THYROID NODULES : EVALUATION WITH COLOR DOPPLER ULTRASONOGRAPHY.

Chutiwan VIWATTANASITTIPHONG, Bussanee WIBULPOLPRASERT, Achara SANGSAI, Chatchai THANUDUMRONG

ABSTRACT

The aim of this study was to assess prospectively the value of thyroid Color Doppler sonographic examination of the patients with a solitary thyroid nodule and correlation with the fine needle aspiration cytology.

Sixty patients with a solitary thyroid nodule underwent Color Doppler sonography with 7.5 MHz transducer which proved histologically to be 10 (15%) malignant and 50 (85%) benign nodules. Perinodular color flow signal were depicted in 6 out of 10 (60%) malignant nodules and 29 out of 50 (58%) benign lesions. Intranodular color flow signal were exhibited in 3 out of 10 (33%) and 2 out of 50 (4%) of malignant and benign lesions respectively. This left 20 out of 60 (33%) to have absence of color flow signal. The malignant nodule showed greater tendency to exhibit intranodular color flow signal than benign lesion but perinodular color flow signal was found in both benign and malignant nodule equally. The quantitative evaluation of the peak flow velocity obtained from the Doppler wave form shows no significant difference of the peak flow velocity between benign and malignant lesion (mean peak flow velocity 15.85 cm/sec of malignant nodule and 13.37 cm/sec of benign lesion.

Management of the solitary thyroid nodule poses a problem for the clinician in the selection of patients who require surgery. 10-20% of solitary thyroid nodules are malignant (1). Clinical history and examination are frequently unable to distinguish between benign and malignant thyroid nodules. (2,3)

Although sonography is widely used as a single and noninvasive diagnostic tool in a wide spectrum of thyoid disease, the lack of histopathological specificity accentuates its limitation. (4) Color doppler sonography provides not only the standard gray scale image but also a color display of blood flow and hence permits the evaluation of vascularity in thyroid tumors and tumorlike lesions. (5,6)

However it is not yet clear that an analysis of flow pattern types could differentiate carcinoma from benign lesions. (7)

The study therefore attemped to assess the characteristic of blood flow within the thyroid nodules with the emphasis on the correlation between flow patterns and pathology with correlation between color doppler patterns and the gray scale appearance of the lesions was also evaluated.

MATERIALS AND METHODS

From february to october 1994, 60 patients with solitary thyroid nodules underwent examination with color doppler sonography at the department of Radiology in Ramathibodi Hospital by the author (*) and confirmed by experienced consultant radiologist (**) prior to the fine needle aspiration cytology (FNAC). Results were recorded prospectively.

The age of patients varied from 20 to 84 years, average 46 years.

Department of Radiology, Ramathibodi Hospital, Rama VI road, Bangkok, Thailand.

Color doppler sonography was performed using a commercially available color doppler system (ALOKA SSD 680) with a 7.5 Mhz, transducer, wall filter of 100 Hz pulse repetition frequency of 100 Hz to 2 Khz, sampling volume 1 mm.

1) The patients first underwent the gray scale scanning to evaluate echo texture.

2) Subsequently color flow imaging and doppler examination were performed.

Color gain was adjusted to a level associated with minimal artifacts. The color flow image was used as a guide to select the points for recording the doppler time-velocity wave form with a sampling volume of 1 mm. (Fig 4.) when no color signals could be depicted, the quantitative doppler examination was not performed.

Flow toward the transducer was displayed as red and blue indicated flow in the reverse direction.

Nodules were classified on the basis of flow distribution as follows :-

TYPE O : Absence of color, singals (Fig.1)

TYPE I : Color flow at the periphery of the nodule (Fig.2)

TYPE II : Mixed peripheral and internal flow signal (Fig.3)

The doppler wave form record at the point with the highest frequency shift was used for statistcal analysis.

RESULTS

The mean patient age was 46.8 years and the female to male ratio was 7.5 to 1 (female 53, male 7).

The histological diagnoses are shown in Table 1.

There were ten (16%) malignant nodules :- seven papillary, three follicular carcinoma, This left 50 patients (84%) with benign lesions.

All 60 patients had thyroid ultrasonography and doppler exam performed. The correlation between pathologic and color doppler findings is summarized in Table 2 and 3, correlation between B-mode images and flow patterns is shown in Table 4.

Color signal could be depicted in 9 out of 10 (90%) malignant tumors and 37 out of 50 (74%) benign lesions. However no specific flow pattern for malignancy could be found.

As regards to flow distribution, type II was seen in 3 out of 10 (33%) malignant lesions and in 2 out of 50 (4%) benign lesions. Malignant nodules showed greater tendency to exhibit type II flow than benign lesion. However no specific flow pattern for malignancy could be found.

No color flow pattern that correlated specifically with the conventional B-Mode characteristics of the nodules and no correlation existed between the presence of color flow signals and peak flow velocity and pathology.

DISCUSSION

The quantitative evaluation of color doppler and flow of this report showed that no correlation existed between pathology and flow pattern and peak flow velocity obtained from the doppler wave form (Chi's Square Test)

Similarly, no correlation was found between conventional B-Mode images and the doppler data.

However, as shown angiographically (8,9) most malignant tumors are rich in irregular, tortuous vessels. This discrepancy might occur because color doppler songraphy is relativelly less "sensitive" in the depiction of fine tumor vessels than angiography.

"sensitivity" in color doppler sonography related to several factors (10) (gain setting, pulse repetition frequency, doppler filter) and technical difficulties also exist in selecting the precise setting at which optimal image would be obtained (10). Depiction of fine vasculature with slow flow is still difficult.

Taylor and coworkers (11) reported that high doppler velocity were detected in primary malignant tumors of the liver, kidney, adrenal gland and pancreas and that such high velocity doppler signals were due to arteriovenous shunting.

In conclusion, the presence of color flow signal and flow distribution within the nodule and peak flow velocity did not establish the differrential diagnosis between benign and malignant thyroid nodule. Doppler pattern could not significantly improve the limitation of the conventional B-Mode scan and the doppler examination would play a limited role in evaluating the nature of disease vasculature within the nodules.

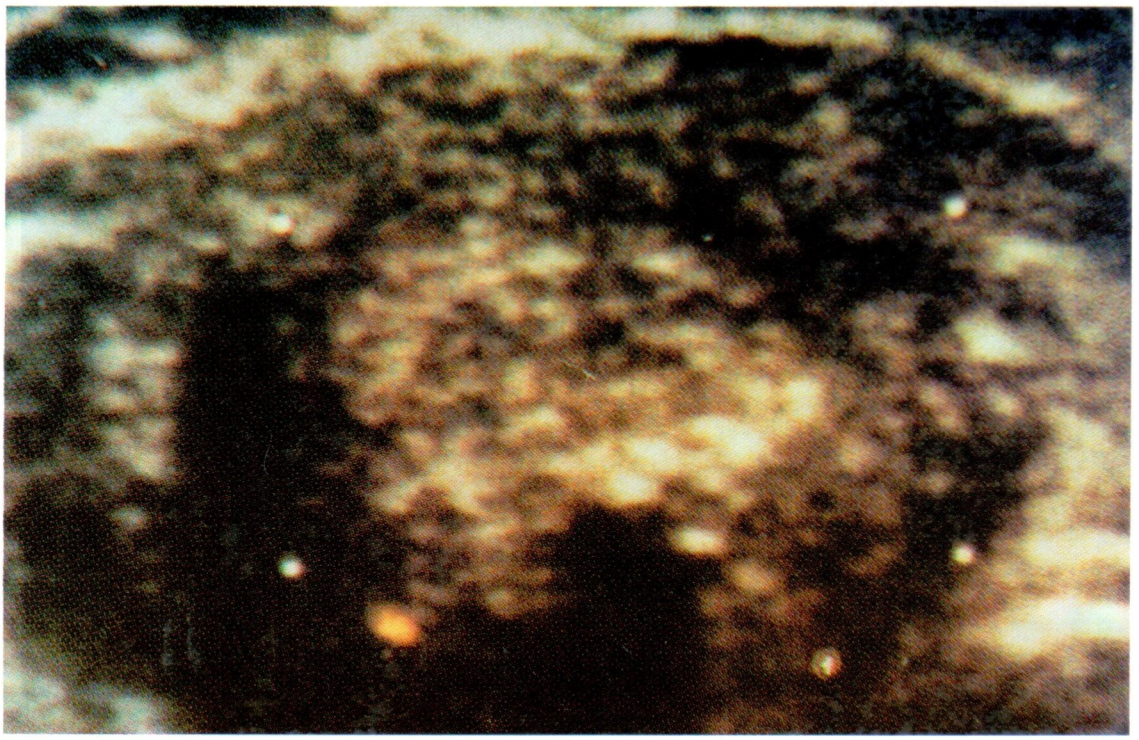

Fig. 1 FLOW DISTRIBUTION TYPE 0
NO COLOR FLOW SIGNAL IS DETECTED IN THE NODULE

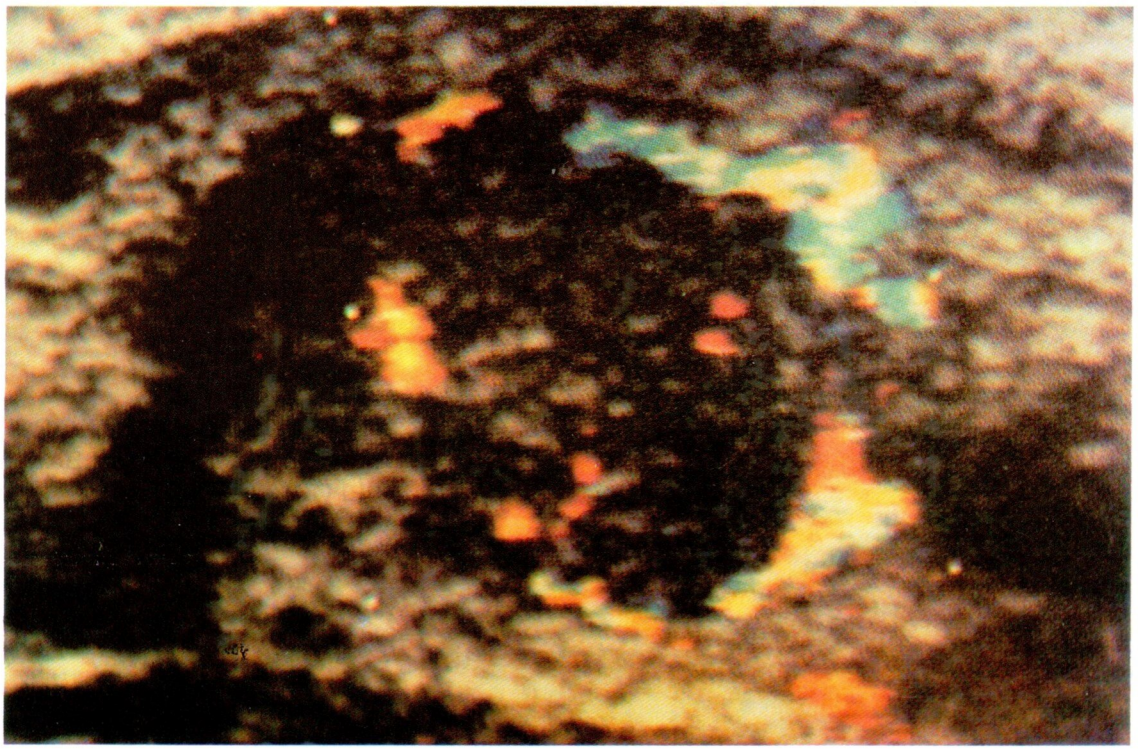

Fig. 2 FLOW DISTRIBUTION TYPE 1
COLOR FLOW SIGNAL IS DEPICTED AT PERIPHERY OF THE NODULE

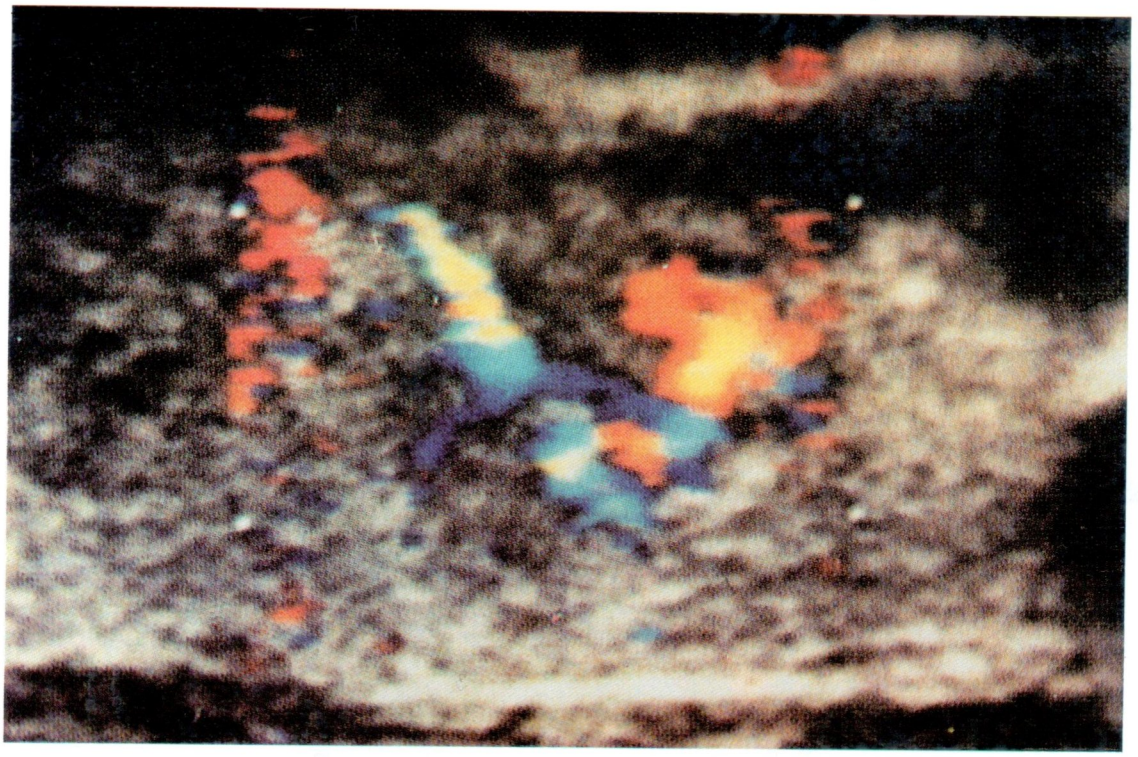

Fig. 3 FLOW DISTRIBUTION TYPE 2
MIXED PERIPHERAL AND INTRANODULAR COLOR FLOW SIGNAL

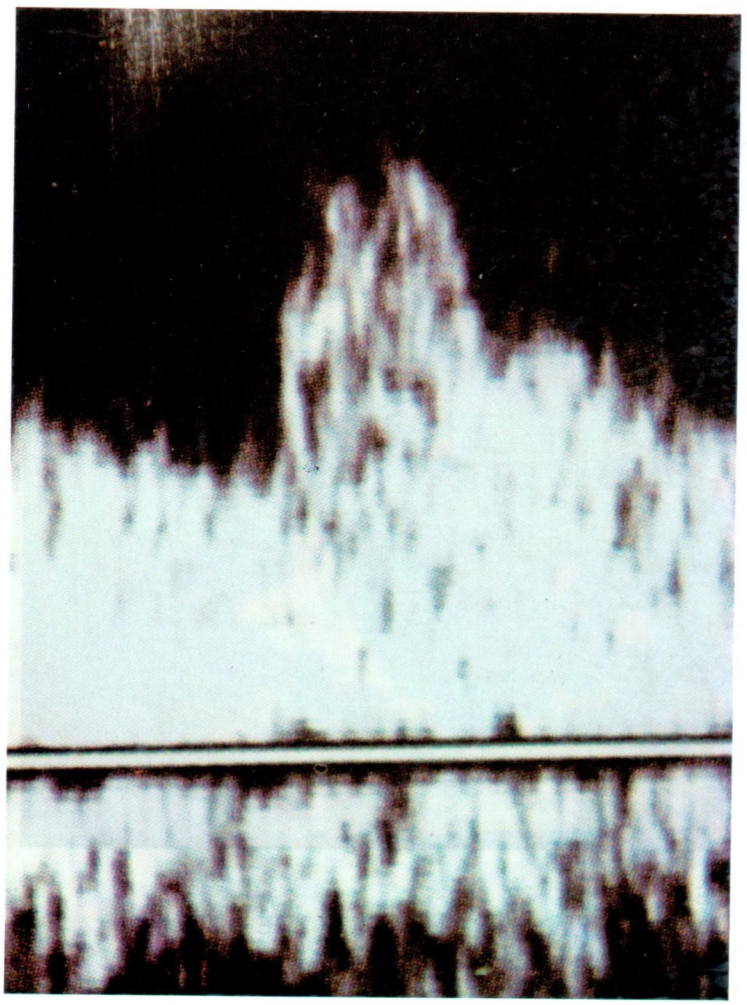

Fig. 4
THE DOPPLER TIME-VELOCITY WAVE FORM SHOWS PEAK FLOW VELOCITY 20.1 Cm/sec

Table. 1 Histological diagnosis of solitary thyroid nodules

Histological diagnosis	No.
Malignant	
papillary carcinoma	7 (11.2%)
Follicular carcinoma	3 (4.8%)
Benign	
Hurthle cell adenoma	2 (3.2%)
Colloid nodule goiter	12 (19.2%)
Cystic nodular	12 (19.2%)
Adenomatous nodule	11 (17.6%)
Hemorrhagic cystic nodular goiter	7 (11.2%)
Cystic colloid goiter	4 (6.4%)
Hemorrhagic colloid nodule	2 (3.2%)
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	60 (100%)

Table. 2 Correlation between pathology and Color Doppler findings

Pathology	No. of case	Flow pattern*		
Maligant		O	I	II
Papillary carcinoma	7	1	4	2
Follicular carcinoma	3	-	2	1
Benign				
Adenomatous nodule	12	4	8	-
Colloid nodule	12	3	8	1
Cystic nodular goiter	11	5	6	-
Hemorrhagic cystic nodular goiter	7	4	3	-
Cystic colloid goiter	4	3	1	-
Hemorrhagic colloid nodule	2	-	2	-
Hurthle cell adenoma	2	-	1	1

* For the flow pattern
TYPE O : Absence of color signals
TYPE I : Color flow at the periphery of nodule
TYPE II : Mixed peripheral and internal flow signal

Table. 3 Correlation between pathology and Color Doppler findings

Pathology	No. of case	Peak Flow velocity (cm/sec)	
Maligant		Range	Mean
Papillary carcinoma	7	12.45-22.05	15.65
Follicular carcinoma	3	11.50-18.35	16.06
Benign			
Adenomatous nodule	12	10.95-17.45	14.20
Colloid nodule	12	11.65-19.00	14.10
Cystic nodular goiter	11	9.63-16.85	12.24
Hemorrhagic cystic nodular goiter	7	10.55-14.45	12.05
Cystic colloid goiter	4	9.25-15.00	10.68
Hemorrhagic colloid nodule	2	10.20-17.35	13.77
Hurthle cell adenoma	2	14.60-18.55	16.55

Table. 4 Correlation between B-Mode image and flow patterns

Echogenicity of nodule	No. of case	Flow pattern		
		O	I	II
Anechoic or cystic	22	11	11	-
Hypoechoic	25	5	17	3
Isoechoic or hyperechoic	9	3	5	1
Mixed	4	1	2	1

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