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Original Research Article

Galectin-3 and Hector Battifora Mesothelial-1 immunohistochemical expression in 50 cases of thyroid neoplasms: a retrospective study done at tertiary care centre

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ABSTRACT

Background: Diagnosis of thyroid carcinoma is not always straight forward on haematoxylin and eosin staining since nuclear features are inconsistent, overlapping and controversial. In regards to this, many studies on the role of immunohistochemical markers for diagnosis of malignant thyroid carcinoma are needed. In order to improve diagnostic accuracy, markers immunohistochemistry techniques have mainly emphasized on galectin-3 (Gal-3) and Hector Battifora Mesothelial-1 (HBME-1). However, results remain unsatisfactory. The aim of the present article was to establish the diagnostic accuracy of Gal-3 and HBME-1 markers, individual and in combination, in the differentiation of malignant and benign thyroid lesions.
Methods: A total of 50 thyroidectomy specimens were studied over a period of 1.5 years from September 2019 to February 2021 at Bhagwan Mahaveer Cancer Hospital Research Centre, Jaipur which included 2 benign and 48 malignant thyroid neoplasms. Histopathologic evaluation of H&E stained sections was done and immunohistochemistry (IHC) staining for Gal-3 and HBME-1 was performed for all neoplasms.
Results: For the immunohistochemistry technique, Gal-3 and HBME-1expression was significantly higher in malignant thyroid neoplasms in comparison to the benign neoplasms. Gal-3 expression for malignant neoplasms showed sensitivity of 97.92%, specificity of 50%. HBME-1 expression for malignant neoplasms showed sensitivity and specificity of 100% each. Gal-3 and HBME-1 are useful markers in differentiating benign and malignant thyroid neoplasms.
Conclusions: This study demonstrated that both immunomarkers studied are sensitive and specific for diagnosis of benign and malignant thyroid lesions. However, the need of further studies for other molecular markers must continue in order to increase the diagnostic accuracy since a proportion of cases still show false-negative and false-positive tests.

Keywords: Galectin-3, HBME-1, Immunohistochemistry, Thyroid carcinoma

INTRODUCTION

Thyroid lesions are fairly common worldwide and are commonly encountered in clinical practice. The estimated occurrence of palpable thyroid nodules in the general population ranges from 4 to 7%.[1] A survey conducted by World Health Organization (WHO) in 2010 revealed that there were around 44,670 new cases of thyroid carcinoma (TC) and 1,690 deaths caused by the disease every year.[2] A surveillance, epidemiology, and end results program (SEER)-based study found that from 1975 to 2009 there was a three-fold increase in incidence rates, from 4.9 to

14.3 per 100,000 individuals, while mortality rates stayed relatively constant at 0.5 deaths per 100,000.[3]

Majority of thyroid swellings are non-neoplastic, only <5% are malignant. Thyroid lesions may be developmental, inflammatory, hyperplastic and neoplastic.[4] About 95% of the TC happen sporadically and inherited in 5%**.** As it is a known fact, malignancies arise due to the accumulation of mutations in genes that directly monitor cell growth and death.[5] Over 90% of TCs are sporadic, with less than 10% being familial. Tumors frequently have genetic alterations leading to the activation of the mitogen- activated protein kinase signaling pathway common mutations in are point mutations of the BRAF and RAS, TERT gene and RET/PTC rearrangement.[6,7]

Papillary thyroid carcinoma (PCT) is the most common type of malignant TC.[8] An earlier diagnosis prompts better prognosis for the patient, delayed diagnosis is related to increased mortality.[9] An increase in the rate of TC cases has been noted over the years, possible contribution is definitely the increase in diagnosis of microcarcinoma and occult disease.[10] In view of the significant numbers of yearly new cases and the importance of early diagnosis for prognosis, it is of importance to study TC and its diagnosis in more detail. The diagnosis of PCT relies on nuclear features optical clearing, elongation, micronuclei and pseudoinclusions. However, morphological overlaps between follicular adenoma, papillary carcinoma and multinodular goitre showing features of papillary budding cause a diagnostic dilemma. In view of these inconsistencies, several immunohistochemistry (IHC) markers have been studied to assess their use in aiding diagnoses.

Galectin-3 (Gal-3) is a component of the beta-galactoside binding lectins. It appears to be involved in the cell-cell and cell–matrix modulation. Therefore, it could play a role in malignant transformation of thyroid cells and expressed in high proportions in carcinomas especially papillary type. Recently, Gal-3 is shown to have utility in differential diagnosis between benign and malignant thyroid lesions.[11] Hector Battifora Mesothelial-1 (HBME-1) is a monoclonal antibody generated against a membrane antigen that exists in the microvilli of the mesothelioma cells. Previous researchers suggested that a high positive rate of HBME-1 was observed in malignant thyroid tissues.[12]

Detecting tumors of benign and malignant category is important because of differences in treatment line and radioablation therapy given and in order to reduce the recurrence rate and improve disease free survival. The gold standard in diagnosis of thyroid lesions is pathologic evaluation using routine hematoxylin and eosin (H and E) staining. However, diagnostic dilemma regarding the morphological overlap between various thyroid neoplasms presents a big challenge for the pathologists. Number of studies have evaluated the value of IHC markers such as Gal-3, HBME-1 results are promising to distinguish benign from malignant thyroid lesions.[11]

The clinicopathological, histopathological and immunohistochemical features collaboratively aid the diagnosis. IHC is now increasingly used in clinical practice for screening patients with thyroid neoplasms. However correct interpretation of IHC stains is critical as each marker has its limitations because of expression in benign thyroid lesions noted to certain extent. Therefore, novel IHC markers or combinations are required to define the criteria for distinction and categorization of benign and malignant thyroid lesions, especially regarding the classification of thyroid follicular lesions.[2]

The objective of our study was to evaluate the role of IHC markers HBME-1, Gal-3 in differentiating benign and malignant thyroid neoplasms and to study statistical significance of IHC markers in a retrospective study done in a tertiary cancer care centre in 50 cases of thyroid neoplasm during September 2019 to February 2021.

METHODS

A retrospective analysis based on data retrieved from the pathology department at Bhagwan Mahaveer Cancer Hospital and Research Centre across a study period of 1.5 years was conducted. The histopathology reports of thyroid neoplasm patients were undertaken from September 2019 to February 2021.

Inclusion criteria

The following inclusion criteria of patients for this analysis were as follows: all lobectomies/hemithyroidectomy/ subtotal thyroidectomy/near total thyroidectomy/total thyroidectomy specimens received at the pathology department, BMCHRC during study period; all age group and both genders are included; and all thyroid lesions including benign as well as malignant.

Exclusion criteria

The exclusion criteria included: incisional biopsies of thyroid lesions; and outside operated cases (where no details are available).

The study was approved by ethical committee and informed consent was obtained, a total of 14,507 patients visited the hospital for various ailments and 10,200 biopsies were sent to our department for histopathological examination, out of which 7200 were diagnosed as malignant cases. Of the 7200 malignant cases, 408 (5.6%) cases were thyroid malignancies.

One hundred forty-five (35.53%) out of 408 thyroid cancer underwent thyroid surgeries, fifty consecutive cases who fulfilled the inclusion criteria were registered in our study. Relevant history, examination findings, age and clinical diagnosis were recorded from hospital registration form.

Gross examination findings of specimens were recorded. All grossed, processed, stained sections of haematoxylin and eosin were reviewed and observed under microscope. All the cases were reported as per CAP protocol thyroid.

Data were described in terms of range; mean±standard deviation (±SD), frequencies (number of cases) and relative frequencies (percentages) as appropriate. For comparing categorical data, Chi square (χ^2) test was performed and exact test was used when the expected frequency is less than 5. A probability value (p value) less than 0.05 was considered statistically significant. All statistical calculations were done using statistical package for the social science (SPSS) 21 version (SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows.

IHC markers HBME-1 and Gal-3 was assessed in all 50 cases, antibodies from Biogenic Life Sciences were used. The clone of antibody used for Gal-3 (A3A12 mouse species), and HBME-1 (A2383 mouse species). Reporting was done according to (by immunohistochemistry) (CAP protocol 2017).

Gal-3

Immunohistochemistry of Gal-3 included: intact cytoplasmic expression, loss of cytoplasmic expression, and cannot be determined (explain).

HBME-1

Immunohistochemistry of HBME-1 included: intact membranous expression, loss of membranous expression, cannot be determined (explain), and background nonneoplastic tissue/internal control (normal thyroidal tissue) with intact cytoplasmic expression.

Expression of markers gal-3: dim focal positive, dim diffuse positive, strong positive, negative HBME-1: focal positive, positive, and negative. Cases were divided into positive, negative immunoexpression.

RESULTS

Age range in this study varies from 22 to 77 years. Youngest case was of 22 years and oldest was 77 years of age. The median age for both male and female was 44.80 years and standard deviation was 15.04. 58% Patients were female while remaining 42% were male, F: M ratio 1.38:1, as illustrated in Table 1. Histological subtypes were categorized. All benign cases 4% were trabecular adenoma (TA) whereas among malignant majority were papillary carcinoma thyroid (PCT) around 72% followed by lesser common follicular carcinoma thyroid (FCT) 14% and least among all follicular variant of papillary carcinoma thyroid (FVPCT) 10%.

Half (1/2) of the benign case underwent lobectomy and other half (1/2) underwent total thyroidectomy. Majority of the patients underwent lobectomy 58% followed by sub-total thyroidectomy 20%, total thyroidectomy 14% and 4% each cases undertook hemithyroidectomy and isthumectomy. Among benign cases (1/2) cases were each multifocal and unifocal. Overall data shows majority tumors were unifocal (62%) whereas multifocal were 38%.

Table 1: Distribution of cases based on demographic profile.

Variables	No.	%
Age group (years)		
<30	8	16.00
31-40	13	26.00
41-50	12	24.00
>50	17	34.00
Total	50	100
Sex		
Male	21	42.00
Female	29	58.00
Total	50	100

In present study conducted, 50 cases were analysed. IHC markers were put in all the cases with 48 neoplastic lesions and 2 benign lesions. Gal-3 expression in terms of cytoplasmic positivity was majority seen as Dim diffuse positivity in 58% of cases followed by strong positivity in 28% cases and Dim focal positivity shown in 10% cases. Negative immunostain expression was noted in 4% cases. Table 2 shows distribution of cases for Gal-3, HBME-1 individual and combined immunohistochemical expression with sensitivity, specificity, positive and negative predictive values.

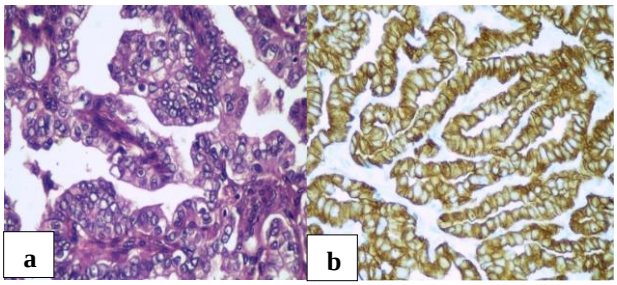

Figure 1: (a) H&E 40X papillary carcinoma thyroid, and (b) membranous immunopositivity of HBME-1 in papillary carcinoma thyroid.

HBME-1 showed positive immunoexpression in 85.4% malignant cases with 14.6% cases showing focal positivity and immunonegative expression for both benign cases as shown in Figure 4c. Among PCT, 13.88% cases showed focal positivity whereas 86.11% cases showed strong positivity, focal positive immunoexpression was seen in 57.14% cases of FCT as shown in Figure 2b and 60% cases of FVPCT with strong positivity in 42.85% FCT cases and 40% cases of FVPCT. HBME-1 showed 100% sensitivity and specificity to differentiate between difficult cases of malignant and benign lesions with statistically significant

p value 0.0001 and 96% disease prevalence ratio. Figures 1a and b shows PCT histology with diffuse HBME-1 membranous positivity. Figures 2a and 4a shows FCT and TA histology.

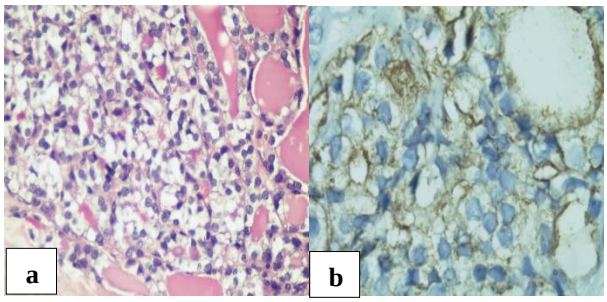

Figure 2: (a) 40X H&E follicular carcinoma thyroid, and (b) focal immunopositive expression of HBME-1 in follicular carcinoma thyroid.

Gal-3 showed strong positivity in 29.2% malignant lesions with dim diffuse positivity and dim focal positivity in 60.4% and 8.3% subsequently with negative immune-expression in 2% cases as shown in Figure 4b. Among benign lesions 50% cases showed immunonegative expression whereas dim focal positive expression was seen in 50% benign cases that contributes 2.3% of all the cases showing immunonegative expression. Among PCT cases, 38.88% cases showed strong immunoexpression followed by dim focal positive in 52.77% cases and dim positive in 5.55% cases and negative expression in 2% cases. FCT cases showed dim focal positive expression in 71.42% cases and dim positive in 28.57% cases whereas follicular variant showed all cases with dim focal positivity. Figure 3b shows FVPCT histology with focal cytoplasmic positivity.

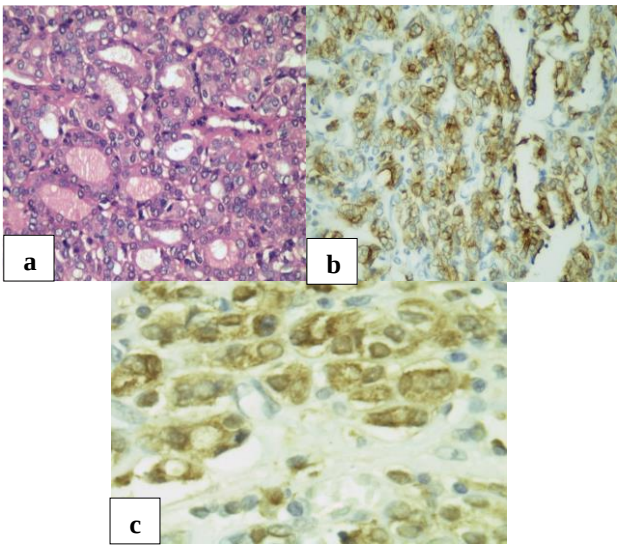

Figure 3: (a) H&E 40X follicular variant of papillary carcinoma thyroid, (b) focal membranous immunopositivity of HBME-1 in follicular variant of papillary carcinoma thyroid, and (c) focal cytoplasmic immunopositivity of gal-3 in follicular variant of papillary carcinoma thyroid.

Table 2: Distribution of cases for Gal-3 and HBME-1, individual and combined Gal-3 and HBME-1 immunohistochemical expression and sensitivity, specificity, positive and negative predictive values with a 95% confidence interval (CI).

Galectin-3	Malignant (%)		Benign (%)	
Gal-3				
Negative	1 (2.1)		1 (50)	
Dim focal+	4 (8.3)		1 (50)	
Dim diffuse+	29 (60.4)		0	
Positive	14 (29.2)		0	
Galectin-3	**Dim focal+**	**Dim diffuse+**	**Positive**	**Negative**
H. sub type				
FCT	2 (40)	5 (17)	0	0
FVPCT	0	5 (17)	0	0
PCT	2 (40)	19 (66)	14(100%)	1(50%)
TA	1 (20)	0	0	1(50%)
HBME-1	**Benign (%)**		**Malignant (%)**	
HBME-1				
Focal+	0		7 (14.6)	
Negative	2 (100)		0	
Positive	0		41 (85.4)	
HBME-1	**Positive**		**Negative**	
H. sub type				
FCT	7 (15)		0	
FVPCT	5 (10)		0	
PCT	36 (75)		0	

Continued.

Galectin-3	Malignant (%)	Benign (%)		
TA	0	2 (100)		
P value	0.0001			
Combined expression of HBME-1 and Gal-3	**Negative**	**Positive**		
H. sub type				
FCT	0	7 (14.2)		
FVPCT	0	5 (10.20)		
PCT	0	36 (73.4)		
TA	1 (100)	1 (2.04)		
Specificity and sensitivity of galectin-3 and HBME-1				
Statistic	**Gal-3**	**95% CI**	**HBME-1**	**95% CI**
Sensitivity	97.92	88.93 to 99.95	100.0	92.60 to 100.00
Specificity	50.00	1.26 to 98.74	100.0	15.81 to 100.00
Positive likelihood ratio	1.96	0.49 to 7.84		
Negative likelihood ratio	0.04	0.00 to 0.45	0.0	
Disease prevalence	96.00	86.29 to 99.51	96.0	86.29 to 99.51
Positive predictive value	97.92	92.16 to 99.47	100.0	
Negative predictive value	50.00	8.44 to 91.56	100.0	
Accuracy	96.00	86.29 to 99.51	100.0	92.89 to 100.00
Specificity and sensitivity of combined expression of HBME-1 and Galectin-3				
Statistic	**Value**	**95% confidence level**		
Sensitivity	100.00	92.60 to 100		
Specificity	50.00	1.26 to 98.74		
Positive likelihood ratio	2	0.50 to 8.00		
Negative likelihood ratio	0			
Disease prevalence	96.00	86.29 to 99.51		
Positive predictive value	97.96	92.31 to 99.48		
Negative predictive value	100.00			
Accuracy	98.00	89.35 to 99.95		

Gal-3: Galectin-3, H. subtype: histological subtype, HBME-1: Hector Battifora Mesothelial-1, FCT: follicular carcinoma thyroid, FVPCT: follicular variant of papillary carcinoma thyroid, PCT: papillary carcinoma thyroid, TA: trabecular adenoma

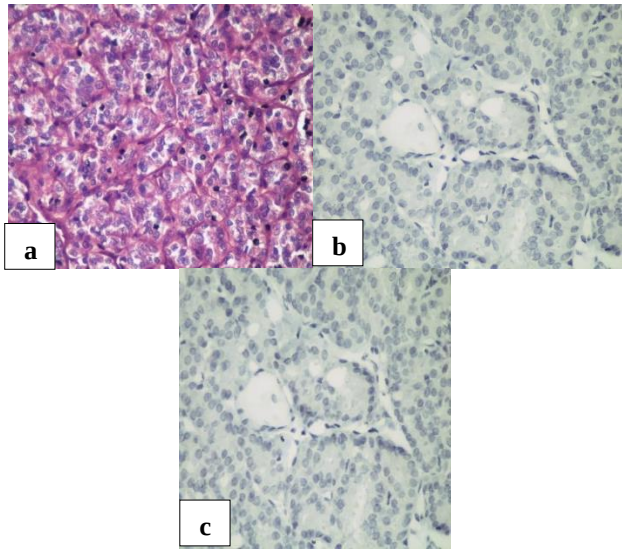

Figure 4: (a) H&E 40X trabecular adenoma, (b) immunonegative expression of galectin-3, and (c) immunonegative expression of HBME-1.

Gal-3 showed 97.92% sensitivity and 50% specificity with 1.96 and 0.04 positive and negative likelihood ratio. 97.92% positive predictive value was seen with 50% negative predictive value. It was found statistically significant to differentiate between malignant and benign lesions of thyroid with p value 0.002.

The novel combination of HBME-1 and Gal-3 showed immunopositivity in 98% cases and negativity in 2% cases with sensitivity of 100% and specificity of 50%. It had positive likelihood ratio 2 with positive and negative predicitive value of 97.96% and 100%. It was found 98% accurate which is more than Gal-3 (96%) however less than HBME-1 (100%).

DISCUSSION

The present study was carried out in department of pathology at Bhagwan Mahaveer Cancer Hospital and Research Centre, Jaipur from September 2019 to February 2021. Fifty consecutive cases who fulfilled the inclusion criteria were registered in our study. Demographic profile, histomorphological profile and IHC was evaluated on all cases.

Females have higher overall incidence of TC as compared to males.[13,14] Simpson et al conducted study on 1074

patients with PCT and 504 with FCT followed for four to 24 years. And stated incidence rate ratio ranging from 5:1. to 3:1 (female to male) has been found.[14] Females had better survival rates than males, p value 0.003 (reported to live maximum 20 years longer than male counterpart). In present study conducted, female to male ratio was 1.38:1, 58% cases were female patients and remaining 42% were male patients. The findings were consistent with above studies.

Rageh et al studied 50 cases each of unifocal and multifocal PCT were taken. It stated multifocality is related to poorer prognosis as it is found associated with increased tumor size (p value <0.05), has higher rate of locoregional recurrence (24%), significant increase in the incidence of cervical lymph nodes metastasis and distant metastasis in multifocality (90%) was found as compared with unifocality (72%).[15] In present study conduted on 50 cases, 38% cases were multifocal and 62% cases were unifocal. The findings were consistent with above studies.

Study done by Modi et al on 100 thyroid specimens ranging in age from 6-70 years stated FA and PCT is the most common type of benign and malignant thyroid tumor.[16] Study conducted by Sreedevi et al on 620 thyroidectomy specimens, classified them into neoplastic and non-neoplastic lesions based on histology. PCT and FA are the commonest malignant and benign lesion respectively.[17] In present study, only 4% benign cases encountered were of TA and among malignant cases 72% cases were PCT followed by FVPCT 10% and 14% cases of FCT. The findings were consistent with above studies.

Study done by Mazzaferri et al on 1355 TC had stated surgery being the main provision for stage II, III cases 51.55% comprising of total or near total thyroidectomies (lobectomy, isthmusectomy or contra-lateral subtotal thyroidectomy), 32.177% cases underwent minor biopsy procedures for lesions, the recurrence rate was significantly high in second group (40%) as compared to first (26%).[18] In present study, all cases including benign and malignant cases underwent surgical maneuvers. Majority of the cases 58% underwent lobectomy followed by sub-total thyroidectomy in 20% cases, 14% underwent total thyroidectomy, 4% each underwent hemithyroidectomy and isthmusectomy. The findings were consistent with above studies.

Arcolia et al aimed for reaching an efficient and accurate differential diagnosis between benign and malignant thyroid lesions for betterment of treatment approach, they aided to resolve this by applying IHC markers Gal-1, 3, 7, 8; HBME-1, thyroid peroxidase (TPO) on two tissue microarrays composed of 66 FA and 66 PCT. This clinical series included 100 women and 32 men. The data revealed that the combination of Gal-3/HBME-1 exhibits high sensitivity and specificity to assess the diagnosis.[19] Sanuvada et al conducted study on the thyroidectomy specimens of 120 cases to know the expression and the diagnostic importance of HBME-1, CK-19, Gal-3 in histopathologically diagnosed non-malignant and malignant cases. Out of the 120 cases,70 were non-malignant and 65 were malignant and 5 being FA. All three markers applied on cases and it was deduced that Gal-3 has highest sensitivity and HBME-1 has highest specificity (independently or in combination).[20]

Zhou et al conducted study on 120 thyroid samples to evaluate the clinical and diagnostic significance of Ki67, CK-19, Gal-3 and HBME-1protein in PCT. The specimens were evaluated for IHC markers. It was deduced that CK-19 and Gal-3 had more sensitivity, HBME-1 had more specificity, Gal-3 was the best marker among these for differential diagnosis.[21] Casey MB conducted study on 30 cases of papillary thyroid hyperplasia and 30 cases of PCT. IHC markers were put CK-19, Gal-3 and HBME-1, Gal-3 showed 100% sensitivity and 40% specificity with strong immunoexpression in 18 cases and rest showing focal staining. HBME-1 stained 27 cases strong positive and rest 3 focal positive showing 100% sensitivity and 96.7% specificity to differentiate between benign and malignant lesions.[22]

In present study conducted, Gal-3 showed positivity in 96% cases. Statistically significant p value 0.002 value was found to differentiate between benign and malignant cases with 97.92% sensitivity and 50% specificity. HBME-1 showed positivity in 96% cases (all malignant cases) whereas 4% benign cases showed negative expression. Majority cases 85.4% showed diffuse positivity whereas 14.6% cases comprising of FCT and FVPCT showed focal positivity. Statistically significant p value 0.0001 was found to differentiate between malignant and benign cases with 100% sensitivity and specificity. The findings were consistent with above studies.

Various studies have shown the ability of Gal-3 and HBME-1 to discriminate thyroid cancer from benign thyroid nodules. Thus, use of Gal-3 and HBME-1 expression represents a promising adjunctive test that aids in thyroid cancer diagnosis.

In our study following limitations were encountered the histopathological examination is the gold standard for the diagnosis of thyroid neoplasms. However, the morphological overlap is often found in various cases and analysis is difficult. Numerous studies have found statistically significant inter and intra-observer variation in categorizing benign and malignant cases, however, IHC is expensive so it cannot be used for screening of all thyroid neoplams. Thus, the clinicopathological and histopathological features that will be used in the selection of the patients to be referred to IHC diagnosis must be clarified. Categorizing tumors as benign and malignant is important because of differences in line to surgery correlating to poor prognosis of malignancies, high recurrence rate and radioablation therapy, in order to improve the disease free survival rate of the patient. However, the value of clinical use of these markers is still

in debate, because positivity is also reported in benign cases.

CONCLUSION

Amongst the 50 neoplastic thyroidectomy specimens analysed, the commonest benign lesion encountered was trabacular adenoma and the commonest malignant lesion encountered was papillary carcinoma thyroid. Gal-3 and HBME-1 were highly expressed in TC, but not in normal thyroid tissue and infrequently in benign thyroid lesions. To conclude Gal-3 and HBME-1 are useful markers in differentiating benign and malignant thyroid neoplasms, aids in TC diagnosis, target oriented therapies and acts as an adjunctive ancillary technique in TC diagnosis.

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REFERENCES

1. Arcolia V, Journe F, Renaud F, Leteurtre E, Gabius HJ, Remmelink M, et al. Diagnostic performances of individual or combined thyroid markers. Oncol Lett. 2017;14:4183-9.
2. Matos LL, Giglio ABD, Matsubayashi O, Farah MDL, Giglio AD, Pinhal MADS. Expression of CK-19, galectin-3,HBME-1 in the differentiation of thyroid lesions:systemic review and meta-analysis. Diagnostic Pathol. 2012;7:97.
3. Davies L, Welch HG. Current Thyroid Cancer Trends in the United States. JAMA Otolaryngol Head Neck Surg. 2014;140(4):317-22.
4. Gopal MR, Rao KJ, Sai AR. Clinico-pathological study of thyroid lesions over a period of one year in a tertiary care centre. Jemds. 2018;7(31):3513-7.
5. Luzon-Toro B, Fernandez RM, Villalba-Benito L, Torroglosa A, Antinolo G, Borrego S. Influencers on thyroid cancer onset: Molecular genetic basis. Genes (Basel). 2019;10(11):913.
6. Xing M. Molecular pathogenesis and mechanisms of thyroid cancer. Nat Rev Cancer. 2013;13(3):184-99.
7. Cancer Genome Atlas Research Network. Integrated genomic characterization of papillary thyroid carcinoma. Cell. 2014;159(3):676-90.
8. Longo DL, Kasper DL, Jameson JL, Fauci AS, Hauser SL, Loscalzo J. Harrison's Principles of Internal Medicine, 16th ed.; McGraw-Hill Publishers: New York, NY, USA. 2012.
9. Xu D, Wang L, Long B, Ye X, Ge M, Wang K, et al. Radiofrequency ablation for postsurgical thyroid removal of differentiated thyroid carcinoma. Am J Transl. 2016;8:1876-85.
10. Chen AY, Jemal A, Ward EM. Increasing incidence of differentiated thyroid cancer in the United States, 1988–2005. Cancer. 2009;115:3801-7.
11. Alshenawy HA. Utility of immunohistochemical markers in differential diagnosis of follicular cell derived thyroid lesions. Pathol Oncol Res. 2014;20(4):819-28.
12. Zhou Y, Chen Z-H, Lu B-H, Jiang H-G. Diagnostic significance of Ki67, CK-19,Gal-3 and HBME-1expression for papillary thyroid microcarcinoma. Biomed Res. 2017;28(9):4002-6.
13. Tubiana M, Schlumberger M, Rougier P, Laplanche A, Benhamou E, Gardet P, et al. Long-term results and prognostic factors in patients with differentiated thyroid carcinoma. Cancer. 1985;55(4):794-804.
14. Simpson WJ, McKinney SE, Carruthers JS, Gospodarowicz MK, Sutcliffe SB, Panzarella T. Papillary and follicular thyroid cancer Prognostic factors in 1,578 patients. Am J Med. 1987;83(3):479-88.
15. Rageh TM, Samaka RM, Hagag MG, Motawa EA. Relationship between focality and cervical lymph nodes metastasis in papillary thyroid carcinoma. Int Surg J. 2019;6(2):453.
16. Sreedevi AR, Sheela KM. Histopathological Spectrum of Non-Neoplastic and Neoplastic Lesions. J Med Clin Res. 2018;6(6):514-9.
17. Modi M, Daveshwar M. Study of histopathological pattern of thyroid lesions. Int J Biomed Adv Res. 2018;9(1):27-36.
18. Mazzaferri EL, Jhiang SM. Long-term impact of initial surgical and medical therapy on papillary and follicular thyroid cancer. Am J Med. 1994;97(5):418-28.
19. Arcolia V, Journe F, Renaud F, Leteurtre E, Gabius HJ, Remmelink M, et al. Diagnostic performances of individual or combined thyroid markers. Oncol Lett. 2017;14:4183-9.
20. Sanuvada R, Nandyala R, Chowhan AK, Bobbidi P, Yootia M, Hulikal N, et al. Value of Cytokeratin-19,Hector Battifora Mesothelial-1 and Galectin-3 immunostaining in the diagnosis of thyroid neoplasms. J Lab Physicians. 2018;10(2).
21. Zhou Y, Chen Z-H, Lu B-H, Jiang H-G. Diagnostic significance of Ki67, CK-19,Gal-3 and HBME-1expression for papillary thyroid microcarcinoma. Biomed Res. 2017;28(9):4002-6.
22. Casey MB, Lohse CM, Lloyd RV. Distinction between papillary thyroid hyperplasia and papillary thyroid carcinoma by immunohistochemical staining for cytokeratin 19, galectin-3, and HBME-1. Endocr Pathol. 2003;14(1):55-60.

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