MDCT Perfusion versus MRI Perfusion in Management of Acute Cerebral Ischemic Stroke

Essay

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مقارنة بين قياس التشبع عن طريق الأشعة المقطعية متعددة القواطع والرنين المغناطيسى في حالات السكتة الدماغية الحادة نتيجة القصور الدموي

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List of Abbreviations

ACA	anterior cerebral artery
ACoC	anterior communicating artery
AICA	anterior inferior cerebellar artery
AIF	arterial input function
ASL	arterial spin labeling
CBF	cerebral blood flow
CPP	cerebral blood pressure
$CMRO_2$	cerebral metabolic rate of oxygen
CTA	CT-angiography
CTP	CT perfusion
DWI- MR	diffusion weighted magnetic resonance
ICA	internal carotid artery
IP	ischemic penumbra
MRA	magnetic resonance angiography
MCA	middle cerebral artery
MDCT	multi-detector CT
MTT	mean transit time
NCCT	noncontrast CT
OEF	oxygen extraction fraction
PCA	posterior cerebral artery
PET	positron emission tomography
PICA	posterior inferior cerebellar artery

PWI-MR	perfusion-weighted magnetic resonance
ROI	region of interest
SCA	superior cerebellar artery
SPECT	single photon emission CT
TAC	time-attenuation curves
TTP	time to peak
XeCT	xenon-enhanced CT

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INTRODUCTION

Stroke is the third frequent cause of death in the U.S after cardiovascular diseases and cancers.However,prognosis may be improved if thrombolytic therapy is administered to patients within the first three hours of ischemic stroke.***(Lee,et al.,2004).***

One of the essential roles of stroke imaging is to reveal the severely ischemic but potentially reversible tissue "penumbra" that is the target of thrombolytic therapy. For optimal qualitative assessment of penumbra, stroke imaging should be able to accurately predict the extent of final infarct volume and should depict the extent of irreversibly damaged tissues ***(Thomas et al, 2008).***

Modern CT survey, consisting of three elements: noncontrast CT (NCT), CT-angiography (CTA) and perfusion-CT (PCT). NCT is still the primary imaging modality following acute stroke due to its wide availability. CTA can define the occlusion site, illustrate arterial dissection, grade collateral blood flow, and characterize atherosclerotic disease ***(Wintermark, 2005).*** CT perfusion is critical in determining the extent of irreversibly infarcted brain tissue and potentially reversible penumbra. This is of great importance for patient selection before thrombolytic therapy. CT perfusion also can predict the clinical outcome of patients with acute stroke ***(Meuli, 2004).***

MRI with perfusion images is particularly useful for acute ischemia when CT perfusion is negative and clinical suspicion for stroke remains,MRI is also the primary imaging tool when clinical questions includes a posterior fossa or brainstem lesion ,MRI with perfusion images been found exteremly helpful in guiding therapy when available ***(Kim JT , 2009).***

Fusion imaging CT and MRI perfusion is a functional imaging technique that provides important information about capillary-level hemodynamic of the brain parenchyma in the evaluation of acute stroke, Perfusion can be performed by monitoring the contrast agent through the cerebral vasculature.Post processing of the perfusion data allows the generation of color-coded maps of various perfusion parameters including cerebral blood flow (CBF), cerebral blood volume (CBV), mean transit time (MTT), and the time to peak (TTP). ***(Konstas et al, 2009).***

Introduction of recent multi-detector CT as well as recent MRI technologies have the ability to perform both CTA and multi-section PCT as well as Perfusion MRI simultaneously providing rapid imaging of the entire neurovascular axis in patients with acute stroke providing a very useful tool for rapid and adequate diagnosis of almost all infarctions ***(Maruya et al, 2005).***

The incorporation of clinical findings and neuroimaging are essential to determine the treatment technique, which includes local or systemic thrombolytic therapy to dissolve the clot and devices to remove or bust the clot ***(Gonzalez et al, 2007).***

Aim of work

The aim of this study is to highlight and compare the role of Perfusion CT and Perfusion MRI as reliable tools for the identification of reversibly damaged brain tissue, proper selection of patient before thrombolytic therapy and for the prediction of clinical outcome of patients with acute stroke.

الملخص العربي

قياس التشبع بالأشعة يسمح بتصوير تدفق الدم إلى الأنسجة ويتم حاليا تطبيقه على نطاق واسع لتشخيص السكتة الدماغية الحادة. باستخدام التصوير المقطعى أو التصوير بالرنين المغناطيسي ، يمكن إنشاء خرائط التشبع في وقت قصير للسماح استخدامها الروتيني في التشخيص و لتمكن الطبيب من تحديد الأنسجة التي يمكن انقاذها مع تحديد الاختيار المناسب للمريض.

بظهور دراسة التشبع بالأشعة المقطعية أصبح بالإمكان تقييم مرضى السكتة الدماغية الحادة وكذلك التنبؤ بما ستؤول إليه الحالة

يتم قياس التشبع للصبغة خلال عن طريق الاشعة المقطعية بحقن صبغة و تتبعها فى الأوعية الدموية، و التي منها يمكن الحصول علي الخرائط الملونة التي تمثل تدفق الدم للمخ، حجم الدم في المخ، متوسط وقت مرور الصبغة و كذلك قياس وقت وصول الصبغة إلي ذروتها.

هناك بروتوكولات مختلفة عن قياس التشبع بالأشعة المقطعية . الاختلافات بين البروتوكولات تهدف إلى تصوير أكبر حجم من أنسجة الدماغ في نفس الوقت ، والحفاظ على التعرض للاشعاع ضمن حدود معقولة.

ويستند قياس التشبع بالرنين المغناطيسي وكذلك المقطعية من خلال تتبع دوران الصبغة فى الأوعية الدقيقة . أيضا عن طريق قياس التشبع بالرنين المغناطيسي يمكن الحصول علي الخرائط الملونة التي تمثل تدفق الدم للمخ، حجم الدم في المخ، متوسط وقت مرور الصبغة و كذلك قياس وقت وصول الصبغة إلي ذروتها.

قياس التشبع بالرنين المغناطيسى يسمح بتقييم حالة الدورة الدموية للأنسجة الدماغية المتضررة و يؤدى الى تحسن كبيرفى تقييم السكتة الدماغية الحادة.

حساسية التشبع بالاشعة المقطعية عالية جدا ، حتى عندما يجري الفحص في غضون الدقائق الأولى . في هذه اللحظات ، فمن المحتمل للكشف عن انخفاض كبير في تدفق الدم في منطقة الدماغ المتضررة ، وفي الوقت نفسه ، فمن الممكن حساب المؤشرات الكمية من تشبع الدماغ. هذا قد لعب دورا هاما في اختيار العلاج والتعامل مع المرضى. ويظهر العديد من الباحثين أن هذا الأسلوب هو أكثر حساسية في الساعات الأولى بعد الإصابة بالسكتة الدماغية من التصوير بالرنين المغناطيسي.

ولذلك الخيار يستند إلى توافر المحلية والخدمات اللوجستية. نظرا للتوافرالواسع للتصوير المقطعي وحساسيته العالية إلى وجود نزيف ، فإن معظم المرضى التي يشتبة اصابتها بالجلطات ستخضع للاشعة القطعية و إذا كان يمكن الحصول على صورة وعائية وصورة تشبع في عشر دقائق إضافية دون تحريك المريض سيكون السيناريو المثالي.

Vascular anatomy of the brain

The arterial supply of the CNS is derived from the internal carotid and vertebral arteries.All arteries entering the surface of the brain are end arteries,that is they have no precapillary anastomoses with other arteries and obstruction of them causes infarct of the supplied territorym(*Snell ,2001*).

1. INTERNAL CAROTID ARTERY

The internal carotid arteries and their major branches essentially supply blood to the forebrain,with exception of the occipital lobe.The internal carotid artery arises from the bifurcation of the common carotid artery and enters the carotid canal of the temporal bone (*Snell ,2001*).

Once the carotid artey enters the carotid canal it has a very tortous course_six bends in all before its terminal division.The reason For this tortuosity is unknown but it may have arole in reducing the pulsating force of the blood supply to the brain.(*Ryan et al, 2004).*

The artery runs anteriorly across the cartilaginous plate,and then the cavernous part of the artery runs along the carotid groove on the lateral side of the body of the sphenoid,traversing the cavernous sinus.Inferior