Predictive Value of Perfusion CT in Evaluating Metastatic Lymphadenopathy.

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Authors:	A. Mahajan, M. H. Thakur; Mumbai/IN
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Purpose

INTRODUCTION

An increasing number of vascular-modulating drugs are used in the treatment of cancers, which in turn increase demand for noninvasive methods of assessing tumor vascularity in vivo.

Perfusion CT is a new technology that allows measurement of tumor vascular physiology .

Apart from being noninvasive and fast, it can be repeated at regular intervals to assess tumor response to antiangiogenic therapy.

Here we present a futuristic clinical applications of perfusion CT using 64 slice MDCT scanner.

AIMS AND OBJECTIVES

Evaluation of the role of computed tomography perfusion (CTP) examination for : differentiation between malignant and non-malignant lymph nodes.

Methods and Materials

402lesions prospectively studied from January to Dec 2008.

98 head and neck pathologies

26 esophageal pathologies

142 lung pathologies

101 abdominal pathologies

42 pelvic pathologies

Of which 33 previously untreated patients with H& N , abdominal , lung and esophageal malignancies (25 males, 8 females, aged 47-69 years) which had lymphnodal metastasis were included in the study.

CT perfusion was performed with a 64 -slice MDCT. Tumor was localized and a 4-cm lesions region was selected independently for the dynamic study . Contrast bolus infusion at a rate of 50 mL at 5 mL/sec for 10 seconds, followed by a saline flush at 40 mL at 5mL/sec for 8 seconds. Total 30 dynamic acquisitions with inter - cycle interval 2sec and total scan time 60 seconds. Followed by routine contrast-enhanced scan. This scan was used for routine cancer diagnosis.

Data processed on Extended Brilliance_ Workstation and analyzed by using Brilliance perfusion 2.1.1 software. The artery input (ROI) was placed over the aorta/ respective main artery. ROI was repeated for each contiguous transverse level of the entire lesion. Global values of the entire lesion were calculated by taking the mean values of all individual sections.

We used maximum slope analytical model method, yielding five major kinetic parameters:

(1) Perfusion (measured in ml/min/ml); (2) Peak enhancement intensity (PEI, measured in HU); (3) Time to peak (TTP, measured in s); (4) Blood volume (BV, measured in ml/100 g); (5)Mean transit time (MTT) (sec),

Along with colour maps of the five kinetic parameters, time attenuation curves (TACs) for the input artery and tumour were generated.

The mean value of each parameter was calculated for every node separately.

Since all patients underwent neck dissection/ respective tumor resection, the results were compared with the histological analysis of resected nodes.

Results

Good agreements were obtained between the replicated measurements (interclass correlation coefficient > 0.99)

When compared to normal, benign lesions showed higher BF and BV but were not statistically significant($p > 0.05$). MTT and TTP values in benign lesions were comparable to that of normal.

On the perfusion maps, malignant nodes showed remarkable hypoperfusion compared to non-malignant ones.

Except for MTT and TTP, which were statistically ($p < 0.05$) lower in malignant lesions, all CTP parameter values were significantly ($P < 0.05$) higher in malignant nodes when compared with the benign and the normal nodes.

The mean value of BF in malignant nodes was 12.6 (± 2.9), BV was 2.1 (± 0.34) and MTT was 6.8 (± 1.7).

Comparing to non-malignant nodes, the malignant ones showed significantly low BF values ($P < 0.05$) and low BV values.

The accuracy of detecting malignant nodes was 91%, sensitivity 92%, specificity 84%, positive predictive value 92.5% and negative predictive value 78.7%.

The smallest detected node on CTP was 6 mm.

DISSCUSION:

Higher median perfusion index in malignant nodes than for those with benign nodes and the normal nodes can be explained on the basis of intrinsic high neoangiogenic activity of tumor or a secondary response to tissue hypoxia The arteriovenous shunts have very low resistance to flow, which results in markedly increased blood flow and shorter MTT. Benign nodes constitutes inflammed nodes and does not show much distortion in the

vascular architecture and thus shows similar perfusion indices as that of the normal nodes.

We observed that in our series many malignant nodes show clear perfusion changes that may be helpful for differentiation from benign nodes. Although our experience is limited, we believe that perfusion CT can reveal blood flow in cases with malignancy and therefore may aid in the differentiation of the benign Vs malignant Vs normal Nodes.

LIMITATIONS

We did not study tumor permeability, which might have served as an independent predictor of tumor grade or response. The observational period was relative short, and the clinical outcomes based on the perfusion parameters obtained using dynamic CT could not be analyzed.

Images for this section:

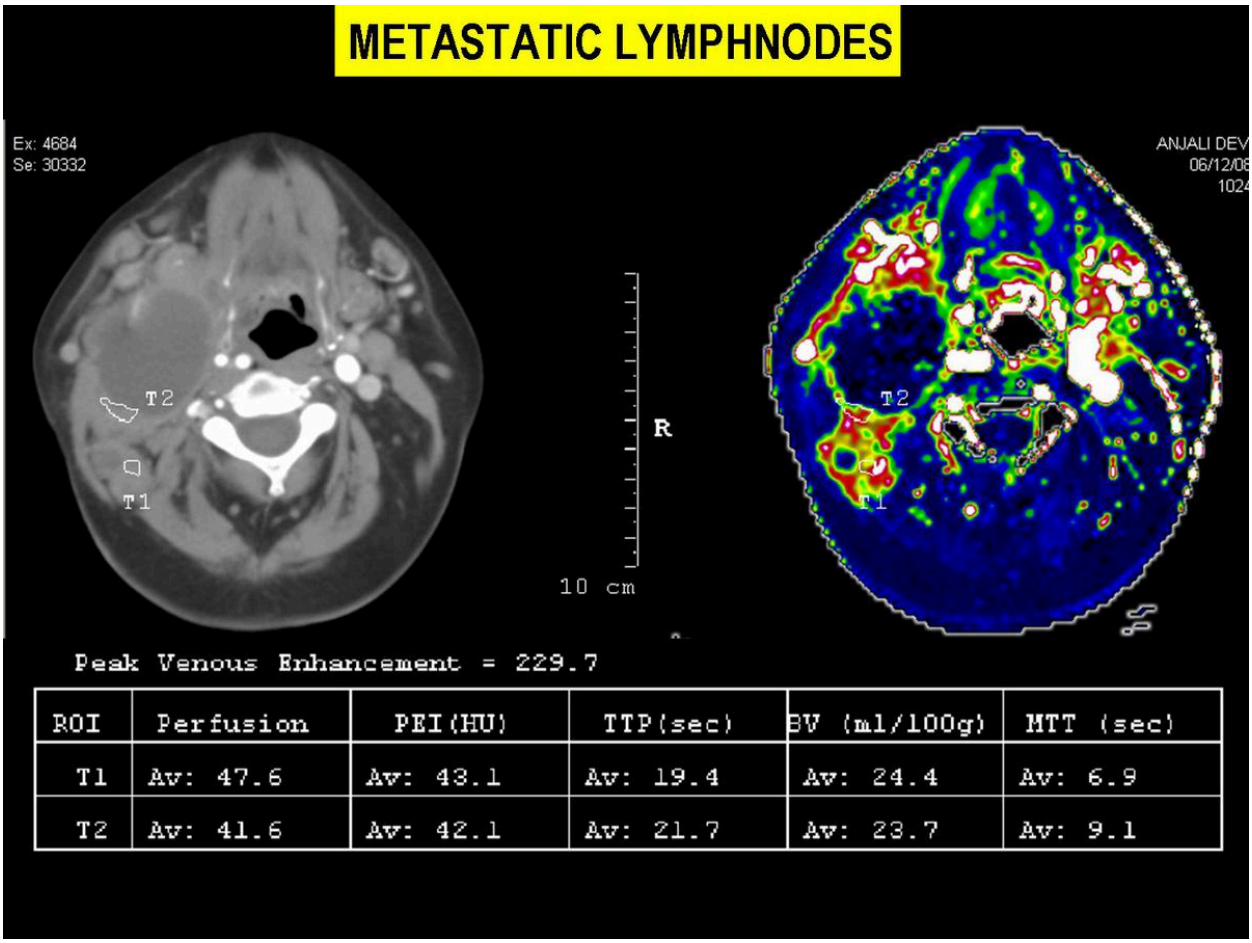
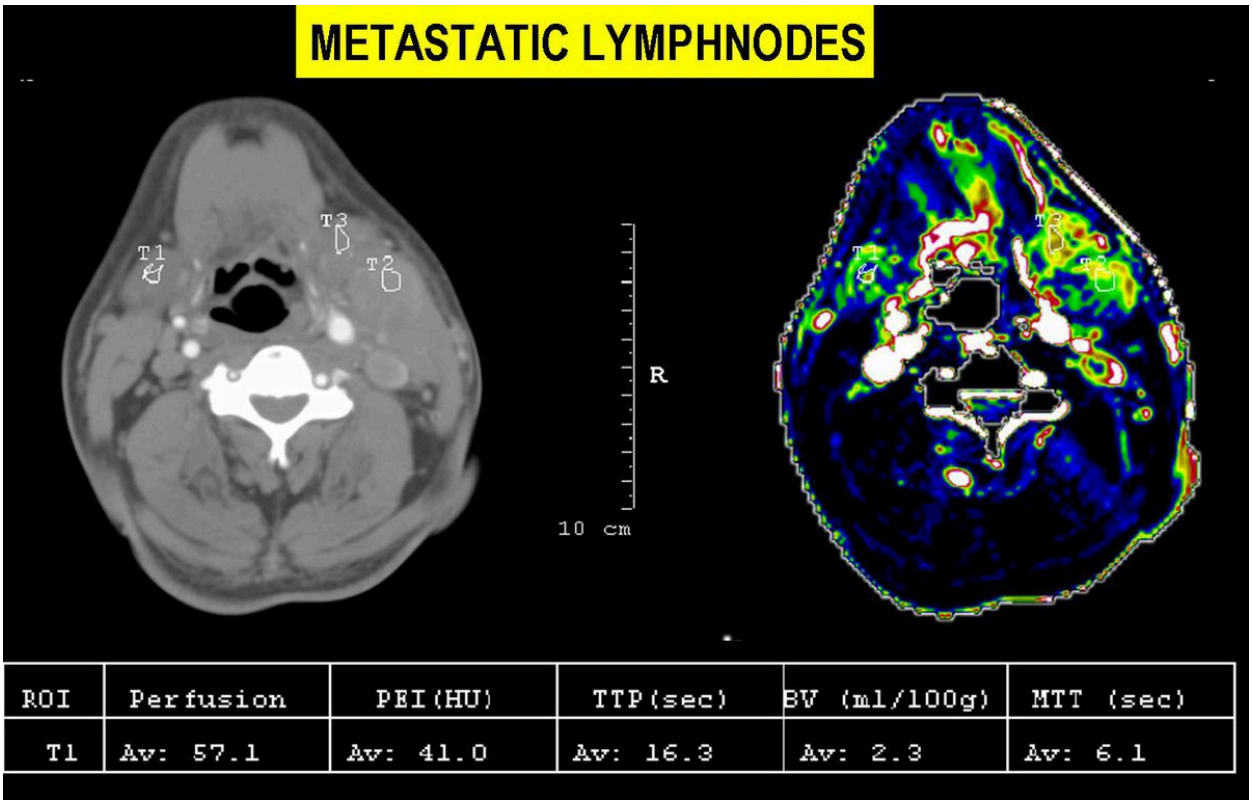


Fig. 0: CASE



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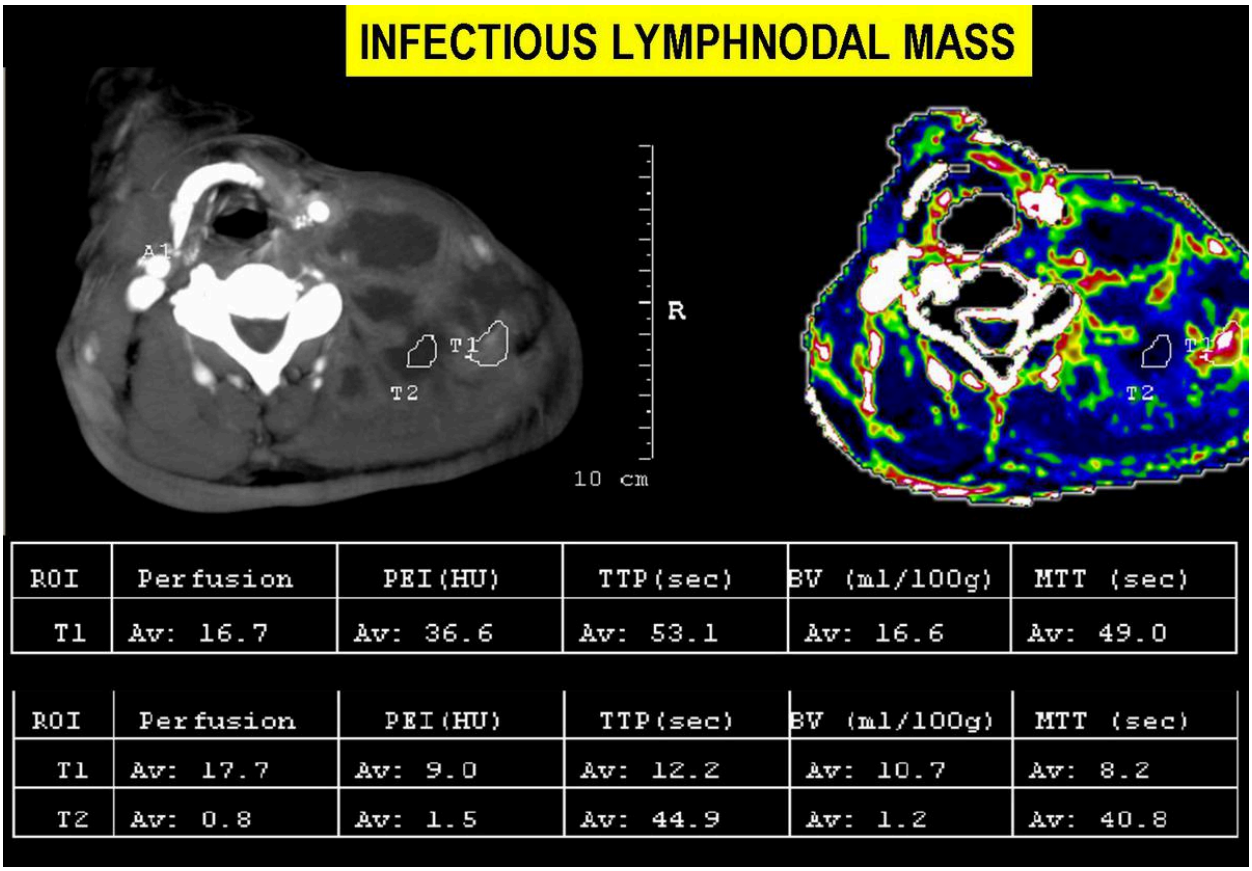

ROI	Perfusion	PEI(HU)	TTP(sec)	BV (ml/100g)	MTT (sec)
T1	Av: 16.7	Av: 36.6	Av: 53.1	Av: 16.6	Av: 49.0

ROI	Perfusion	PEI(HU)	TTP(sec)	BV (ml/100g)	MTT (sec)
T1	Av: 17.7	Av: 9.0	Av: 12.2	Av: 10.7	Av: 8.2
T2	Av: 0.8	Av: 1.5	Av: 44.9	Av: 1.2	Av: 40.8

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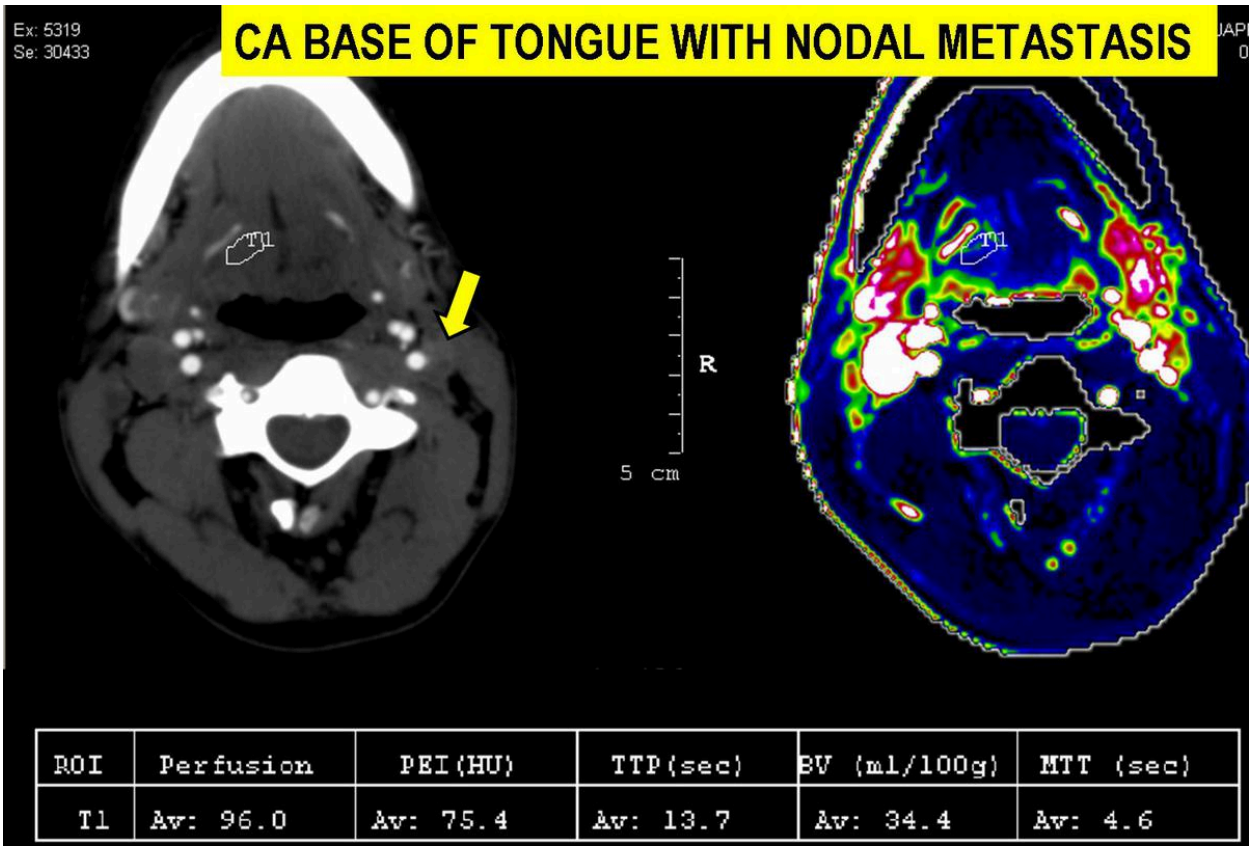

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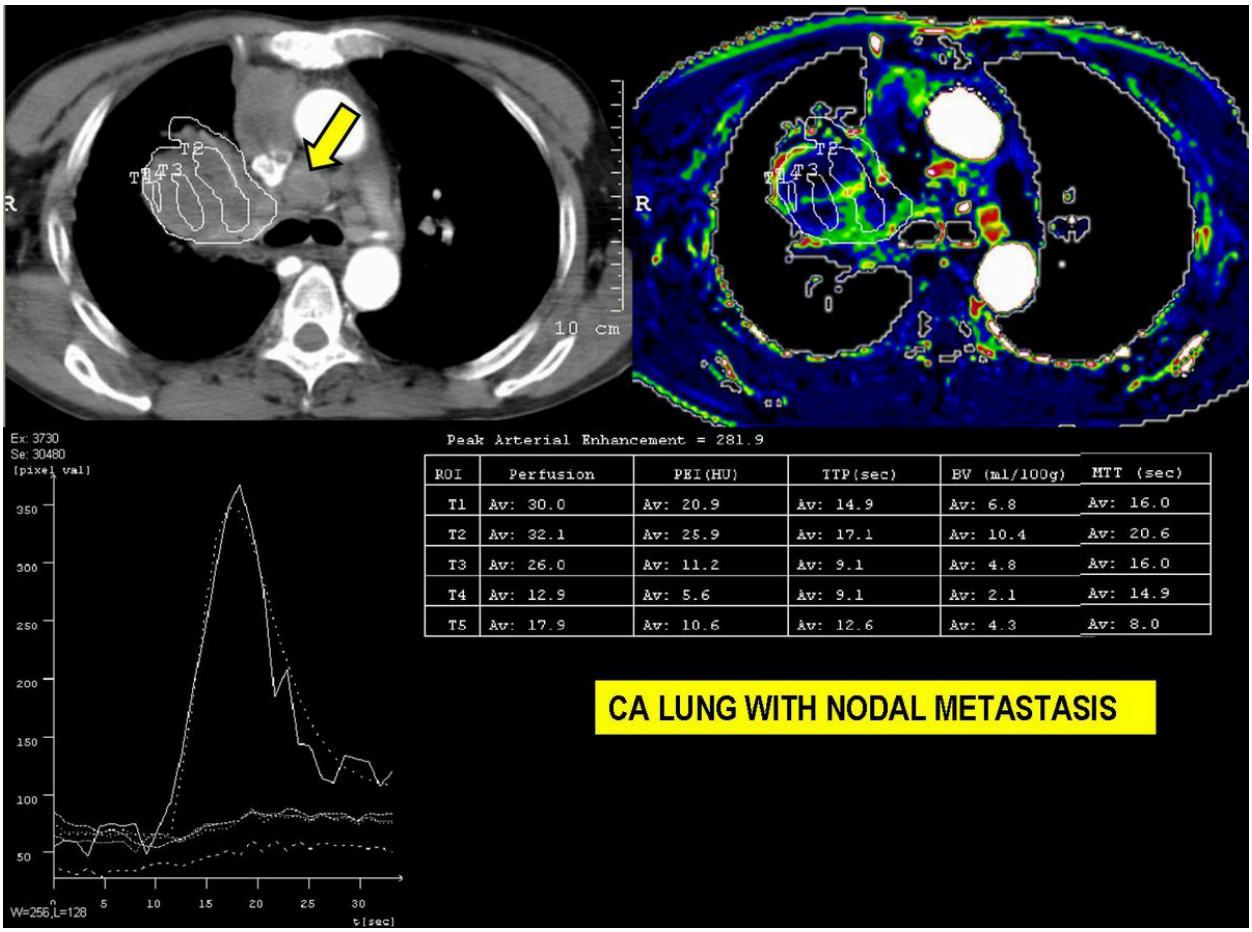

ROI	Perfusion	PEI(HU)	TTP(sec)	BV (ml/100g)	MTT (sec)
T1	Av: 30.0	Av: 20.9	Av: 14.9	Av: 6.8	Av: 16.0
T2	Av: 32.1	Av: 25.9	Av: 17.1	Av: 10.4	Av: 20.6
T3	Av: 26.0	Av: 11.2	Av: 9.1	Av: 4.8	Av: 16.0
T4	Av: 12.9	Av: 5.6	Av: 9.1	Av: 2.1	Av: 14.9
T5	Av: 17.9	Av: 10.6	Av: 12.6	Av: 4.3	Av: 8.0

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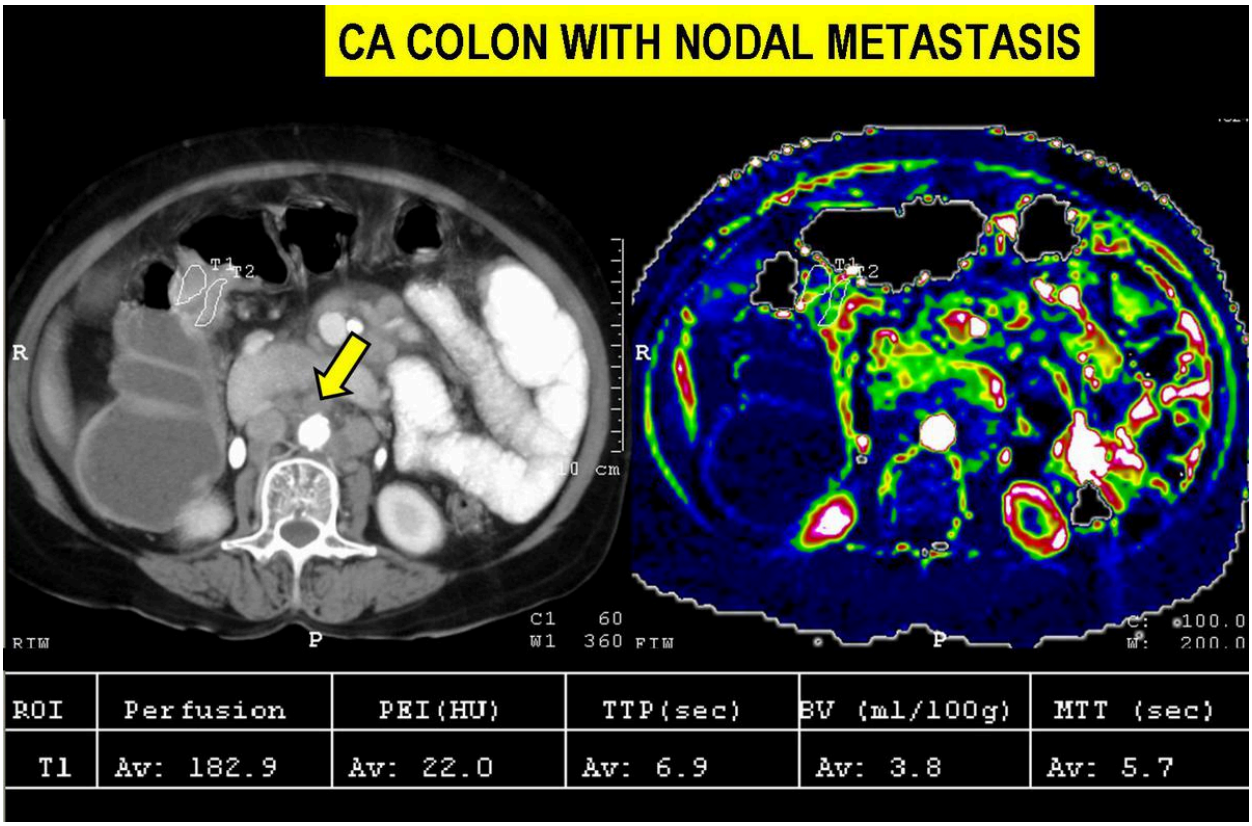

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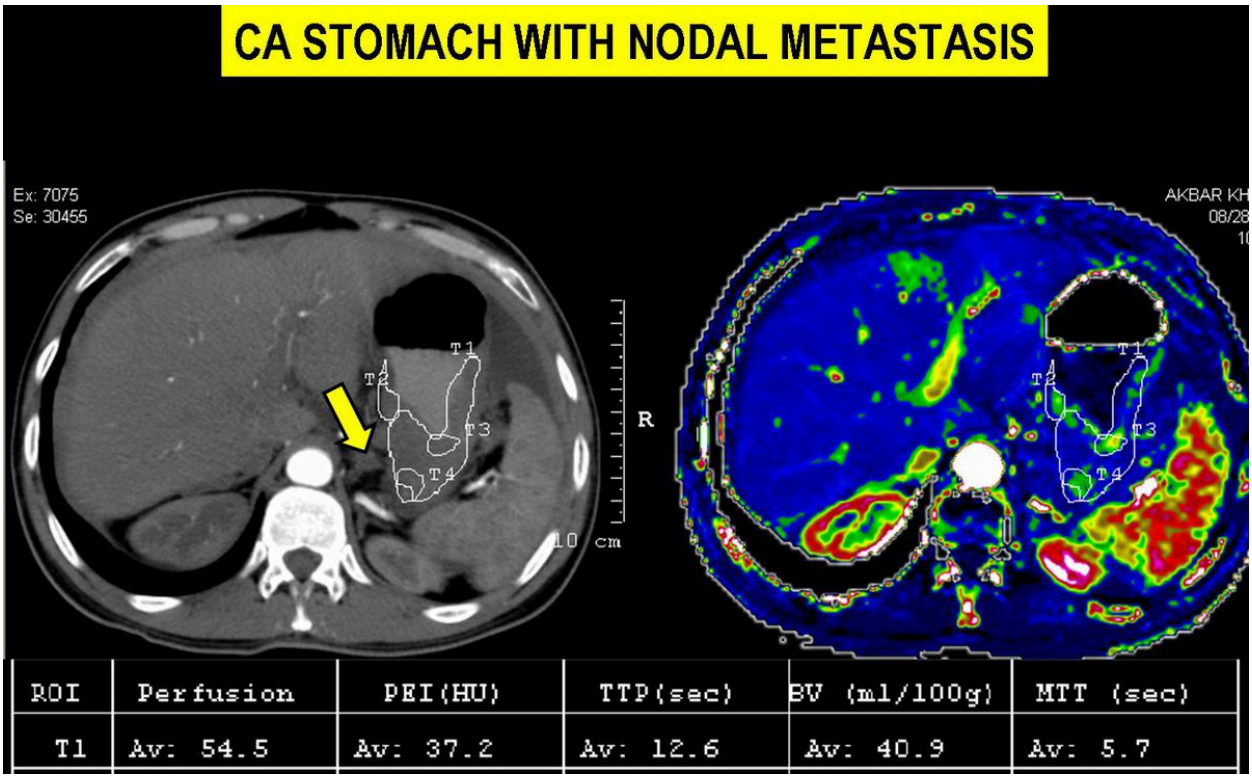

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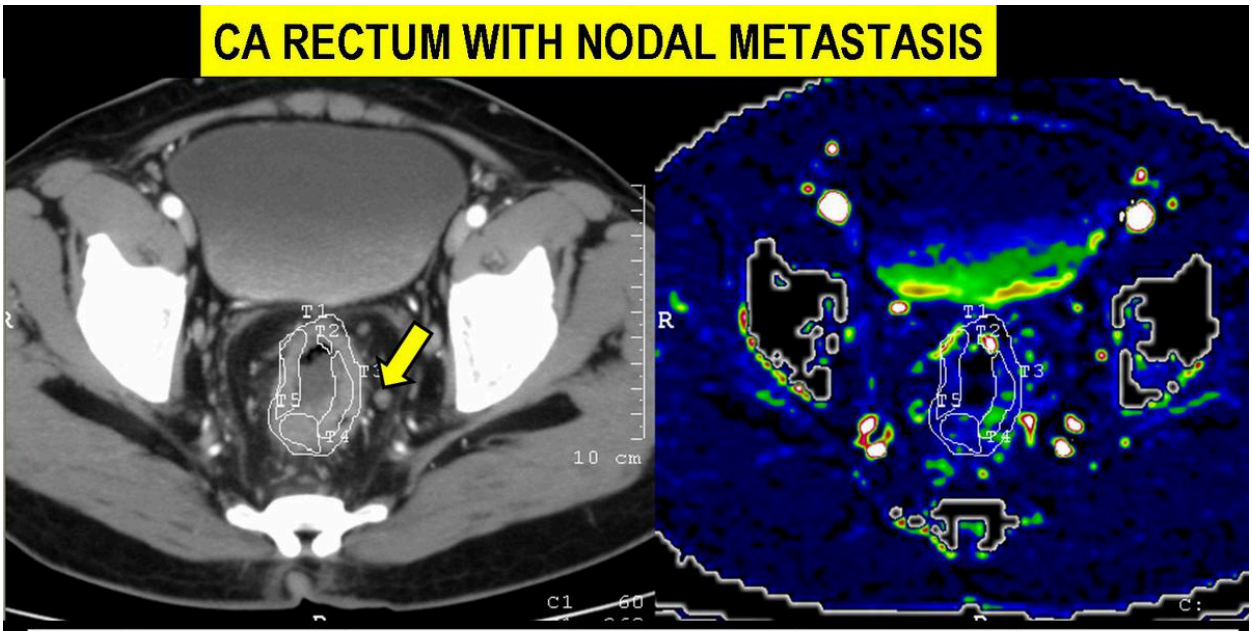

ROI	Perfusion	PEI(HU)	TTP(sec)	BV (ml/100g)	MTT (sec)
T1	Av: 59.3	Av: 12.4	Av: 9.2	Av: 7.4	Av: 8.0
T2	Av: 88.0	Av: 16.0	Av: 8.0	Av: 8.2	Av: 6.9
T3	Av: 29.4	Av: 14.5	Av: 21.7	Av: 7.8	Av: 20.6
T4	Av: 6.2	Av: 3.1	Av: 21.7	Av: 0.9	Av: 20.6

Fig. 0: CASE

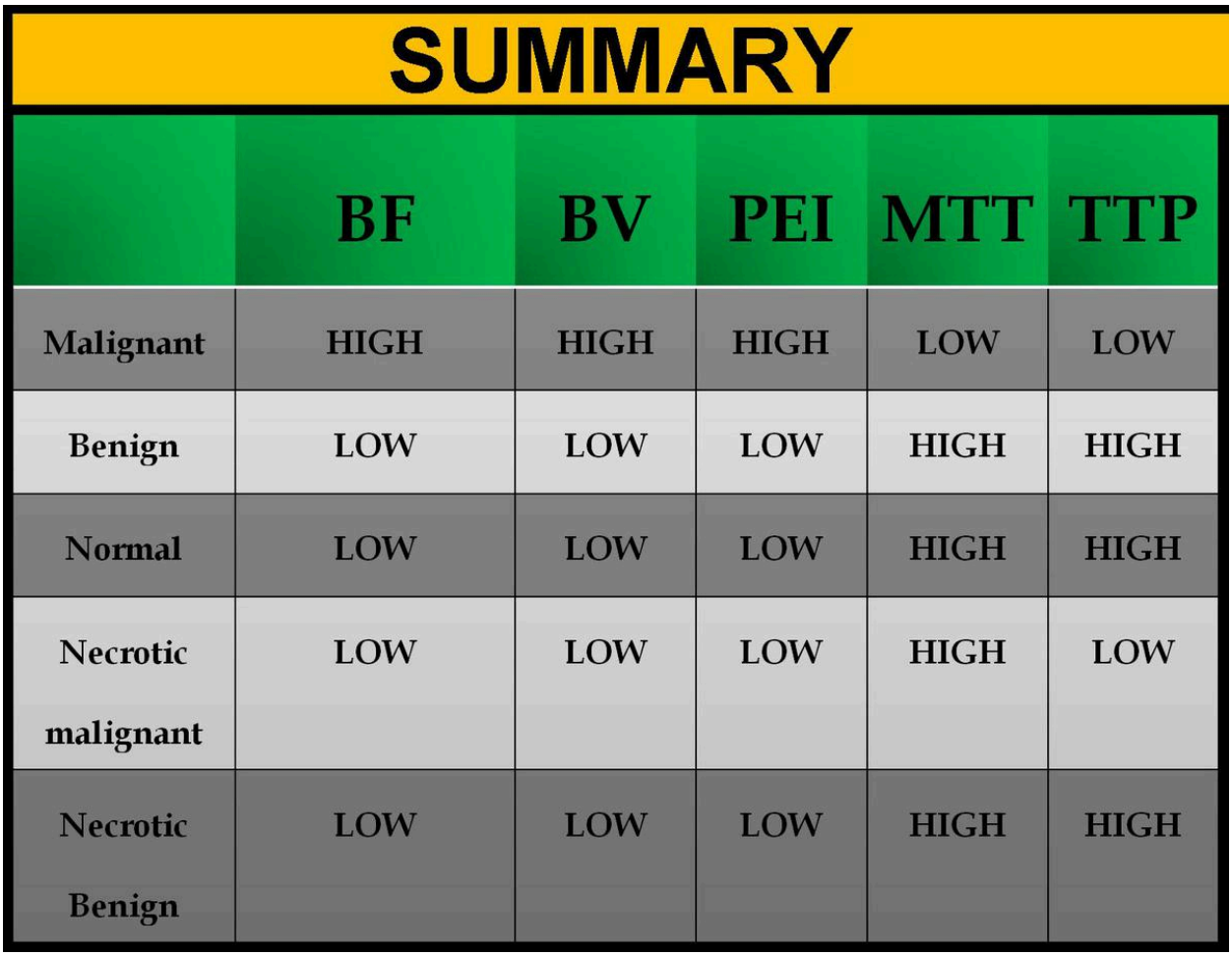

Fig. 0: SUMMARY

Conclusion

Finally we conclude, CTP provides additional functional information regarding characterization of lymph nodes.

It might be useful in differentiation between malignant and non-malignant lymph nodes; however, this study requires further validation.

Therefore perfusion CT tool may be helpful in oncology, providing a higher degree of diagnosis security, differentiation in malignancy and for the therapeutical follow-up

One of the important applications of this technique is the indication of a highly perfused node, which could be used to guide biopsy and thus reducing the chance of sampling error.

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Personal Information

Author details:

Dr. Abhishek Mahajan, MBBS,MD

Fellow in Cancer Imaging

Dept of Radiodiagnosis & Imaging

Tata Memorial Hospital

Dr E Borges Road

Parel

Mumbai

Maharashtra

400 012

India

(+919920354764)

drabhishek.mahajan@yahoo.in