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A practical approach to ultrasound of cervical lymph nodes

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Abstract

Although the role of high resolution ultrasound (US) in evaluating cervical nodes is well established, it is often combined with fine needle aspiration cytology (FNAC). As a result, US appearances that help in distinguishing the various causes of cervical adenopathy are often overlooked and not emphasized. The aim of this study is to re-emphasize to the sonologist the US clues that may help in differentiating the aetiology of abnormal cervical nodes.

We, therefore, present the spectrum of US appearances of lymph nodes. One hundred and forty patients (702 abnormal nodes) with known pathology were compared with 100 normal subjects (1211 nodes).

After identifying an abnormal node, US features that further help in distinguishing between the various pathologies are the distribution of lymphadenopathy, echogenicity, calcification, distal enhancement, intranodal cystic necrosis, matting and soft tissue oedema.

Key words: Ultrasonography; Lymph nodes

Introduction

The sonologist is often the first to identify the presence of an abnormal node. It would be useful if the sonologist can suggest the source and direct the search for the aetiology. It is therefore necessary to be familiar with the US features that may help to distinguish the various cases of nodes in the neck.

The aim of this study is to emphasize those US features which help in the differentiation rather than those which are useful to identify abnormal nodes but not specific for aetiology.

Materials and methods

We reviewed the US scans of 140 patients (702 nodes) with cervical lymphadenopathy. Table I shows the spectrum of diseases evaluated in this study. There were 65 males and 75 females with an age range of 13–94 years. These appearances compared to nodal appearances previously described in similar sites in 100 normal Chinese subjects (Ying *et al.*, 1996).

In all the patients cytological and/or histological diagnosis was obtained from the largest node. In each patient, all nodes with a similar ultrasound appearance to the aspirated or biopsied node were then considered to have a similar pathology.

All the scans were performed on a commercially available scanner (Aloka 650) with a linear 7.5 and a sector 10 Mhz transducer with a built-in water bath.

In evaluating the nodes the features we looked at were distribution, the size and shape of the nodes, echogenic hilus, echogeneity, echogenicity, calcification, intranodal necrosis, nodal border, posterior enhancement, and ancillary features such as soft tissue oedema and matting of nodes. The distribution was classified into eight areas similar to the ones described by Hajek *et al.*, 1986: (1) Submental, (2) Submandibular, (3) Inferior angle of parotid, (4) Upper cervical, above hyoid and along internal jugular vein (IJV) and common carotid artery (CCA), (5) Mid cervical, between hyoid and cricoid cartilage and along the IJV/CCA, (6) Lower cervical, below cricoid cartilage and along the IJV/CCA, (7) Supraclavicular fossa, (8) Posterior triangle.

In evaluating size, for the definition of metastatic nodes of ENT cancers 8 mm is taken as the cutoff

TABLE I
SPECTRUM OF DISEASES IN THIS STUDY

Diseases	Number of patients
Pharynx, larynx, oesophageal carcinomas (PLO)	13
Oral cavity carcinomas (OC)	12
Infraclavicular carcinomas (IC)	10
Papillary carcinoma of the thyroid (PAP)	30
Nasopharyngeal carcinoma (NPC)	30
Non-Hodgkin's lymphoma (LYM)	15
Tuberculous lymphadenitis (TB)	30
Total	140

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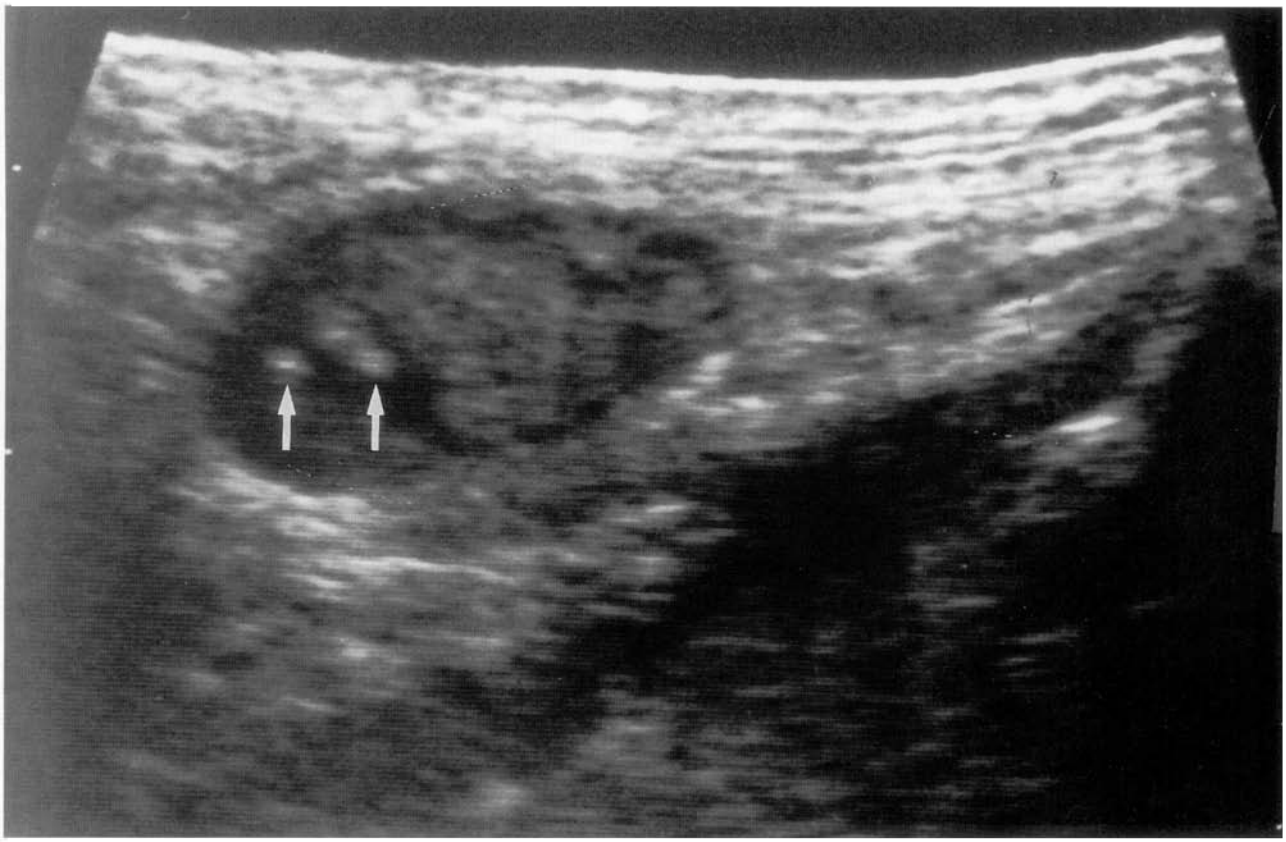

FIG. 1
Longitudinal sonogram of a heterogeneous lymph node showing coagulation necrosis (arrows).

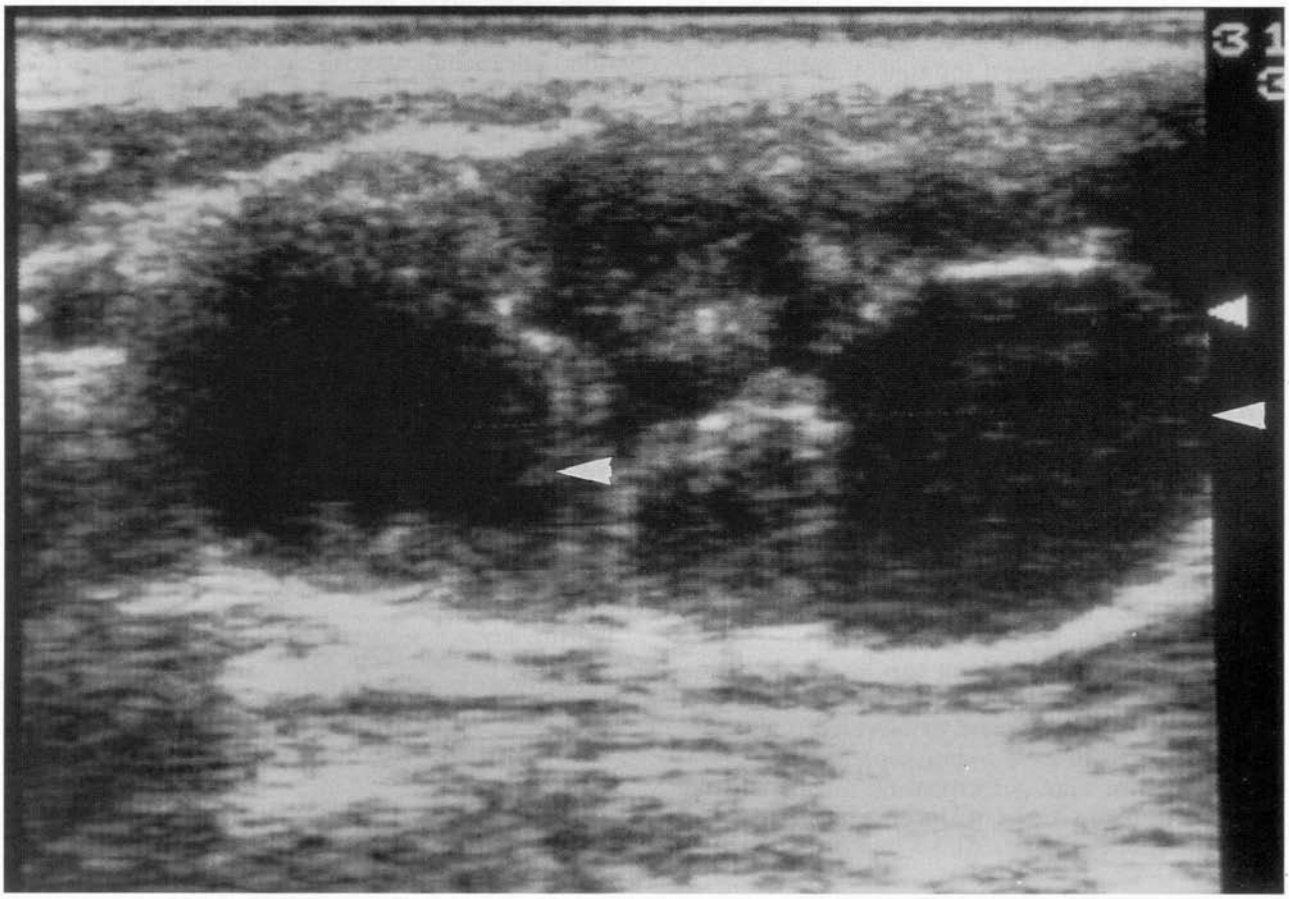

FIG. 2
Longitudinal sonogram of a lymph node showing large areas of cystic necrosis (arrowheads).

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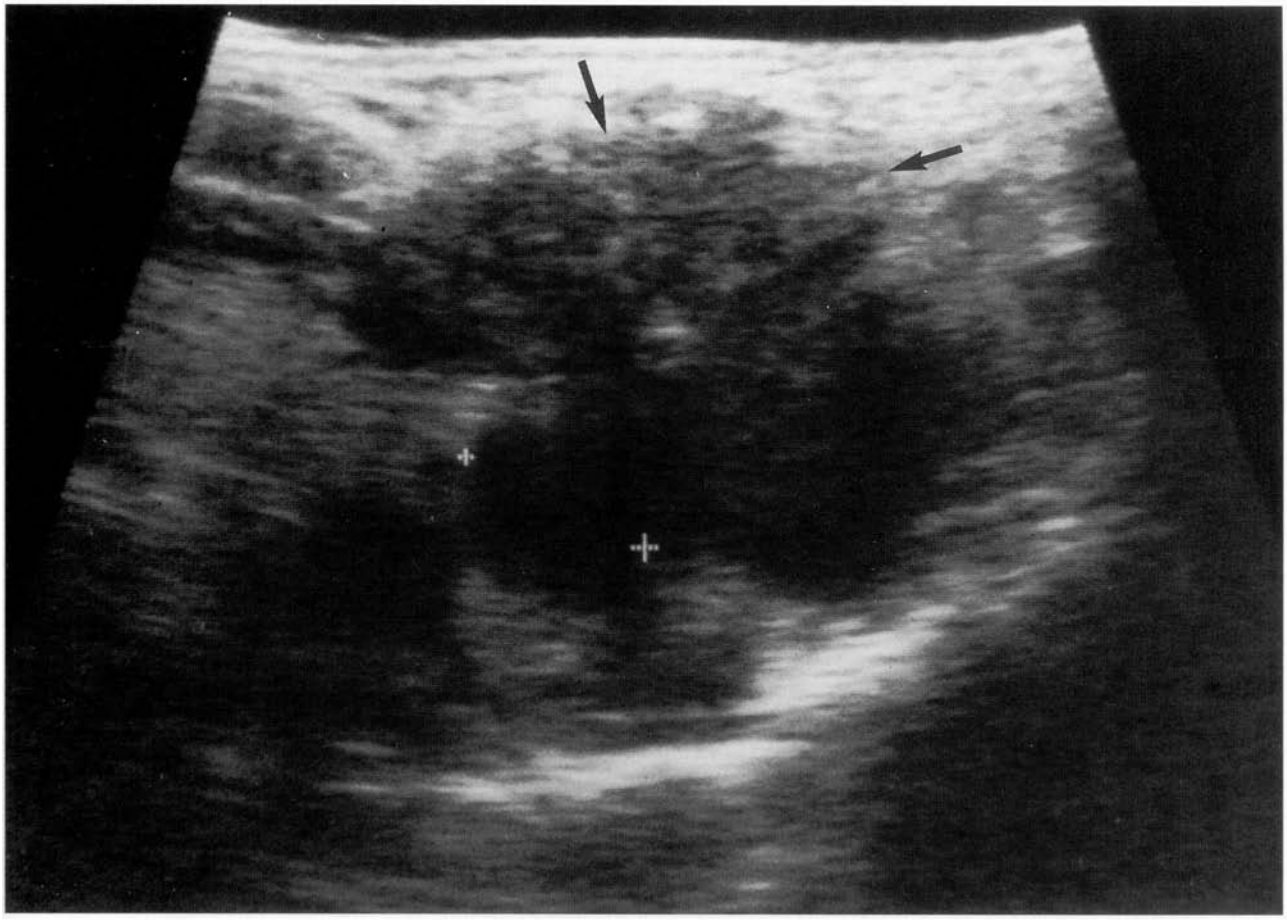

FIG. 3

Transverse sonogram showing loss of normal fascial planes between abnormal nodes and soft tissue edema (arrows). Calipers identify one of the abnormal nodes.

point (Bruneton and Normand, 1987). For nodes less than 8 mm all nodes with intranodal necrosis were considered malignant.

Shape was assessed on the basis of short axis (SA) to long axis (LA) ratio (Tohnosu *et al.*, 1989). SA/LA ratio greater than 0.5 indicates round nodes, less than 0.5 indicates oval nodes.

In assessing internal architecture we looked at cystic necrosis, coagulation necrosis and the presence/absence of hilus. Coagulation necrosis appears as echogenic foci within abnormal nodes (Figure 1). It is less echogenic than normal hilus, separate from it and discontinuous from surrounding fat (Sakai *et al.*, 1988). Cystic necrosis is seen as focal irregular echolucent areas in a node (Figure 2).

The soft tissues were analysed for oedema of the subcutaneous tissues and/or adjacent muscle. Oedema being indicated by a diffuse decrease in echogenicity in adjacent tissues, and loss of fascial planes (Figure 3). Matting was defined as clumps of nodes adherent to each other with no normal echogenic connective tissues between (Figure 4).

Results

In the 140 patients, 702 lymph nodes were detected, ranging in size from 5 x 7 mm – 37 x 46 mm. Table II shows the comparative distribution of abnormal nodes in the neck. Table III shows the comparative US appearances of abnormal nodes in the neck. Table IV compares the incidence of ancillary findings such as abnormal soft tissues and matting associated with abnormal nodes.

Of all the abnormal nodes in a particular site the relative frequency of various diseases in that site is shown in Table V.

Tables VI–X show the US features of common abnormal nodes in individual sites in the neck ie. submandibular area, upper cervical, mid/lower cervical areas, supraclavicular fossa and the posterior triangle. The Tables also demonstrate the appearance of normal nodes in these sites.

Discussion

The nodal features of normal Chinese subjects have previously been reported (Ying *et al.*, 1996). We have used this data to assist in correctly analysing lymph nodes. Nodal size (Bruneton and Normand, 1987), shape (Tohnosu *et al.*, 1989), intranodal necrosis (Sakal *et al.*, 1988), absence of echogenic hilus (Rubaltelli *et al.*, 1990) and sharp nodal border (Shozushima *et al.*, 1990) may help in identifying an abnormal node, but these are of no value in differentiating between the various causes of malignant adenopathy. In fact, in some areas of the

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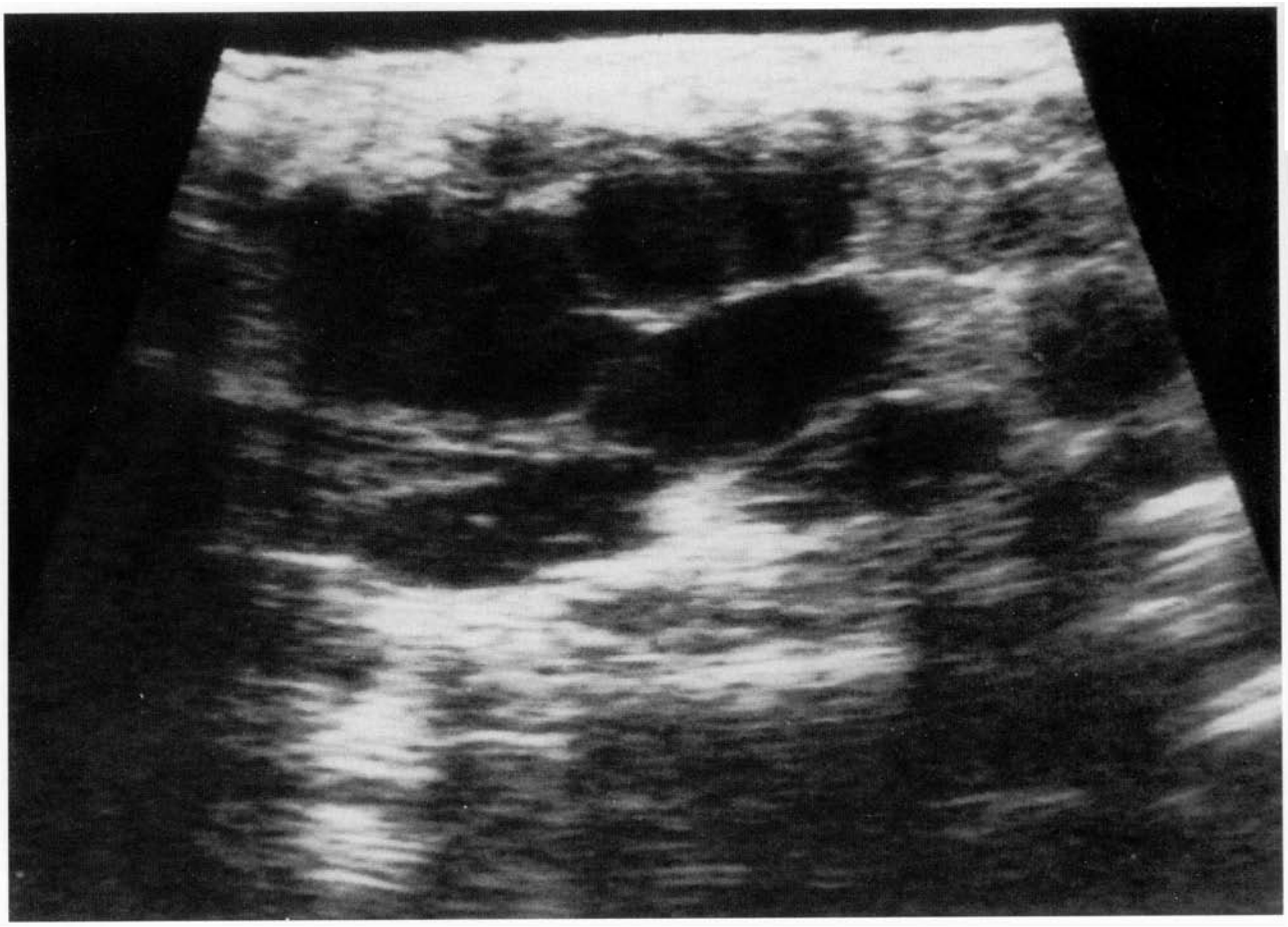

FIG. 4
Longitudinal sonogram of a group of lymph nodes clumped together with loss of normal fascial planes between them.

neck, these features may not even help in identifying abnormal nodes from normal nodes, these limitations are discussed subsequently, and have also been previously described (Ying *et al.*, 1996). Therefore, in the neck, even for identifying normality these features should be interpreted with caution.

Metastatic nodes in the neck are site specific. If the primary itself is not visible the pattern of distribution of lymphadenopathy may suggest a primary location. The distribution of adenopathy in this study (Table II) for the various pathologies is similar to previous reports (Lindberg, 1972; Muraki *et al.*, 1984; Som, 1987; van Overhagen *et al.*, 1991; Ahuja *et al.*, 1995a,b). As the distribution of the abnormal nodes is consistent in various studies, it is a reliable feature to distinguish between the various causes of cervical lymphadenopathy. It is, therefore, necessary for the sonologist to be familiar with the statistically expected nodal metastases for primary tumours of the head and neck.

In this study the majority of malignant nodes were hypoechoic compared to sternomastoid (Figure 5).

TABLE II
OVERALL DISTRIBUTION OF NORMAL AND ABNORMAL NODES IN VARIOUS AREAS OF THE NECK

	Number of lymph nodes (percentage)							
Regions	PLO (%)	OC (%)	IC (%)	PAP (%)	NPC (%)	LYM (%)	TB (%)	Normal (%)
1	4 (6.6)	3 (8.6)	0 (0.0)	0 (0.0)	4 (2.6)	1 (1.3)	0 (0.0)	50 (4.1)
2	3 (5.0)	12 (34.3)	1 (1.9)	0 (0.0)	10 (6.5)	29 (38.2)	7 (3.4)	286 (23.6)
3	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.7)	1 (0.7)	0 (0.0)	0 (0.0)	86 (7.1)
4	10 (16.7)	15 (42.9)	1 (1.9)	49 (41.9)	34 (22.2)	9 (11.8)	18 (8.7)	287 (23.7)
5	9 (15.0)	2 (5.7)	1 (1.9)	25 (21.4)	3 (2.0)	2 (2.6)	4 (1.9)	38 (3.1)
6	3 (5.0)	1 (2.9)	0 (0.0)	20 (17.1)	3 (2.0)	4 (5.3)	8 (3.8)	2 (0.2)
7	18 (30.0)	0 (0.0)	23 (43.4)	15 (12.8)	0 (0.0)	7 (9.2)	25 (12.0)	8 (0.7)
8	13 (21.7)	2 (5.7)	27 (50.9)	6 (5.1)	98 (64.1)	24 (31.6)	146 (70.2)	454 (37.5)
Total	60	35	53	117	153	76	208	1211

PLO, pharyngeal/laryngeal/oesophageal carcinomas; OC, oral cavity carcinomas; IC, infraclavicular carcinomas; PAP, papillary carcinoma of the thyroid; NPC, nasopharyngeal carcinoma; LYM, lymphoma; TB, tuberculous lymphadenitis.

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TABLE III
OVERALL ULTRASOUND FEATURES OF ABNORMAL NODES

	Number of lymph nodes (percentage)							
US features	PLO	OC	IC	PAP	NPC	LYM	TB	Normal
Shape								
S/L<0.5	10.0	17.1	1.9	28.2	26.1	34.2	32.2	70.1
S/L≥0.5	90.0	82.9	98.1	71.8	73.9	65.8	67.8	29.9
Echogenicity								
Hypoechoic	95.0	97.1	83.0	20.5	100.0	100.0	100.0	96.6
Isoechoic	5.0	2.9	17.0	0.0	0.0	0.0	0.0	3.4
Hyperechoic	0.0	0.0	0.0	79.5	0.0	0.0	0.0	0.0
Hilus absent	86.7	85.7	86.8	94.9	83.7	72.4	76.4	14.4
Echogeneity								
Homogeneous	61.7	77.2	90.6	68.4	94.1	97.4	38.9	100.0
Heterogeneous	38.3	22.8	9.4	31.6	5.9	2.6	61.1	0.0
Calcification	0.0	0.0	0.0	50.4	0.0	0.0	0.0	0.0
Coagulation necrosis	13.3	8.6	0.0	0.0	0.7	1.3	7.2	0.0
Cystic necrosis	25.0	14.3	9.4	21.4	5.2	1.3	55.3	0.0
Nodal border								
Sharp	98.3	88.6	71.7	88.0	90.8	86.8	68.8	48.7
Unsharp	1.7	11.4	28.3	12.0	9.2	13.2	31.2	51.3
Enhancement								
Present	1.7	11.4	9.4	9.4	11.8	84.2	21.6	0.0
Absent	98.3	88.6	90.6	90.6	88.2	15.8	78.4	100.0

PLO, pharyngeal/laryngeal/oesophageal carcinomas; OC, oral cavity carcinomas; IC, infraclavicular carcinomas; PAP, papillary carcinoma of the thyroid; NPC, nasopharyngeal carcinoma; LYM, lymphoma; TB, tuberculous lymphadenitis; S/L, short axis to long axis ratio.

However, one should note that even normal nodes in the neck are often hypoechoic. However, hyperechogenicity although uncommon is a useful feature and typically identifies metastatic nodes from papillary carcinoma of the thyroid. Of metastatic nodes from papillary carcinoma 79.5 per cent (Table III) were hyperechoic (Figure 6) compared to the sternomastoid, a feature previously described (Ahuja *et al.*, 1995a).

Calcification within cervical nodes is unusual and has most often been reported with previous granulomatous infection (Som, 1987; Solbiati *et al.*, 1992). Metastatic tumoral calcification is uncommon and the commonest likely primary neoplasm is a papillary carcinoma of the thyroid (Som, 1987). The presence of calcification in cervical lymph nodes has been described in patients with medullary carcinoma of the thyroid (Schwerk *et al.*, 1985; Gorman *et al.*, 1987). This accounts for only five to 10 per cent of all thyroid tumours (De Lellis, 1989), but in this study 50.4 per cent (Table III) of metastatic nodes from papillary carcinoma showed the presence of characteristic calcification (Figure 7) which is seen as fine echogenic foci within the node some with acoustic shadowing. In distinguishing between calcification and intranodal coagulation necrosis one must note that the bright areas of intranodal coagulation necrosis are less echogenic compared to calcification and do not cast distal shadows. None of the nodes from other metastases and TB in this study showed any calcification, contrary to previous reports. Thus the presence of punctate calcification within a hyperechoic node should therefore raise suspicion of the presence of a papillary carcinoma of the thyroid.

In this study 84.2 per cent (Table III) of nodes in non-Hodgkins lymphoma (NHL) showed distal enhancement (Figure 8), a feature not commonly seen in malignant nodes from other primaries. It is thus a consistent distinguishing feature between NHL and other metastases (Bruneton and Normand, 1987; Ishii *et al.*, 1992).

Any node with intranodal cystic necrosis, regardless of its size must be considered pathologic (Som, 1987). Intranodal cystic necrosis has been described

TABLE IV
ANCILLARY FEATURES OF ALL LYMPH NODES IN DIFFERENT CATEGORIES

	Percentage of lymph nodes							
Regions	PLO	OC	IC	PAP	NPC	LYM	TB	Normal
Soft tissues								
Normal	90.0	100.0	100.0	100.0	91.5	98.7	62.5	100.0
Abnormal	10.0	0.0	0.0	0.0	8.5	1.3	37.5	0.0
Matting	15.0	14.3	5.7	0.0	4.6	9.2	46.2	0.0

PLO, pharyngeal/laryngeal/oesophageal carcinomas; OC, oral cavity carcinomas; IC, infraclavicular carcinomas; PAP, papillary carcinoma of the thyroid; NPC, nasopharyngeal carcinoma; LYM, lymphoma; TB, tuberculous lymphadenitis.

TABLE V
INCIDENCE OF COMMONEST ABNORMAL NODES AT EACH SITE IN THE NECK (AS A PERCENTAGE OF ALL ABNORMAL NODES IN THE SAME SITE)

	Regions						
Disease groups	1 (%)	2 (%)	3 (%)	4 (%)	5, 6 (%)	7 (%)	8 (%)
PLO	4 (33.3)	3 (4.8)	0 (0.0)	10 (7.4)	12 (14.1)	18 (20.5)	13 (4.1)
OC	3 (25.0)	12 (19.4)	0 (0.0)	15 (11.0)	3 (3.5)	0 (0.0)	2 (0.6)
IC	0 (0.0)	1 (1.6)	0 (0.0)	1 (0.7)	1 (1.2)	23 (26.1)	27 (8.5)
PAP	0 (0.0)	0 (0.0)	2 (66.7)	49 (36.0)	45 (52.9)	15 (17.0)	6 (1.9)
NPC	4 (33.3)	10 (16.1)	1 (33.3)	34 (25.0)	6 (7.1)	0 (0.0)	98 (31.0)
LYM	1 (8.3)	29 (46.8)	0 (0.0)	9 (6.6)	6 (7.1)	7 (8.0)	24 (7.6)
TB	0 (0.0)	7 (11.3)	0 (0.0)	18 (13.2)	12 (14.1)	25 (28.4)	146 (46.2)
Total	12	62	3	136	85	88	316

PLO, pharyngeal/laryngeal/oesophageal carcinomas; OC, oral cavity carcinomas; IC, infraclavicular carcinomas; PAP, papillary carcinoma of the thyroid; NPC, nasopharyngeal carcinoma; LYM, lymphoma; TB, tuberculous lymphadenitis.

in metastases from squamous cell carcinoma (Muraki *et al.*, 1984; Som, 1987) and papillary carcinoma of the thyroid (Som, 1987). In this study (Table III) 21.4 per cent of nodes from papillary carcinoma had cystic necrosis compared to 25 per cent in nodes from PLO carcinomas, 14.3 per cent in metastases from oral cavity tumours, and 55.3 per cent of tuberculous nodes. Undifferentiated or AIDS lymphoma in nodes in the head and neck may have cystic necrosis (Harnsberger, 1995), however typical non-Hodgkins lymphoma of neck nodes is usually non-necrotic (Muraki *et al.*, 1984; Harnsberger, 1995). In this study only 1.3 per cent of nodes from NHL showed cystic necrosis. Thus intranodal cystic necrosis is another useful feature in distinguishing these groups of nodes from lymphoma and other metastases. Coagulation necrosis was most commonly seen in metastases from PLO carcinomas (13.3 per cent), and may also be a useful distinguishing feature of metastases from PLO carcinomas.

In this study 46.2 per cent of tuberculous nodes were matted (Table IV and Figure 4) and 37.5 per cent showed adjacent soft tissue oedema/induration (Figure 3). These features were not commonly seen with most metastatic nodes and thus are useful in identifying tuberculous adenopathy. One third (31.2 per cent) of all tuberculous nodes showed unsharp nodal borders, a feature that may help to identify tuberculous nodes from others.

The general principles of identification of abnormal nodes are well known (Bruneton and Normand, 1987; Tohnosu et al., 1989; Rubaltelli *et al.*, 1990). These are generally sensitive but not specific. Increased awareness of detection of normal nodes necessitates more critical distinction of abnormal nodes. Also increased awareness of the existence of sporadic US features other than the non-specific indicates the possibility of the diagnosis of the aetiological agent from the appearance alone.

TABLE VI
ULTRASOUND FEATURES OF ABNORMAL AND NORMAL NODES IN THE SUBMANDIBULAR AREA (REGION 2)

Ultrasound features	OC (%)	NPC (%)	LYM (%)	TB (%)	Normal (%)
Shape					
S/L<0.5	16.7	10.0	10.3	14.3	4.9
S/L≥0.5	83.3	90.0	89.7	85.7	95.1
Echogenicity					
Hypoechoic	91.7	100.0	100.0	100.0	96.5
Isoechoic	8.3	0.0	0.0	0.0	3.5
Hyperechoic	0.0	0.0	0.0	0.0	0.0
Hilus absent	75.0	50.0	65.5	71.4	2.1
Echogeneity					
Homogeneous	75.0	100.0	100.0	85.7	100.0
Heterogeneous	25.0	0.0	0.0	14.3	0.0
Calcification	0.0	0.0	0.0	0.0	0.0
Coagulation necrosis	8.3	0.0	0.0	0.0	0.0
Cystic necrosis	16.7	0.0	0.0	14.3	0.0
Nodal border					
Sharp	100.0	100.0	86.2	57.1	23.1
Unsharp	0.0	0.0	13.8	42.9	76.9
Enhancement					
Present	33.3	0.0	82.8	28.6	0.0
Absent	66.7	100.0	17.2	71.4	100.0

OC, oral cavity carcinomas; NPC, nasopharyngeal carcinoma; LYM, lymphoma; TB, tuberculous lymphadenitis; S/L, short axis to long axis ratio.

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TABLE VII
ULTRASOUND FEATURES OF ABNORMAL AND NORMAL NODES IN THE UPPER CERVICAL AREA (REGION 4)

Ultrasound features	OC (%)	PAP (%)	NPC (%)	TB (%)	Normal (%)
Shape					
S/L<0.5	20.0	34.7	17.6	33.3	95.1
S/L≥0.5	80.0	65.3	82.4	66.7	4.9
Echogenicity					
Hypoechoic	100.0	28.6	100.0	100.0	94.4
Isoechoic	0.0	0.0	0.0	0.0	5.6
Hyperechoic	0.0	71.4	0.0	0.0	0.0
Hilus absent	86.7	93.9	79.4	38.9	17.1
Echogeneity					
Homogeneous	66.7	65.3	100.0	94.4	100.0
Heterogeneous	33.3	34.7	0.0	5.6	0.0
Calcification	0.0	44.9	0.0	0.0	0.0
Coagulation necrosis	13.3	0.0	0.0	0.0	0.0
Cystic necrosis	20.0	20.4	0.0	5.6	0.0
Nodal border					
Sharp	86.7	85.7	88.2	66.7	44.6
Unsharp	13.3	14.3	11.8	33.3	55.4
Enhancement					
Present	0.0	4.1	2.9	0.0	0.0
Absent	100.0	95.9	97.1	100.0	100.0

OC, oral cavity carcinomas; PAP, papillary carcinoma of the thyroid; NPC, nasopharyngeal carcinoma; TB, tuberculous lymphadenitis; S/L, short axis to long axis ratio.

Furthermore, although FNAC is obviously very helpful for metastatic lesions there are certain limitations, particularly in the assessment of low grade non-Hodgkins lymphoma because of a high rate of false negatives (Pilotti *et al.*, 1993); FNAC may also not be definitive in diagnosis of TB, particularly in children (Gupta *et al.*, 1992) in whom a similar picture may be seen in cases of reactive hyperplasia due to viral or toxoplasma infection (Kline, 1981). This places even more responsibility on the sonographer to help identify the aetiology.

Therefore, we would like to present our experience which demonstrates how we collate the known and described features to be able to identify aetiology rather than simply detect or confirm the presence of nodal pathology. We realize the figures for frequency of aetiologies is determined by our own population and may not translate to other parts of the world but we hope there is sufficient information in the following guidelines to enable any interested reader to adapt these guidelines to their own practice.

TABLE VIII
ULTRASOUND FEATURES OF ABNORMAL AND NORMAL NODES IN THE MIDDLE AND LOWER CERVICAL AREAS (REGIONS 5 AND 6)

Ultrasound features	PLO (%)	PAP (%)	TB (%)	Normal (%)
Shape				
S/L<0.5	16.7	24.4	66.7	97.5
S/L≥0.5	83.3	75.6	33.3	2.5
Echogenicity				
Hypoechoic	100.0	6.7	100.0	100.0
Isoechoic	0.0	0.0	0.0	0.0
Hyperechoic	0.0	93.3	0.0	0.0
Hilus absent	91.7	97.8	66.7	20.0
Echogeneity				
Homogeneous	58.3	73.3	33.3	100.0
Heterogeneous	41.7	26.7	66.7	0.0
Calcification	0.0	66.7	0.0	0.0
Coagulation necrosis	25.0	0.0	0.0	0.0
Cystic necrosis	16.7	17.8	33.3	0.0
Nodal border				
Sharp	100.0	86.7	100.0	97.5
Unsharp	0.0	13.3	0.0	2.5
Enhancement				
Present	0.0	17.8	0.0	0.0
Absent	100.0	82.2	100.0	100.0

PLO, pharyngeal/laryngeal/oesophageal carcinomas; PAP, papillary carcinoma of the thyroid; TB, tuberculous lymphadenitis; S/L, short axis to long axis ratio.

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TABLE IX
ULTRASOUND FEATURES OF ABNORMAL AND NORMAL NODES IN THE SUPRACLAVICULAR FOSSA (REGION 7)

Ultrasound features	PLO (%)	IC (%)	PAP (%)	TB (%)	Normal (%)
Shape					
S/L<0.5	0.0	0.0	13.3	0.0	75.0
S/L≥0.5	100.0	100.0	86.7	100.0	25.0
Echogenicity					
Hypoechoic	100.0	95.7	13.3	100.0	100.0
Isoechoic	0.0	4.3	0.0	0.0	0.0
Hyperechoic	0.0	0.0	86.7	0.0	0.0
Hilus absent	72.2	73.9	100.0	100.0	25.0
Echogeneity					
Homogeneous	50.0	95.7	60.0	20.0	100.0
Heterogeneous	50.0	4.3	40.0	80.0	0.0
Calcification	0.0	0.0	40.0	0.0	0.0
Coagulation necrosis	5.6	0.0	0.0	0.0	0.0
Cystic necrosis	44.4	4.3	40.0	80.0	0.0
Nodal border					
Sharp	100.0	87.0	93.3	60.0	100.0
Unsharp	0.0	13.0	6.7	40.0	0.0
Enhancement					
Present	0.0	0.0	0.0	4.0	0.0
Absent	100.0	100.0	100.0	96.0	100.0

PLO, pharyngeal/laryngeal/oesophageal carcinomas; IC, infraclavicular carcinomas; PAP, papillary carcinoma of the thyroid; TB, tuberculous lymphadenitis; S/L, short axis to long axis ratio.

We subject each region of the neck to the following analysis:

(1) the number of nodes normally seen.
(2) Special regional caveats regarding overlap of normal and non-specific features which therefore reduce the reliability of these signs in this region.
(3) The relative frequency (in our experience) of aetiologies causing abnormality in this region of the neck.
(4) Features that help specify the causal aetiology.

In the submandibular area nodes are seen in 99 per cent of all normal Chinese subjects. Nodes in this area are commonly solitary, or in pairs (53.7 per cent, 42.1 per cent) (Ying *et al.*, 1996). Most of the normal nodes have an echogenic hilus (97.9 per cent) making it a useful criterion for identifying normality and the majority have unsharp borders (76.9 per cent). Most of the normal nodes are hypoechoic (96.5 per cent) and have a SA/LA ratio greater than 0.5 (95.1 per cent), making these criteria for abnormality unreliable at this site (Table VI). Of

TABLE X
ULTRASOUND FEATURES OF ABNORMAL AND NORMAL NODES IN THE POSTERIOR TRIANGLE (REGION 8)

Ultrasound features	IC (%)	NPC (%)	LYM (%)	TB (%)	Normal (%)
Shape					
S/L<0.5	0.0	33.7	33.3	35.6	98.2
S/L≥0.5	100.0	66.3	66.7	64.4	1.8
Echogenicity					
Hypoechoic	100.0	100.0	100.0	100.0	99.1
Isoechoic	0.0	0.0	0.0	0.0	0.9
Hyperechoic	0.0	0.0	0.0	0.0	0.0
Hilus absent	100.0	88.8	79.2	78.1	19.2
Echogeneity					
Homogeneous	85.2	90.8	100.0	32.9	100.0
Heterogeneous	14.8	9.2	0.0	67.1	0.0
Calcification	0.0	0.0	0.0	0.0	0.0
Coagulation necrosis	0.0	1.0	0.0	10.3	0.0
Cystic necrosis	14.8	8.2	0.0	61.0	0.0
Nodal border					
Sharp	74.1	92.9	100.0	68.5	70.5
Unsharp	25.9	7.1	0.0	31.5	29.5
Enhancement					
Present	14.8	14.3	95.8	28.8	0.0
Absent	85.2	85.7	4.2	71.2	100.0

IC, infraclavicular carcinomas; NPC, nasopharyngeal carcinoma; LYM, lymphoma; TB, tuberculous lymphadenitis; S/L, short axis to long axis ratio.

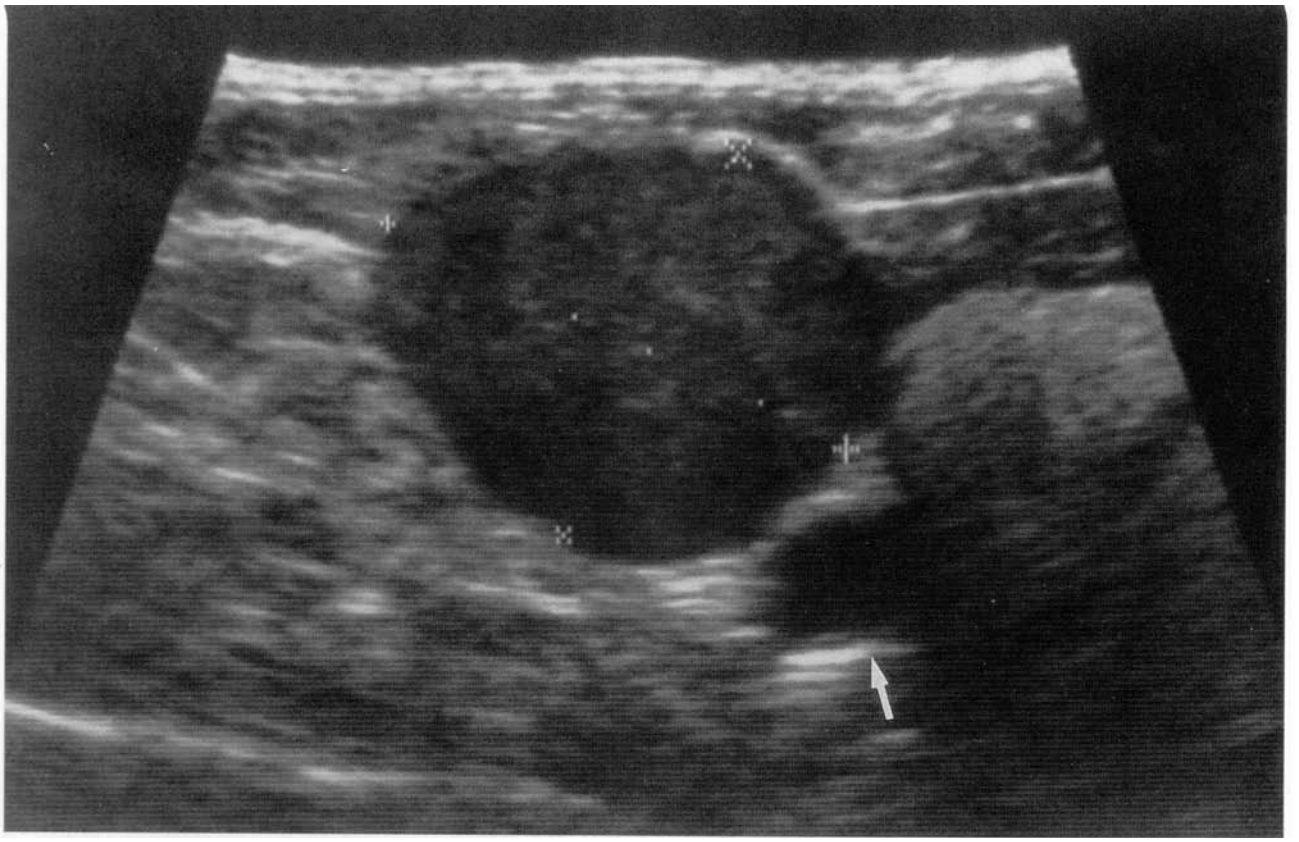

FIG. 5
Transverse sonogram showing a round, hypoechoic node (calipers) along the common carotid artery (arrows).

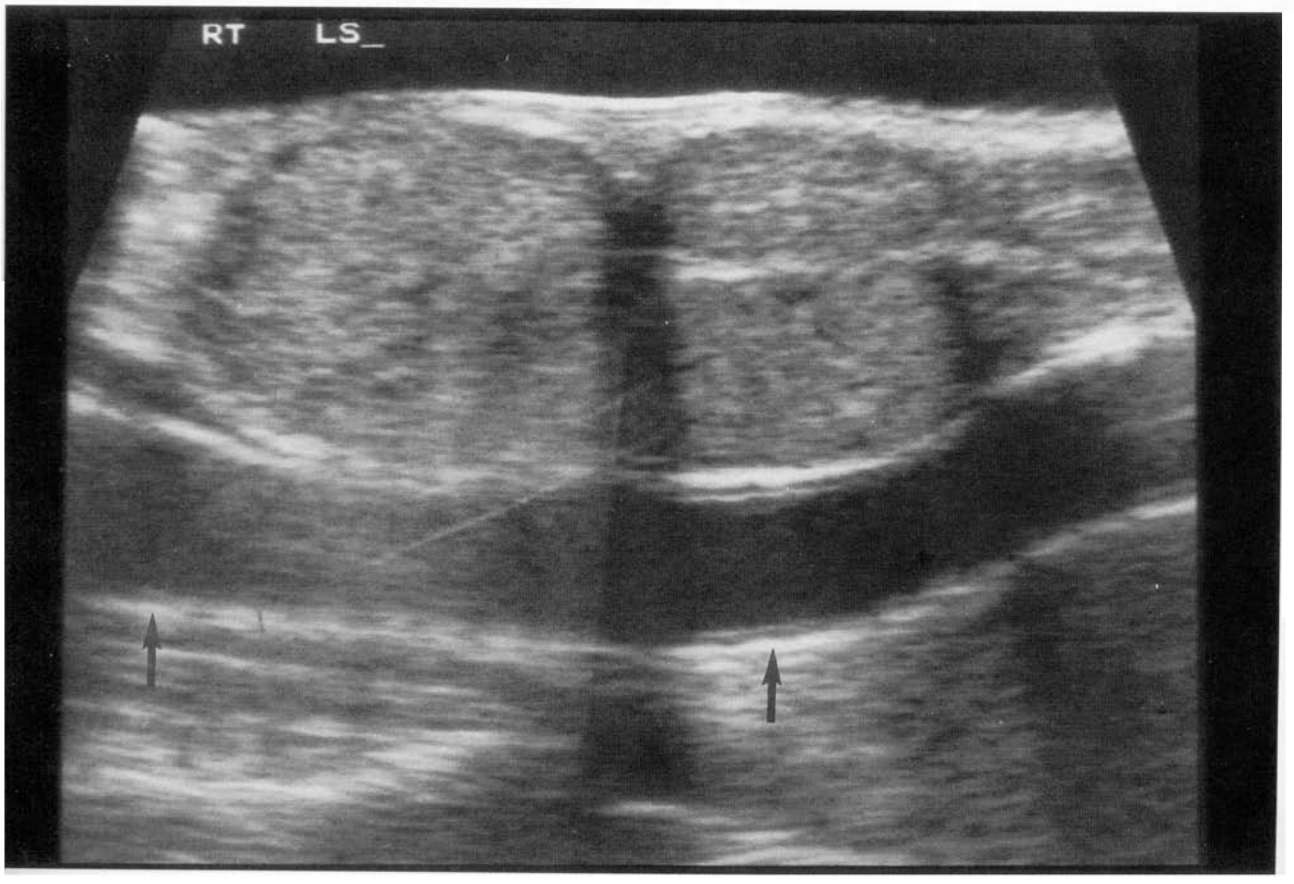

FIG. 6
Longitudinal sonogram of nodes along the common carotid artery (arrows). The intranodal echoes are much brighter compared to the node in Fig. 5.

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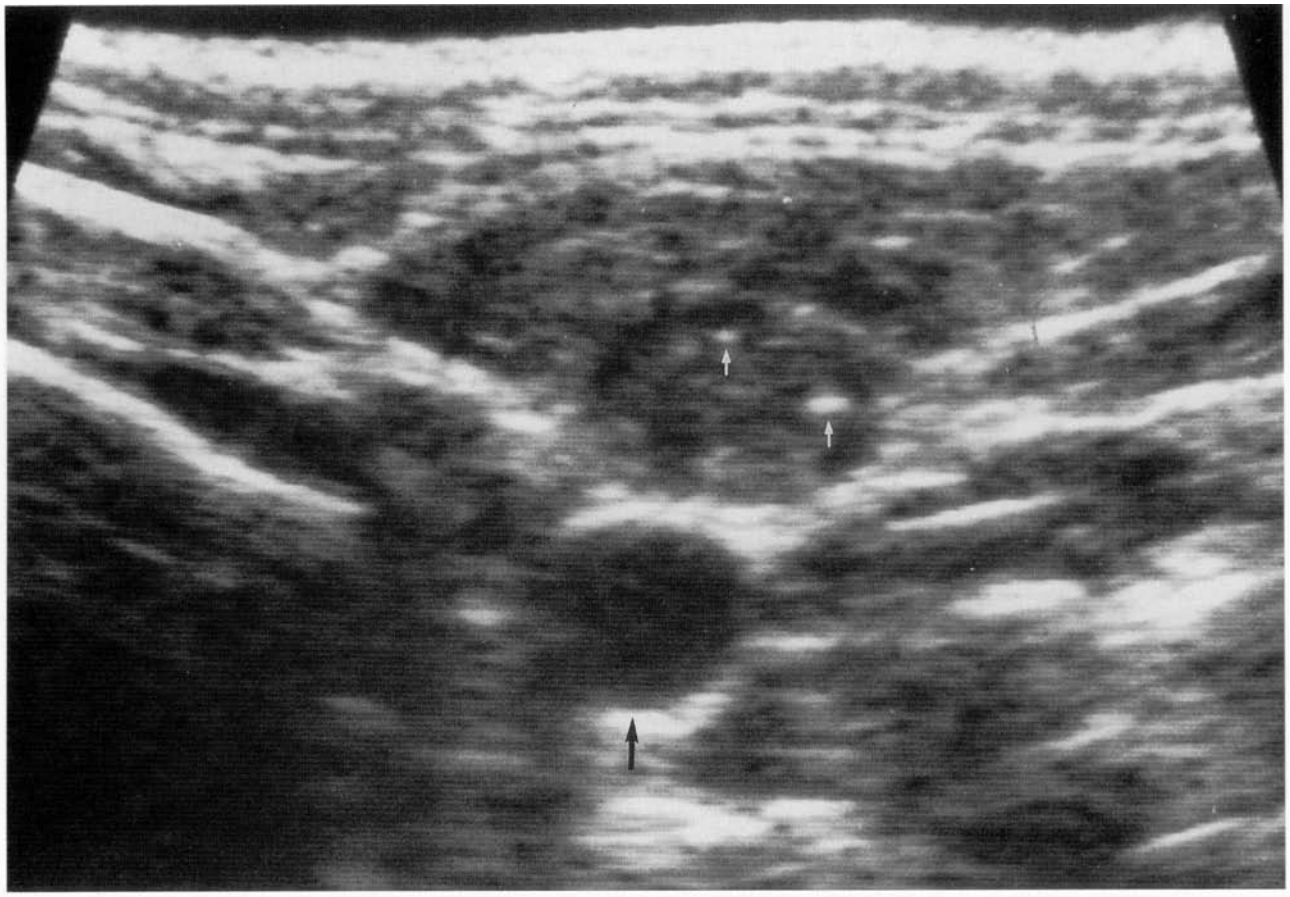

FIG. 7
Transverse sonogram showing a round node with punctate intranodal calcification (white arrows) along the common carotid artery (black arrow).

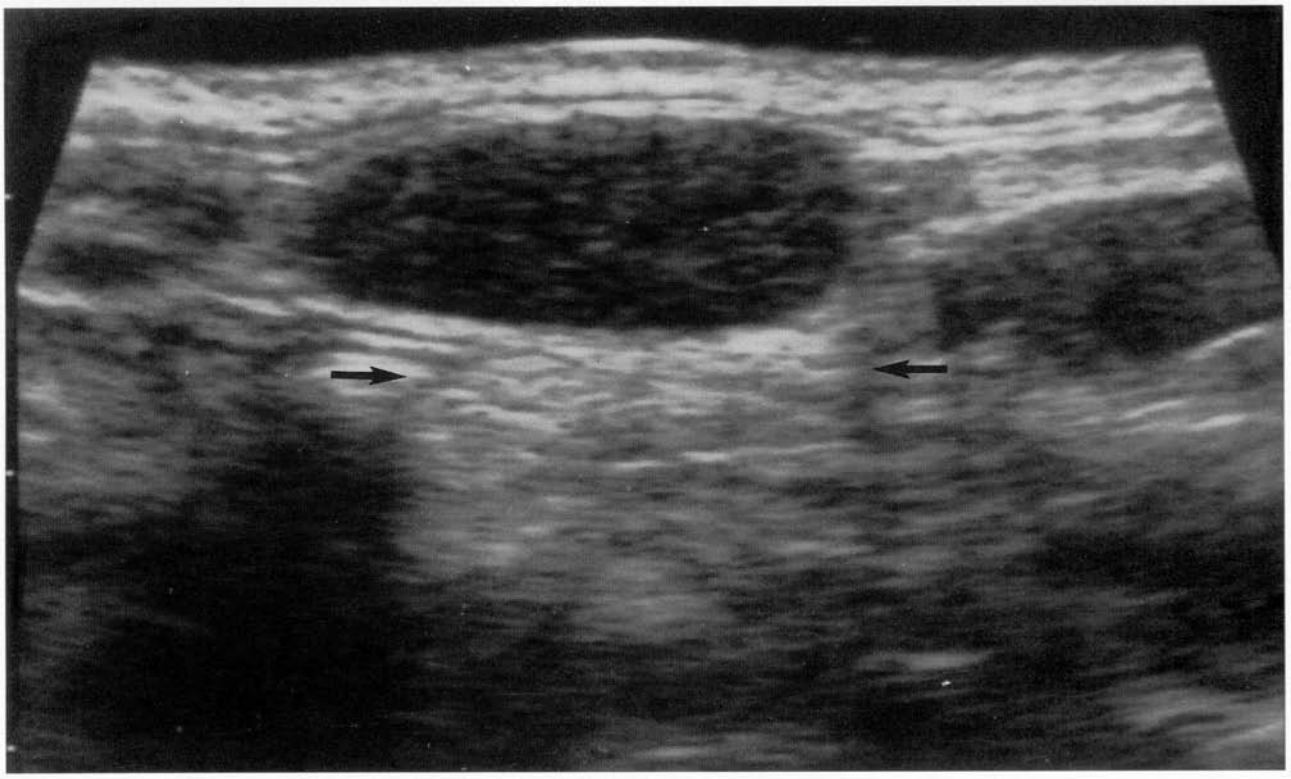

FIG. 8
Longitudinal sonogram showing homogeneous, hypoechoic node with posterior enhancement (arrows).

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all the abnormal nodes at this site (Table V) the commonest are metastases from oral cavity tumours (19.4 per cent) and NPC (16.1 per cent), lymphoma (46.8 per cent) and tuberculous adenopathy (11.3 per cent). Features that help to identify the aetiology are: distal enhancement in solid nodes with sharp borders and normal adjacent soft tissues helps to identify lymphoma, whereas intranodal necrosis in nodes with sharp borders, with normal adjacent soft tissues should suggest metastases from oral cavity tumours. Unsharp borders, cystic necrosis, matting of nodes and soft tissue of oedema are seen in TB nodes. Non-specific abnormal nodes, presence of associated adenopathy in the upper cervical chain and posterior triangle in a patient of Chinese origin should suggest metastases from NPC.

In the upper cervical area nodes are seen in 99 per cent of all normal Chinese subjects. Nodes in this area are commonly solitary, or in pairs (53.6 per cent, 43.3 per cent), (Ying *et al.*, 1996). Normal nodes at this site have a SA/LA ratio less than 0.5 (95.1 per cent), with an echogenic hilus in 82.9 per cent. Most of the normal nodes are hypoechoic (94.4 per cent) and frequently have sharp borders (44.6 per cent) making these criteria for abnormality less reliable at this site (Table VII). The commonest abnormal nodes at this site (Table V) were metastases from oral cavity tumours (11 per cent), papillary carcinoma of the thyroid (36 per cent), NPC (25 per cent) and tuberculous nodes (13.2 per cent). Oral cavity metastases once again maybe identified by coagulation and cystic necrosis in nodes with sharp borders and normal adjacent soft tissues. Hyperechoic nodes, calcification and cystic necrosis identify metastatic nodes from papillary carcinoma of the thyroid. Tuberculous nodes have unsharp borders, are associated with adenopathy in supraclavicular fossa, posterior triangle, are often matted and frequently associated with adjacent soft tissue oedema. NPC nodes once again have no obvious distinguishing features, however the distribution of similar abnormal nodes in other sites in a Chinese patient may help to identify them.

In the mid and lower cervical area nodes are seen in 33 per cent of all normal Chinese subjects. Nodes in this region are commonly solitary (Ying *et al.*, 1996), 97.5 per cent have a SA/LA ratio less than 0.5 and show a hilus in 80 per cent. They are always hypoechoic and 97.5 per cent have sharp borders making these criteria for abnormality less reliable also at this site (Table VIII). The commonest abnormal nodes at this site (Table V) were metastases from PLO carcinoma (14.1 per cent), papillary carcinoma (52.9 per cent) and tuberculous adenopathy (14.1 per cent). Metastases from papillary carcinoma can be identified by their typical appearance ie. hyperechoic, calcification and cystic necrosis. Metastases from PLO carcinoma frequently demonstrate intranodal necrosis, with sharp nodal borders, normal adjacent soft tissues and are associated with similar nodes in the lower neck/supraclavicular fossa. Tuberculous nodes demonstrate their usual appearances ie. cystic necrosis, matting surrounding soft tissue oedema and associated nodes in supraclavicular fossa and posterior triangle.

In the supraclavicular area nodes are seen in seven per cent of all normal Chinese subjects. They are frequently solitary (85.7 per cent), (Ying *et al.*, 1996), have a SA/LA ratio less than 0.5 (75 per cent), and show the presence of a hilus (75 per cent). These criteria for normality should therefore be interpreted with caution. Normal nodes are always hypoechoic and have sharp borders making these criteria for abnormality unreliable (Table IX). The commonest abnormal nodes were from PLO tumours (20.5 per cent), papillary carcinoma of the thyroid (17 per cent), metastases from infraclavicular primaries (26.1 per cent) and tuberculous adenopathy (28.4 per cent). Metastases from infraclavicular primaries show no specific US appearances, however their selective distribution in the lower neck is a useful identifying feature. Metastases from PLO tumours, papillary carcinoma and tuberculous nodes can be differentiated as discussed above.

In the posterior triangle nodes are seen in 99 per cent of all normal Chinese subjects. They are frequently multiple (77.4 per cent), (Ying *et al.*, 1996), have a SA/LA ratio less than 0.5 (98.2 per cent), and show the presence of a hilus (80.8 per cent). Similar to the normal nodes in the supraclavicular fossa, normal nodes in the posterior triangle are also hypoechoic (99.1 per cent) and frequently have sharp borders (70.5 per cent) making these criteria for abnormality unreliable at this site (Table X). Metastases from NPC (31 per cent), tuberculous nodes (46.2 per cent), lymphoma (7.6 per cent) and metastases from infraclavicular primaries (8.5 per cent) were the commonest abnormal nodes in the posterior triangle (Table V). The majority of the TB nodes showed intranodal necrosis, were frequently unsharp, matted and associated with soft tissue oedema. Lymphoma could be identified by posterior enhancement in solid nodes with sharp borders. Both NPC nodes and metastases from infraclavicular primaries had no obvious identifying features. Their specific distribution pattern in the neck is the only distinguishing feature, ie. NPC nodes are commonly seen in the upper cervical chain and posterior triangle whereas nodes from infraclavicular primaries are seen in the supraclavicular fossa and lower posterior triangle.

Conclusion

To differentiate the various causes for malignant adenopathy, the only US features the sonologist will find useful are the distribution of nodes, hyperechogenicity, calcification, posterior enhancement and intra-nodal necrosis. Matting of nodes and adjacent soft tissue oedema further help in identifying tuberculous nodes.

Features indicating normality, ie. shape, absence of hilus, nodal border and echogenicity should be interpreted with caution in the different regions of the neck.

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