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Role of arterial spin labelling cerebral Perfusion in assessment of different intra cranial disorders (using 3 Tesla MRI)

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Abstract

Background: Newly invented arterial spin labelling (ASL) is an MR perfusion approach that does not need gadolinium contrast injection or radiation exposure, but instead uses radiofrequency pulses to create magnetically labelled blood protons as an endogenous tracer to measure tissue perfusion. However, it is now extensively employed for acute and chronic cerebrovascular disorders, dementia, epilepsy and neuro oncological objectives in the various perfusion modalities and in functional MRI (fMRI) based on perfusion. There were 121 patients admitted to Alexandria University hospitals between August 2019 and August 2021 with various types of cerebral abnormalities; all of these cases were examined by ASL perfusion after the initial conventional MRI examinations, which sometimes included advanced modalities such as MR spectroscopy (MRS) and Dynamic susceptibility contrast perfusion Study participants ranged in age from one year old to 93 years old, with a mean age of 33.88 +/-25.03. Of them, 72 (59.5%) were men and 49 (40.5%) were females. Nine out of 23 (91.3 percent) of the cases with acute infracted cases showed a diffusion perfusion mismatch with a subsequent ischemic penumbra, but only 11/23 (478.8 percent) showed no diffusion perfusion mismatch. 39 of the study's cases were diagnosed as ischemic insults using conventional MRI, and 23 were acute infarcts. There were 3/23 examples with delayed ASL labelling, and all of them demonstrated an improvement in perfusion on the delayed phases. There were 19 instances in the research where hypo perfused zones had no MRI abnormalities that indicated an epileptic focal. Fifty-five of the study's cases (45.5 percent) were found to be space-occupying lesions, and 22 of those instances had their histopathology examined. Chi-Square tests also show that ASL perfusion may identify the grade of cerebral malignancy, with a P value of 0.0010. 12 Since it does not employ contrast medium, it may be used to evaluate ischemia cases, characterise lesions that take up space in the brain, identify epileptogenic foci and evaluate other abnormalities of the brain.

Key words: Arterial spin labeling, MR perfusion.

1. Background

All of these techniques need exogenous injection of a contrast media or use ionising ra; nevertheless, all of these techniques require the use of a contrast media or the use of ionising ra to detect cerebral tissue perfusion. Perfusion without contrast material was studied in the early 1990s using a quantitative MRI method called arterial spin labelling (ASL), which employs arterial water protons tagged by radiofrequency pulses as an endogenous trace. One of the newer MR perfusion techniques that does not require gadolinium contrast injection is arterial spin labelling (ASL), which uses radiofrequency pulses to achieve blood protons as an endogenous tracer to estimate tissue perfusion by magnetically labelling the inflowing arterial blood protons before they enter the tissue of interest. Aside from nephrogenic systemic fibrosis in patients with renal disorders who are predisposed to gadolinium injection, it is considered the simplest repeatable technique that can provide quantitative values that eliminate the risks of gadolinium injection as well as the risks of radiation exposure with wider use among children. There are several clinical applications for ASL MR-perfusion, including acute and chronic cerebrovascular illness, dementia, epilepsy, and neurooncological objectives; however, in the present day, ASL MR-perfusion is most often employed for these purposes. (CASL) and pseudocontinuous (PASL) ASL techniques are pulsed, continuous, and pseudocontinuous (pCASL). It is the earliest and oldest method that uses short inversion RF pulses (10-15ms) and is simple to construct since no special MR hardware is needed. However, the primary disadvantage of this method is the poor signal-to-noise ratio (SNR).

The labelling pulse must be long enough to attain steady state in continuous ASL (CASL), in which inflowing arterial water spins are constantly tagged. About a 2-second pulse is common for labelling. As a result of its implementation issues (specific sequence programming, sophisticated MR hardware for continuous RF production, and sluggish acquisition), it provides a substantially higher SNR.

A lengthy labelling pulse isn't essential, but numerous brief RF pulses are instead administered with a more effective labelling pulse in the pseudo-continuous ASL (pCASL) approach, which leverages the advantages of CASL's high SNR and PASL's high labelling efficiency.
[2]

2. Methods

To conduct this cross-sectional study, the local human research committee approved it. In line with the Declaration of Helsinki, all study methods were carried out in accordance with the Declaration of Helsinki [4]. All patients were given written permission to participate in the study.

Observe the people

ASL perfusion studies, conventional MRIs, and other complementing advanced procedures were recommended for patients with cerebral anomalies at Alexandria university hospitals and other private institutions from August 2019 to August 2021. Patients with pacemakers, metallic devices, and other contraindications to MRI were not allowed to participate in the study.

Protocol for MRI images

A 3T MR scanner was used for the MRIs (Discovery MR750 w 3.0T, General Electric, Milwaukee, USA). Axial, sagittal, and coronal T2-weighted turbo spin-echo (4000100), as well as axial FLAIR (repetition time msecinversion time msec, 110001402200) and diffusion-weighted imaging with diffusion gradient b values of 0 and 1000 smm2 along three orthogonal axes (x, y, and z) were used to acquire MR images. The following protocols were used to

PCASL and 3D rapid spin-echo encoding and spiral trajectory collection methods were used in the 3T 3D PCASL ASL MR Perfusion sequence. Here are the imaging settings: It took 2025.0 ms to invert, flip angle was 40°, FOV was 250x250 cm, matrix was 512x8 and the number of dynamics was 30. For this study, the labelling slab thickness was positioned in the upper cervical area.

Each subject's ASL data was processed using Functool Brain stat software (ADW4.7 GE workstation) and automated production of quantitative perfusion and CBF maps. In the CBF map, an area of interest (ROI) of 4–6mm2 was drawn, avoiding the regions of arteries, calcification, haemorrhage, cyst, and necrosis. In order to estimate rCBF values, a second ROI was formed across the normal region on the contra-lateral side.

In other circumstances, additional strategies were employed:

Each case had its own unique set of MRI sequences that were used, such as the following examples: Post contrast MRI series (following injection of gadolinium diethylenetriamine penta acetic acid (GAD-DTPA) in the dose of 0.01 mmol/kg body weight obtained in axial, coronal and sagittal T1-weighting spin echo MRI sequences).

MR perfusion using dynamic susceptibility contrast (DSC). Here are the imaging settings: In TRTE, the flip angle is 35°, the FOV is 240 240 cm, the matrix is 96 128, and the slice thickness and gap are 6.5 mm and 0.0 mm, respectively. These photos were captured before, during, and after the bolus administration of the contrast agent (40 series). The next step is to create rCBV and rCBF maps and the T2*-weighted susceptibility signal intensity-time curves that go along with them. The entire acquisition time was 1 minute and 30 seconds. A 4–6 mm2 ROI was constructed across the tumour location with the greatest perfusion value in the rCBF and rCBV maps, avoiding the regions of vasculature, calcification, haemorrhage, cyst and necrosis. The ROI was then scanned. It was necessary to create another ROI across the contralateral region in order to measure the rCBF and rCBV values of relative cerebral blood flow.

MR spectroscopy: Water suppression was accomplished using a chemical shift selection method in multivoxel MRS. High concentrations of NAA and Cho are seen in the lesions as well as in the perilesional zones distant from CSF and scalp fat, where TE 144 msec is intermediate. Lactate inverted doublets and the lipid signal were recorded. In the spectroscopic grid, voxel size within the lesion is set to 10 mm, and the spectroscopic grid is manually stretched and modified to encompass the lesion, any edoema, and the normal brain tissue (5 minutes). 2D MRSI PRESS at middle TE 144 msec.

Histopathological final diagnosis: Forensic evaluation of the suspected malignant brain tumours was carried out using intra-operative frozen sections and extensive pathological examination in the pathology laboratory. Hematoxylin and eosin was used to stain the sections and embed the samples in paraffin. Using the 2016 WHO classification of central nervous system cancers, we categorised all tumours.

In epilepsy, an electroencephalogram (EEG) was performed on all patients who presented with convulsions in order to determine the epileptic focus and its kind.

Statistical analysis

The IBM SPSS 20.0 software suite was used to examine the data. The IBM SPSS 20.0 software suite was used to examine the data. (IBM Corp., Armonk, New York, 1964). The normality of the distribution of variables was checked using the Kolmogorov-Smirnov, Shapiro, and D'agstino tests. The chi-square test was used to compare two groups on category variables. The diagnostic performance of the markers was evaluated using the receiver operating characteristic curve (ROC). The greatest result for the exam may be found in the range between 50 and 100 percent. It was determined that the findings had a significance level of 5%. In the case of quantitative data with abnormally distributed distributions, the Mann-Whitney test was utilised to compare two groups.

3. Results

Demographic data

The study group included 121 patients ranging from 1 year to 93 years with mean age of 33.88 ± 25.03 years. According to decades, 10 groups were identified: most of the patients are in the age group of (<10) years.

Conventional MRI data

Non significant MRI findings were detected in 19 cases (15.7%) of the study sample. however all these nineteen cases were presented by convulsive attacks and showed important ASL hypo perfused inter ictal areas. So we decided to add these 19 cases to the large study group. 39 cases (32.2%) were diagnosed as

ischemic insults on basis of conventional MRI. Twenty three of them were acute ischemic infarcts presented by restricted diffusion and three of which show associated clinical and radiological features suggesting underlying Moya Moya disease. Otherwise; 2/39 were sub acute, 8/39 were old ischemic infarcts, 2/39 were cortical laminar necrosis, 1/39 was hemorrhagic infarction, and the last three cases were multiple ischemic infarcts with different chronological ages. Fifty five cases (45.5%) in the study were diagnosed as space occupying lesions. Fourty two cases of them were intra axial masses; 40 of them were suspicious lesions including two cases presented by multiple lesions, one was diagnosed as cerebral hematoma and the last one was diagnosed as Virchow Robin space. 6/55 cases were diagnosed as extra axial lesions; five of them were typically meningeomas and the last one was large arachnoid cyst. 6/55 cases were operative bed lesions; Three of them showed recurrence and residual lesions, two of them showed necrotic changes and the last one showed gliotic changes. And only 1/55 case presented by mixed intra axial and extra axial masses and initially diagnosed as neurosarcoidosis on the basis of conventional MRI examination. 6 cases (5%) were presented by dysplastic cortex; two of them showed focal cortical dysplasia, other two cases were mesial temporal sclerosis presented by signal changes and volume loss, other case showed focal cortical dysplasia combined with focal pachygyria, and the last case showed focal cortical atrophy due to Sturge Weber syndrome. The last two cases of the study group (1.6%) were diagnosed as developmental venous anomaly (DVAs) on basis of conventional MRI.

MR Spectorscopy date

Only 34/121 instances in the research group had MRS performed as a supplement to the original diagnosis of these particular cases; this was done as a supplemental diagnostic tool. There are 18 men (53 percent) and 16 women (47 percent) in this group. There were 34 patients in all, the youngest of whom was 12 years old and the oldest of whom was 82. There are 46.73 patients with a mean age of 46.73, and a standard deviation of +17.12. Only one of the 29/34 instances (85.3 percent) had normal MRS parameters around the lesion, which suggests that the lesion is metastatic rather than original gliomatous, based on the abnormality of their MRS curves. Three-fourths of the patients (8.8%) did not display the characteristic MRS malignant curve with intact Hunter's angle. As hemorrhagic components and subsequent susceptibility artefacts distorted the detection of MRS metabolites were present in the remaining 2/34% of cases, the MRS curves in these instances were not considered useful. Only 17 of the 34 instances investigated by MRS received histological evaluation, which indicated that 16/17 cases (94.2 percent) were malignant gliomas, while the remaining 1/17 cases (5.8) were not malignant and were found to be neurosarcoidosis.

Perfusion data from DSC MR scans

MR perfusion with dynamic susceptibility contrast was performed in only 12/55 of the 55 patients with space-occupying lesions as a supplemental diagnostic step. Males make up half of the 12 instances, while females make up the other half. One of these 12 patients was 30 years old, while the other was 70. There is a standard deviation of +15.87, and the mean age of the patients is 52.25. The mean DSC CBF was 70 mL/100 gm/min, with a standard deviation of +20.05, a minimum value of 35, and a maximum value of 95 in these 12 patients, according to the results. The mean DSC rCBF was 162.17 percent, with a standard deviation of +44.35, a minimum value of 70, and a high value of 210, when compared to the contralateral side.

The results of histopathology

One case proved to be Meningeoma and the last case proved to be neurosarcoidosis, with the histopathological results showing that 14/22 (63.63 percent) cases were high grade gliomas, including 13 primary lesions and one recurrent operative bed lesion; the histopathological results confirmed that 6/22 (27.73 percent) cases were low grade gliomas.

Influx data from the ASL

For all of the cases in the study, ASL was performed; on qualitative assessment of the area of interest, 84/121 (69.4 percent) showed a hypo perfused pattern, but only 21/121 (17.4 percent) showed hyper perfusion, and 15/121 (12.4 percent) showed mixed hypo and hyper perfusion patterns, with the last case showing near iso perfusion. All patients in the study group had their ASL CBF and ASL rCBF measured in comparison to the normal contralateral side.

ASL CBF ranged from 4 mL/100gm/min to 111 mL/100gm/min in the research. The average CBF was 31.74, with a standard deviation of +23.47 among all instances.

Comparing the results to the normal contralateral side, the research found the lowest ASL rCBF was 36% and the highest was 294% above that value. Of the total instances, 94.02% of them had a rCBF of at least 94.02%, and the standard deviation was +63.43%.

Traditional MRI was used to identify ischemia insults in 39 of the research participants, including 27 men (69.2 percent) and 12 females (31.8%).

A total of 39 patients were included in this study, with the youngest being 3 years old and the oldest being 93. Patients' average age is 49.5 years old, with a standard deviation of 24.1 years.

ASL CBF ranged from 9 mL/100gm/min to 111 mL/100gm/min in these 39 instances. The average CBF was 43.22 and the standard deviation was +33.87 for all patients combined.

The lowest ASL rCBF was only 39% of the normal contralateral side, while the highest was 171% of the normal contralateral side in these 39 instances.

The average rCBF was 88.12 percent, with a standard deviation of +44.98 percent in this group of patients. Restrictive diffusion was seen in 23/39 (59 percent) of the ischemic patients. However, the ischemic penumbra or region at risk of continuing infarction was identified in 9/23 (39.1%) of the instances of acute infarcts with bigger areas of perfusion abnormalities termed diffusion perfusion mismatch. There was no penumbra in 11/23 (47.8%) of the instances of acute infarcts that had no diffusion perfusion mismatch. Only 3/23 instances (13.1 percent) had multi-delayed ASL labelling, and all of them (100 percent) exhibited an increase in perfusion on the delayed phases, indicating patent collaterals. ASL 1.5 second CBF was 12.3 mL/100gm/min, compared to 3.5 second CBF of 29 mL/100gm/min. For example, in ASL 1.5 second the mean rCBF was only 47.7%, but it was 83.77% in ASL 3.0 second. Conventional MRI was used to classify 39 instances as ischemic insults, and ASL luxury hyper perfusion was seen in 5 (12.8 percent) of those cases, either in the infarct core or on the periphery.

More than five percent of the ischemic patients (2/39) revealed hypo perfused zones, which is a sign of early ischemic stroke and was discovered even before the emergence of acute infarction or diffusion restriction on conventional MRI, indicating a very early ischemic stroke. Of the ischemic patients, 8% (or 23% of them) had ancient infarcts with encephalogliosis, and all of them had hypo perfused patterns on ASL ranging from relative parenchymal hypo perfusion to black holes in the old encephalomalacic regions. One example of bilateral diffuse global hypo perfusion in an anaesthetized patient was found in just 2.6 percent of the patients studied, mostly owing to anaesthetic drugs or general ischemia.

All 102 patients in the first trial group had conventional MRI results that necessitated additional ASL perfusion testing. However, we chose to include the 19 patients who had epileptic episodes and had normal conventional MRIs in our analysis because of the brilliant ASL results that demonstrated hypo perfused epileptic foci in all of them because of the inter ictal condition. Eleven of the 19 instances (57.9%) include men, while the other eight cases (42.1 percent) involve women. These 19 patients ranged in age from one year old to twenty-five years old. There is a +7.1 standard deviation in the mean patient age. ASL CBF ranged from 13 mL/100gm/min to 41 mL/100gm/min in these 19 epileptic patients without conventional MRI findings. ASL rCBF in these 19 epileptic patients without conventional MRI findings ranged from 67% to 86% relative to the normal contralateral side, with the mean being 23.9 and the standard deviation being +8.4. rCBF averaged 76.3 percent across all cases, with a standard deviation of +5.2 percent. ASL showed focal hypo perfused areas in all 19 cases, representing the epileptic focus during the interictal phase; these findings are also correlated with electroencephalogram (EEG), which demonstrated the same epileptic focus.. These patients did not have hyper perfused patterns that may be explained by examinations performed too late after the ictus of an epileptic event. 11/19 instances (59%) of hypo perfused lobes were in the left parietal lobe, followed by the left temporal lobe (5/19 cases) in the ASL sequence (26.4 percent).

Space-occupying lesions were seen in 55 instances (45.5 percent) of the patients studied by conventional MRI. Only 28 (50.9 percent) of the participants are male, with the remaining 27 (49.5 percent) female. More over half of these 55 patients were under the age of 35. There are 45,65 average patients, with a standard deviation of 19,03, ASL CBF ranged from 5 mL/100gm/min to 105 mL/100gm/min in these 55 instances. 78.22 percent was the average CBF, with a standard deviation of +46.23 percent. The lowest ASL rCBF was 36%, and the highest was 294%, as compared to the normal contralateral side in these 55 patients. A 95.18 percent average rCBF was found, with a standard deviation of +66.29 percent

ASL perfusion pattern was correlated with the histopathologically assessed 22 cases among the study group. Among 14 high grade gliomas; 13/14 cases (92.9%) were hyper perfused and the remaining 1/14 case (7.1%) were hypo perfused. And among 8 low grade gliomas or benign lesions; 6/8 cases (75%) were hypo perfused and the remaining 2/8 cases (25%) were hyper perfused. In high grade gliomas; ASL showed hyper perfused pattern in 3/4 cases (75%) but DSC showed hyper perfused pattern in 4/4 cases (100%) with sensitivity = 42.9% and specificity = 0%. In low grade gliomas; ASL showed hypo perfused pattern in 2/2 cases (100%) but DSC showed hypo perfused pattern in 1/1 cases (50%) with sensitivity = 66.6% and specificity = 100%.

6/121 cases of the study group (5%) were diagnosed as abnormally dysplastic cortex on conventional MRI; Five of them (83.33%) are males and the remaining case (16.66%) are females. The youngest patient of these 6 cases was 2 years old and the oldest was 23 years old. Mean Age of patients is 11.83 and standard deviation is +8.01, All of these cases showing ASL hypo perfused patterns either the cases with focal cortical dysplasia, pachygyria, Sturge Weber syndrome or mesial temporal sclerosis, this is may be explained as these areas were considered epileptic foci and the patients were examined during the inter ictal status. The lowest ASL CBF in these 6 cases was 14 mL/100gm/min and the highest was 27 mL/100gm/min. Mean CBF of all cases was 21 and standard deviation was +4.47, The lowest ASL rCBF in these 6 cases was 63% compared to the normal contra lateral side and the highest was 92% compared to the normal contra lateral side. Mean rCBF of these cases was 79% and standard deviation was +10.43

Two cases were diagnosed as developmental venous anomalies; one of them was male, the other was female and both of them were 7 years old. The

two cases showed perfusion changes in the surrounding parenchyma; one showed hypo perfusion and the other showed hyper perfusion. The lowest ASL CBF in these 2 cases was 22 mL/100gm/min and the highest was 67 mL/100gm/min. Mean CBF of all cases was 44.5 and standard deviation was +31.82, The lowest ASL rCBF in these 2 cases was 82% compared to the normal contra lateral side and the highest was 126% compared to the normal contra lateral side. Mean rCBF of these cases was 104% and standard deviation was +31.11

4.Discussion

As a non-invasive MRI perfusion method, ASL can be used in a wide range of clinical situations, including stroke, cerebral neoplasia, Alzheimer's disease, dementia, epilepsy, and arterio venous malformations and fistulas. ASL is also safe for patients with renal disease and patients with hypertension. ASL perfusion can also be used in a variety of other clinical situations, including arterio venous malformations and fistulas. While the Belani P. study included 676 patients with a mean age of 62.118.5 years, our study included 121 patients with a range of ages from 1 year to 93 years; however, the Belani P. study focused on stroke cases that affected older age groups; our study discussed all cerebral abnormalities with no entity specification.

Our research comprised 72 male patients, 59.5 percent of whom were male, and 49 female patients, 40.5 percent of whom were female. Belani P included 312 men and 364 females. We found that 51 patients (42.1 percent) had convulsive attacks, 38 (31.4 percent) had focal neurological deficits, 19 (15.7%) had persistent headaches, 10 (8.3 percent) had only asked for follow-up on known malignancy, and three (2.5%) had a disturbed level of consciousness when participating in our research. ASL perfusion was examined in our research in relation to all possible cerebral abnormalities, but to our knowledge, ASL perfusion was tested in relation to particular disorders that reduce complaints in their studies. Our broad range of complaints is caused by this study.

84/121 (69.4 percent) of the patients in our study had hypo perfusion, while only 21/121 (17.4 percent) had hyper perfusion, and 15/121 (12.4 percent) had hypo and hyper perfusion patterns mixed together, with the last case showing near iso perfusion. In contrast, Belani P. found 79 patients with hyper perfusion, 250 with hypo perfusion, and 347 with normal perfusion in his study group. A total of 51 (42.1 percent) of our study's patients were characterised by convulsive episodes, 38 (31.4 percent) had focal neurological impairments, 19 (17.7 percent) had chronic headaches, ten (8.3 percent) had only known malignancies, and three (2.5 percent) had a disturbed state of consciousness. No other ASL perfusion studies can be compared to this one, since we only know of one that encompassed all types of cerebral abnormalities, while the others only looked at a single complaint or anomaly.

Acute ischemia infarcts shown by limited diffusion were found in 19% of the 121 cases studied in our investigation, which demonstrated 39 instances of ischemic insults on the basis of conventional MRI, while 257/676 (38.0 percent) of the patients studied by Belani P, etal had acute infarcts. With regards to ischemia ASL findings: ASL Perfusion, in conjunction with structural DWI lesion patterns, gives precise diagnostic information on regional perfusion dynamics, according to Thamm T, etal. Acute ischemic infarcts (59%) were found in 39 instances in our investigation, whereas 24 cases (100%) were found in Wang DJ, et alstudy; .'s all of the infarcts were acute.

Our study's 39 ischemia patients ranged in age from three months to ninety-three years. One hundred and seventy-two of them (69.2%) are men, while the remaining one hundred and twelve (30.8%) are women, according to the data compiled by Wang DJ, etal. On the other hand, Wang DJ, et al., found a mean age of 79.7+11.4 years for 39 ischemia patients in their research. There were 39 ischemic instances in our research, and the lowest ASL CBF was 9 mL/100 gm/min, while the maximum was 111. Mean CBF for all patients was 43.22 +33.87, although Trenka AA and colleagues reported mean CBF of 36.35 21.38. 39 percent of these 39 instances had a lower ASL rCBF than the normal contralateral side, while 171 percent had an ASL rCBF higher than that. This group of patients had an average rCBF of 88.12 percent +44.98 percent, however the mean CBF of Trenka AA, et al was stated to be 85.68% (9)

Instances with acute infarcts that had greater regions of perfusion deficits signifying diffusion perfusion mismatch were identified in 9/23 (39.1 percent) cases. In Thamm T, et alresearch, .'s 84 percent of patients exhibited a diffusion perfusion mismatch, and this may be attributed to the study's emphasis on stroke patients and the quick ASL evaluation, which had a median of 67 hours between symptoms start and MRI testing in Thamm's study group. Diffusion perfusion matching was seen in 11 of our 23 acutely infracted patients, meaning that 47.8 percent of these instances had no penumbra, which is greater than the 16 percent reported by Thamm T, etal. in their analysis of 38 cases with no penumbra. (1) In the infarct core, 5 of 39 ischemic patients (12.8 percent) demonstrated luxury perfusion, characterised by ASL hyper perfusion. The proportion of luxury perfusion instances found by Belani, P, et al., who reported 47/676 cases, is approximately twice as high as this (6.95 percent). Fan AP, et al. stated that the ASL post labelling delay approach necessitates an appropriate measurement of CBF values. Within the scope of our research, only three patients (100 percent) were treated with this approach, and all three (at 2.5 and 3.5 seconds) demonstrated perfusion improvement on delayed 3.5 second that indicated the presence of patent collaterals. For post-labeling delay improvement in parenchymal perfusion, a longer and

more roundabout path to compensate for reduced pre-labeling blood flow to the hypo perfused region was explained by retrograde blood flow through pial collaterals. The mean CBF in ASL 1.5 second was 12.3 mL/100gm/min, compared to 29 mL/100gm/min in 3.5 second, in our three instances of post labelling delay. For example, in ASL 1.5 second the mean rCBF was only 47.7%, but it was 83.77% in ASL 3.0 second. There was an approximate 35% increase in the relative CBF value with multi delay ASL, whereas standard delay ASL was shown to have a 20% reduction in relative CBF. (10)

Our study also found that in 2% of the ischemic cases, conventional MRI did not show acute ischemic infarcts, but showed hypo perfused areas that indicated very early ischemic stroke, which was examined within minutes of arterial occlusion and detected the hypo perfusion even prior to the appearance of acute infarction or diffusion restriction. ASL hypo perused parenchyma with no identifiable acute infarctions has never before been seen in a stroke research. Eight out of every 39 (23 percent) patients in our research with ischemic stroke had previous encephalogliosis and all of them had hypoperfused ASL patterns ranging from relative parenchymal hypoperfusion to black holes in the former encephalomalacic locations. There was a 2.6 percent chance that an anaesthetized patient had bilateral diffuse global hypo perfusion owing to arterial transit defects, most likely related to anaesthetics or global ischemia.

When it comes to the 19 instances with epilepsy and unremarkable conventional MRI, 11 of them (57.9%) are males, while the remaining eight (42.1%) are girls, according to EEG results. These 19 patients ranged in age from one year old to twenty-five years old. ASL perfusion and electroencephalography (EEG) were used to evaluate 43 children, 17 of whom were boys and 26 of whom were girls, who had seizures and whose ages ranged from 9 months to 16 years. The mean age of the children was 6.3 years, while the standard deviation was 3.3%. However, Lee SM, etal. discovered that 25 patients (58.1 percent) exhibited perfusion change, with 22 showing hypo perfusion and three showing hyper perfusion, despite the fact that all of our cases were hypo perfused as a result of the inter ictal presentation. In other words, we found that combining ASL with EEG and structural MRI may be useful in the assessment of juvenile epilepsy, as suggested by Lee SM, etal. There were 55 instances (45.5 percent) in our research in which space occupying lesions were identified based on ASL results. In all, there are 50.9% men and 49.9% females in this group. More over half of these 55 patients were under the age of 35. The average patient's age is 45.65 + 19.03, with one outlier. As opposed to these findings, a smaller sample of 35 patients with space-occupying lesions examined by ASL perfusion (13 men and 22 women) was reported by Noguchi T, etal., with an age range of 4 to 76 years old and a mean age of 50.7 years. (13) In our research, the lowest ASL CBF was 5 mL/100gm/min and the maximum was 105 mL/100gm/min in these 55 space-occupying lesions. These 55 patients had an average CBF of 78.22 percent, with a standard deviation of +46.23 percent, and an ASL-rCBF range from 36 percent to 294% higher than the normal contralateral side. A 95.18 percent average rCBF was found, with a standard deviation of +66.29 percent

As an alternative, ElBeheiry and his colleagues, using contralateral white matter CBF values as quantitative indicators, instead of percent of the contralateral side, explained this because individual differences in CBF values, but also reported that this method is still questionable because of the long transit time and high water content of the normally appearing white matter in brain tumours, which may result in an underestimation of white matter. rCBF (14)

Only 34/121 instances of our research sample had the combined ASL perfusion and MRS method used; 18 of them (53 percent) were men, while the remaining 16 cases (47 percent) were females. There were 34 patients in all, the youngest of whom was 12 years old and the oldest of whom was 82. a 46.73 + 17.12 median patient age

Other studies have shown that ASL and MRS may be used in patients with brain tumours of all ages, with the average age being 47.2 years. He looked at the function of ASL/MRS in determining the optimum location for a brain mass biopsy and found that in 23 out of 30 cases, it was 76.6 percent accurate in determining the optimal biopsy location. It was found that 16 of the 34 cases investigated by MRS had malignant gliomas, whereas the remaining 1/17 cases (5.7 percent) did not have cancer and were diagnosed as having neurosarcoidosis based on the results of the histological investigation. While Jin T, etal. examined all 30 cases histopathologically; 20 of them were gliomas and the other 10 were lymphomas, they found no evidence of a link between the two. One case of meningeoma was found, and the final case was diagnosed as neurosarcoidosis in our study of 55 patients with space-occupying lesions. Of the 22 cases histopathologically assessed, 14 (63.63 percent) were high-grade gliomas, including 13 primary lesions and one recurrence on the operating table. Six (27.3 percent) were low-grade gliomas. For their part, Fu M, etal. examined all 346 patients in their research group, finding 274 instances of high-grade gliomas (79%), and 72 cases of brain metastases (20.8%). High-grade gliomas were found in 13/14 patients (92.9 percent) in our research group, whereas the remaining 1/14 cases (7.1 percent) were hypoperfused. There were six hypoperfused instances and two hyperperfused cases out of eight benign gliomas with low grade characteristics. According to ElBeheiry, et al., the difference in ASL perfusion between high grade gliomas and low grade gliomas is statistically significant as regards ASL-derived CBF including its absolute and relative values, and thus ASL perfusion parameters including both the absolute and relative

certitudes of ASL Only 12 patients in our research had their ASL perfusion, DSC MR perfusion, and histological evaluation all performed at the same time. In all, eight of them were high-grade gliomas, and four were low-grade gliomas.

When it comes to high-grade gliomas, ASL showed a hyper perfused pattern in 3/4 of the cases (75 percent), whereas DSC showed a hypo perfused pattern in 4/4 of the cases (100 percent) with sensitivity of 42.9% and specificity of zero percent, indicating that DSC M. As ElBeheiry and colleagues stated, ASL and DSC MR perfusion can be used interchangeably in preoperative evaluation of glioma grades, but this is not supported by our findings, which show that the non contrast ASL technique is not as accurate as DSC MR perfusion in distinguishing between high- and low-grade tumours based on their perfusion status. Six of the 121 participants in our research were identified with abnormally dysplastic cortex on conventional MRI; five of them (83.33 percent) were males and the other (16.66 percent) was female. These six patients ranged in age from 2 to 23, with the youngest being 2 years old. There is a standard variation of +8.01 years in the mean age of patients. The Blauwblomme T, etal. research, on the other hand, comprised nine children, seven boys and two girls, ranging in age from 4.6 to 15.3 years on average. However, Blauwblomme T etal. claimed that all instances in their research group were diagnosed as focal cortical dysplasia, despite the fact that our analysis only included 6 cases of focal cortical dysplasia, focal cortical dysplasia mixed with pachygyria, and Sturge Weber syndrome.

ASL CBF ranged from 14 mL/100gm/min to 27 mL/100gm/min in the six subjects in our research group. Blauwblomme T, et. al. reported mean CBF = 45 mL/100 mg/min + 14.9, but the contralateral cortex had a mean CBF of 82.1mL/10g/min + 10.3mL, which is significantly lower than that of all patients (21). In other words, we found that the dysplastic cortex has considerably decreased parenchymal perfusion, which may be readily recognised by ASL perfusion, as Blauwblomme T, etal., have shown. Seven-year-old boys and girls, both with developmental venous abnormalities, had ASL results in vascular malformations, which led to the diagnosis of developmental venous anomalies.

Hypoperfusion and hyperperfusion were seen in the surrounding parenchyma in both instances.... A large research group of 248 patients with DVAs and examined by ASL perfusion was described by IV M et al. There were ASL anomalies in only 21/248 (8%), with 2/21 instances showing hyper perfusion in the draining vein, 11/21 cases showing hyper perfusion in the DVA, 8/21 cases showing hyper perfusion in the surrounding parenchyma, and neither one of these 21 cases showing hypo perfused ASL patterns.. (18)

Between 22 and 67 mL/100 grammes per minute, we saw the lowest ASL CBF in our two patients. The average CBF was 44.5, with a standard deviation of +31.82, among all patients. In these two instances, the ASL rCBF was 82% lower than on the normal contralateral side and 126% higher than on the normal contralateral side, respectively. The average rCBF was 104 percent, with a standard deviation of +31.11 percent.

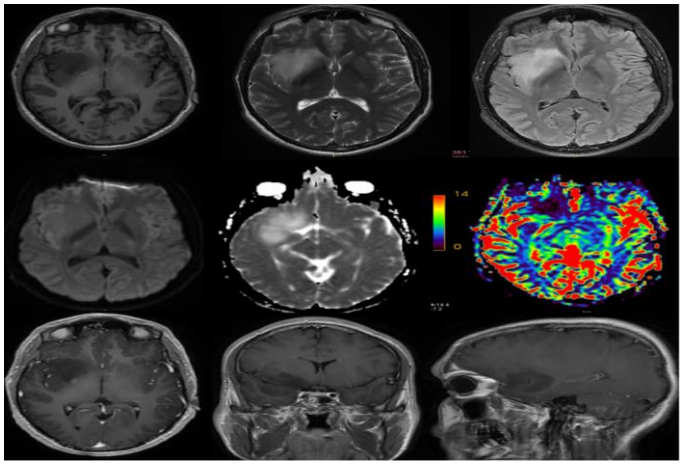

Fig. (1) 32 years old male patient complaining of convulsions. A) T1WI B) T2WI C) FLAIR. D) diffusion E) ADC map F) ASL perfusion G))I) post contrast T1WI showed hypo perfused non enhancing lesion at the right parieto temporal region. CBF = 8 gm/100mL/min, rCBF= 46% to contra lateral side. The lesion proved pathologically to be low grade gliomas.

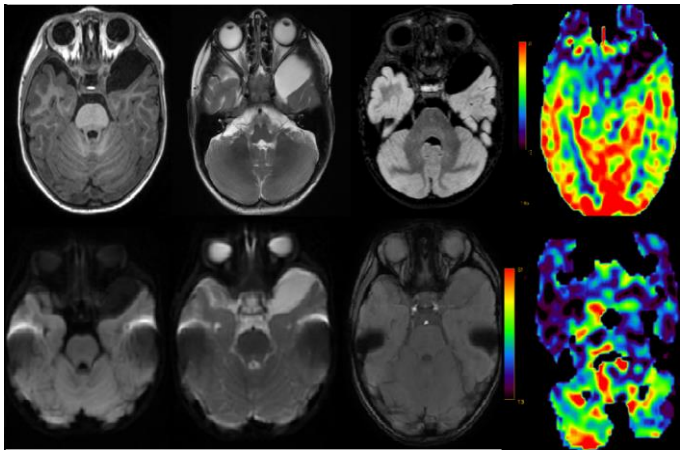

Fig. (2) 3 years old male patient complaining of headache. A) T1WI B) T2WI C)FLAIR. D) ASL perfusion E) diffusion F) ADC map G) SWI H) ASL perfusion at lower level showed hypo perfused left temporal arachnoid cyst. CBF = 5 gm/100mL/min, rCBF= 36% to contra lateral side.

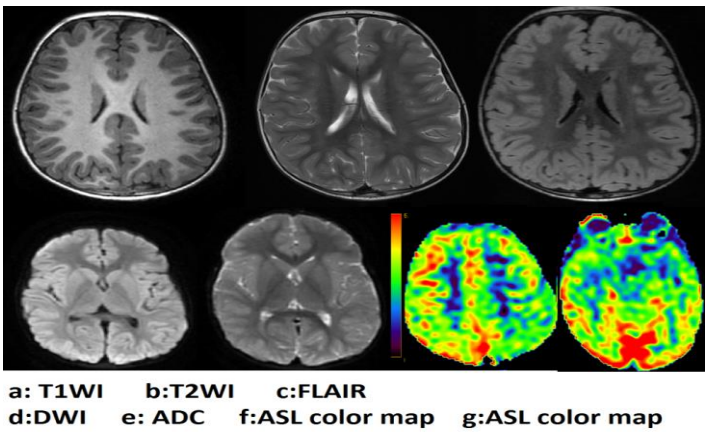

Fig. (3) 16 years old male patient complaining of convulsions, A) T1WI B) T2WI C) FLAIR. D) diffusion E) ADC map F) ASL perfusion showed hypo perfused left parietal lobe reflecting inter ictal epileptic focus. CBF = 33 gm/100mL/min, rCBF= 86% to contra lateral side.

5.Conclusions

Using ASL, a fast and simple perfusion technique that does not require the use of gadolinium contrast materials or ionising radiation, it can provide multiple important information in ischemic cases, particularly in the detection of ischemic penumbrae in acute cases, but also in the detection of luxury perfusions and old ischemic infarcts. ASL can be used by any age group, and it does not require the use of ionising radiation. It was also thought to have a crucial role in the early detection of ischemic strokes, even before acute infarctions occurred or reduced diffusion appeared. An acute ischemic cerebrovascular insult may be diagnosed more accurately by using many delayed ASLs than by using just one delayed ASL. ASL perfusion is the gold standard for quick identification of epileptic foci, even in the absence of structural abnormalities, and may be used as a replacement for DSC-MR perfusion in glioma grade evaluation.

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