toma rápida de decisión en cuanto al uso o no de la terapia trombolítica. El diagnóstico por TC y RM en AVE ayuda de forma confiable a identificar diferencias entre el tejido irreversiblemente afectado del cerebro y el tejido reversible que podrá beneficiarse del tratamiento precoz como la reperfusion, previniendo muerte celular y reestableciendo la función normal (SILVA, OLIVEIRA, 2017). Cada técnica presenta ventajas y desventajas, siendo sugestivo mayores estudios que puedan comparar a través de medidas de mayor precisión la eficiencia puntual entre las técnicas.

Palabras clave: "accidente cerebrovascular"; "tomografía computadorizada"; "resonancia magnética"

TOMOGRAFIA COMPUTADORIZADA E RESSONÂNCIA MAGNÉTICA NO ACIDENTE VASCULAR ENCEFÁLICO**RESUMO**

Acidente Vascular encefálico (AVE) é uma das doenças cerebrovasculares que causa grande impacto na saúde mundial e gera enormes custos sociais e econômicos (CONTIN, 2011). O AVE possui uma janela terapêutica de 3 h para o tratamento, período em que se pode intervir na lesão isquêmica ou hemorrágica para diminuir os danos (RAFFIN, 2002). O diagnóstico precoce e exato é fundamental por ser uma emergência médica e apenas a avaliação clínica dos pacientes com suspeita de AVE é insuficiente e incapaz de diferenciar se a lesão é hemorrágica ou isquêmica (SILVA, OLIVEIRA, 2017). Os métodos de imagem aceitos para avaliar inicialmente são a Tomografia Computadorizada (TC) e a Ressonância Magnética (RM) para exame de crânio. A Tomografia Computadorizada e a Ressonância Magnética são importantes na caracterização, identificação, confirmação diagnóstica do AVE e o afastamento de hipóteses de outras causas, facilitando a tomada rápida de decisão quanto ao uso ou não da terapia trombolítica. O diagnóstico por TC e RM em AVE ajuda de forma confiável a identificar diferenças entre o tecido irreversivelmente afetado do cérebro e o tecido reversível que poderá se beneficiar do tratamento precoce como a reperfusão, prevenindo morte celular e reestabelecendo a função normal (SILVA; OLIVEIRA, 2017). Cada técnica apresenta vantagens e desvantagens, sendo sugestivo maiores estudos que possam comparar através de medidas de maior precisão a eficiência pontual entre as técnicas.

Palavras-chave: “acidente vascular cerebral”, “tomografia computadorizada” e “ressonância magnética”.