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Original Research Paper

Pathology

IMMUNOHISTOCHEMICAL EXPRESSION OF GATA 3 IN UROTHELIAL CANCER – AN INSTITUTIONAL EXPERIENCE

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ABSTRACT **Introduction:** GATA-3 binding protein has been described as a diagnostic immunohistochemical marker for urothelial cancer with high sensitivity and specificity. The purpose of this study was the evaluation of immunohistochemical expression of GATA-3 in urothelial cancer. **Material And Methods:** It was observational study where 50 consecutive cases of urothelial carcinoma were included between May 2023 and April 2024. All the cases were histopathologically evaluated and immunohistochemically stained for GATA-3 binding protein. Only nuclear staining was evaluated on the basis of intensity as well as percentage. **Result:** GATA-3 expression were seen in 84 % cases of urothelial cancer. GATA-3 expression were significantly correlated with histological grade and muscle invasion with weaker or negative expression was seen in high grade and muscle invasive tumor as compared to low grade and non- invasive neoplasm . Significantly weaker expression of GATA-3 was observed in cases with severe nuclear pleomorphism, mitosis > 10/10 hpf , presence of necrosis. **Conclusion:** GATA-3 is a sensitive marker for urothelial cancer. GATA-3 can be effectively used in predicting the probable grade and invasion in biopsy tissue with poor morphological characteristic.

KEYWORDS : GATA-3 , Urothelial Cancer , Immunohistochemistry, Senstivity, Grade of tumor.

INTRODUCTION

Bladder cancer ranks 10th in the world in terms of incidence. India ranks 17th in terms of the number of cases and 19th in terms of the number of deaths. The incidence of these cases varies within the Indian population. The incidence of bladder cancer varies considerably in different geographical regions of the world.[1] Urothelial carcinoma accounts for approximately 90% of malignancies of the bladder.[2] Occupations that are particularly susceptible to exposure to aromatic amines include rubber workers, hairdressers, painters, leather workers, aluminum workers, petroleum workers and others.[3]The main symptom that indicates bladder cancer is painless hematuria.[4,5] Urothelial carcinoma is divided into two categories depending on the extent of invasion into the bladder wall: non-muscle invasive bladder cancer (NMBC) and muscle invasive bladder cancer (MIBC). Despite extensive surgery and additional therapeutic measures, the 5-year overall survival (OS) rate for muscle-invasive bladder cancer (MIBC) is approximately 36%.[6] Invasive high grade urothelial cancer may be difficult to distinguish from other genitourinary lesion such as prostatic and renal carcinoma.[7-9]

Urothelial carcinoma (UC) has a remarkable propensity for divergent differentiation, resulting in a number of different histologic variants. Several forms of urothelial carcinoma, including micropapillary, plasmacytoid, small cell and sarcomatoid variants, have very aggressive features and are associated with unfavorable clinical outcomes.[6] Immunohistochemistry is often used to distinguish between the different diagnoses.[7]

GATA binding protein 3 (GATA-3) is an immunohistochemical marker that has high sensitivity and specificity in identifying urothelial differentiation.GATA-3 is a transcription factor that belongs to the GATA family. Compared to other markers associated with urothelial cells, GATA-3 has a higher sensitivity than uroplakin III and a higher specificity than p63, S100P and thrombomodulin.[10-12] There have been few studies done to study expression in different grade, stage and histological variants of urothelial cancer with variable results.[13-16]

MATERIAL AND METHOD

The present observational study has been conducted in the Department of Pathology, B.R.D. Medical college Gorakhpur, from May-2023 to April -2024. Total 50 cases of urothelial carcinoma were taken and after taking informed and written consent, histopathological diagnosis was made and immunohistochemical study of GATA-3 immunostain by using avidin biotin peroxidise. Neuroblastoma tissues taken as positive control.

Clinicoradiological suspected cases included, previuos biopsy tissue of cases in follow up and patients who agreed to sign on consent form. Poorly preserved and inadequate samples, autolysed samples and cases in which proper clinical history and radiological details not available were excluded from the study.

Histopathological examination – Biopsy samples were collected and fixed in 10% formalin, after processing paraffin embedded tissue blocks were prepared. Thin sections of 3-4 micron were cut, after dewaxing stained by hematoxylin and eosin stain and histopathological examination was done. Freshly cut sections were also used for immunostaining

Evaluation Of Immunohistochemical Staining Of GATA 3

Immunoreactivity was evaluated on the basis of percentage (%) of cells stained, pattern of staining (nuclear staining) and intensity of the stain. Standard slides were examined under high power (40x) of microscope and this was followed by counting of the cells. Random ten high power fields were selected, and cells were counted in each field in a zig zag fashion.

A scale of 0 to 4+ was used.

Percentage Of Tumor Cells Stained By GATA-3 Was Scored As Follows:

Scoring of GATA-3 immunoexpression Percentage of the stained cells(%)

1. No tumor cells stained
2. 1 to 10% positive cells
3. 11 to 50% positive cells
4. 51 to 80% positive cells
5. 81 to 100% positive cells

Staining Intensity Of Tumor Cells By GATA-3 Was Scored As Follows:

Scoring of GATA-3 Intensity of nuclear staining

1. No nuclear staining of tumor cells
2. Weak nuclear staining
3. Moderate nuclear staining
4. Strong nuclear staining

Immunoreactivity Score For GATA-3

Immunoreactivity score was calculated by multiplying the number representing percentage of immunoreactive tumor cells by number representing nuclear staining intensity and finally cases were categorize into 4 groups

Group	Immunoreactivity score	Interpretation
1	0 – 1	Negative
2	2 – 4	Weakly positive
3	5 – 8	Moderately positive
4	9 – 12	Strongly positive

Statistical Analysis

Appropriate statistical tools were adopted for the data analysis. Analysis was done by data sorting method, classified by tabulation and presentation by pie charts, and histograms. Chi-square test was employed to find out the significance of the study and a p-value of <0.05 was considered significant.

A statistician's help was sought for the interpretation of the results.

RESULTS

The study included 50 cases of urothelial carcinoma out of which 32% cases were non-invasive UC and 68%cases were invasive UC. There was male predominance with M-F = 6.14:1. Most common age group was 61-70 years (40%) and only 4% patient were aged <40 years. Demographic, clinical presentation, risk factors of all cases were shown in table -1.

Table- 1: Patients Demography Details, Clinical Presentation And Risk Factors

	Number of patients	Percentage
Age group (years) (n=50)		
21-40	02	4
41-60	18	36
61-80	30	60
Gender distribution (n=50)		
Male	43	86
Female	07	14
Personal habits (n=50)		
Smoking and tobacco	20	40
Smoking only	17	34
Tobacco only	10	20
Occupational exposure	02	04
Alcohol	01	02
Clinical presentation		
Hematuria	45	90
Urinary outflow obstruction	28	56
Dysuria	27	54
Weight loss	14	28

GATA 3 expression was analyzed on paraffin embedded tissue sections in accordance with immunoreactivity score. GATA 3 expression was noted in 84% of the cases of urothelial carcinoma, nuclear positivity was seen in malignant urothelial cells and in 16% cases no GATA 3 expression was seen. (Table-2)

Table 2: Distribution Of Cases According To GATA-3 Expression

GATA-3 expression	Number of cases	Percentage (%)
Present	42	84%
Absent	8	16%
Total	50	100%

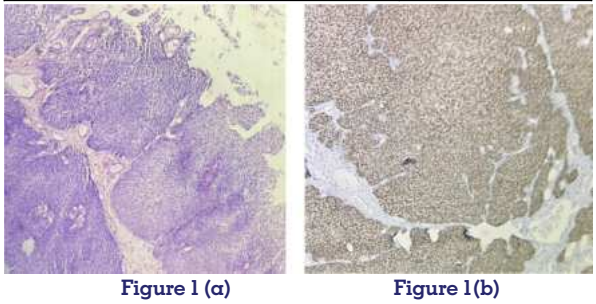

Figure 1 (a) Figure 1(b)

FIgure 1: (a)Hematoxylin and eosin(100X) Low grade non-invasive urothelial carcinoma and corresponding, figure 1 (b) GATA 3 Immunostaining Showing Strong Positivity in non-invasive urothelial carcinoma.

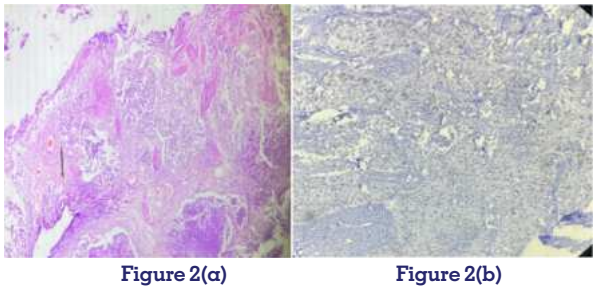

Figure 2(a) Figure 2(b)

Figure 2(a) Hematoxylin and eosin (100X) Muscle invasive urothelial carcinoma and corresponding, Figure 2(b) showing weak GATA 3 Immunohistochemical staining in muscle invasive urothelial carcinoma.

Table 3 : Distribution Of Cases Into Group According To GATA 3 Expression

Immunoreactivity score for GATA-3	Group	Number of cases	Percentage (%)
0-1 (Negative)	I	08	16
2-4 (Weak)	II	12	24
5-8 (Moderate)	III	11	22
9-12 (Strong)	IV	19	38

Variable expression of GATA-3 was seen among the group of urothelial patients and distribution of patients into group was based on immunoreactivity score of GATA-3 expression. Out of 50 cases 19 (38%) cases show strong, 11 (22%) cases moderate and 12 (24%) cases weak expression of GATA-3. In 8 (16%) cases there was no GATA 3 expression seen. (Table-3)

GATA 3 expression significantly correlated with histological

grade (p <0.00001) and invasion (p <0.002) in such a way that low grade and non- invasive urothelial carcinoma showed moderate to strong expression while weak or no expression was seen in high grade and invasive urothelial carcinoma. (Figures 1and 2).

There was no significant association found between GATA 3 expression and clinical presentation, age, gender, risk factors, site of lesion.

When GATA 3 expression was correlated with other histopathological parameters, there was significant association was observed with nuclear pleomorphism, mitosis and necrosis. Negative or weak GATA 3 expression was found with marked nuclear pleomorphism, necrosis and increased mitotic activity.Lymphovascular invasion and perineural invasion was not found to be statistically significant. (Table-4)

Table 4: Intergroup Comparison Of GATA 3 Expression With Histopathological Findings

Histopathological Parameters	Total (n=50)	Group I (n=)		Group III (n=)		Group III (n=)		Group IV (n=)	
		No.	(%)	No.	(%)	No.	(%)	No.	(%)
Grade (n=50)									
Low	20	00	00	00	00	08	16	12	24
High	30	09	18	12	24	05	10	04	08
	Chi square = 24.67 p value <0.00001								
Invasion (n=34)									
Non-invasive	16	00	00	01	02	05	10	10	20
Lamina propria	24	05	10	08	16	05	10	06	12
Muscle	10	04	08	05	10	01	02	00	00
	Chi square = 20.09 p value = < 0.002								
Nuclear pleomorphism									
Mild	06	00	00	00	00	02	04	04	08
Moderate	16	01	02	03	06	07	14	05	10
Severe	28	11	22	12	24	03	06	02	04
	Chi square = 24.03 p value <0.0005								
Mitosis									
<5/10hpf	12	00	00	00	00	05	10	07	14
5-10/10hpf	15	01	02	03	06	06	12	05	10
>10/10hpf	23	10	20	07	14	03	06	03	06
	Chi square = 21.59 p value < 0.001								
Necrosis									
Present	27	10	20	09	18	04	08	04	08
Absent	23	02	04	02	04	11	22	08	16
	Chi square = 14.15 p value < 0.002								
LVI									
Yes	09	03	06	04	08	01	02	01	02
No	41	05	10	08	16	10	20	18	36
	Chi square = 6.65 p value = 0.08								
PNI									
Yes	02	01	02	01	02	00	00	00	00
No	48	08	16	10	20	14	28	16	32
	Chi square= 3.1 p value = 0.36								

DISCUSSION

Carcinoma of the bladder is the most frequent, accounting for 90% of all instances of urothelial origin, and is classified as dysplasia, Carcinoma in situ (CIS), various kinds of invasive urothelial carcinoma, and metastatic carcinoma [17].IHC is a tissue-based technique useful by pathologists as a diagnostic tool and prognostic predictor for patients with cancer that is often performed in cancer studies. In BC, staging and establishing the tumor origin of metastasis evaluation is critical for differential diagnosis and classification in NMIBC and MIBC, and IHC is a non-expensive and widely available technology. Various novel antibodies in refrence to urothelial carcinoma include high-molecular weight cytokeratins, cytokeratin 7, cytokeratin 20, p63, thrombomodulin and GATA-3.(18)

GATA3 protein, discovered as a significant biomarker for UC, acts as a transcription factor driving hematopoiesis, T-cell development, proliferation, and differentiation of epithelial tissues [19]. ***Higgins et al.[20]***were the first to explore GATA-3 expression as an IHC marker for urothelial carcinomas and suggested it to be highly sensitive and specific for urothelial carcinomas with different percentage positivity in various grades and variants of urothelial carcinoma.[4] In the present study, GATA-3 positivity was seen in 84% of cases of urothelial carcinomas. This finding is in close approximation to previous studies of ***Liu et al.***[16]who found 86% of cases with GATA-3 positivity, ***Leivo et al.***[21] with 99% of cases with positive immune expression. Similar findings were noted in previous studies of **Maheshwari et al**[22], reported 85 % GATA-3 expression. **H Agarwal et al**[23]observed GATA-3 immunoexpression in 77% cases of urothelial carcinoma. **K Chandra et al**[24]who found 93.2% cases of GATA-3 positivity.

In the present study most common lesion were invasive urothelial carcinoma 66% cases comprising of 58% cases of invasive high-grade UC and 8% cases of low-grade malignancy. Non-invasive papillary UC was reported in 24% cases, papillary urothelial neoplasm of low malignant potential was reported in 6% cases.60% cases were found in high grade UC and 40% cases were in low grade UC.

On IHC evaluation, 8 (40%) cases showed moderate GATA-3 expression and 12 (60%) cases showed strong GATA-3 expression in low grade carcinoma, among 30 cases of high-grade UC, GATA- expression was seen in 21 (70%) cases and 9 (30%) cases of high-grade UC showed no GATA-3 expression. A statistically significant correlation (p - 0.00001) of GATA-3 expression with grade of UC was seen in our study.

Agarwal H etal[23]**,** stated in their study that all 24 (100%) cases of low-grade UC showed moderate to strong positivity for GATA-3.

In the present study, 16 cases of non-invasive UC were showed 100% positive GATA-3 expression. Among 16 cases, 10 (62.5%) cases were strongly positive, 5 (31.25%) cases were moderately positive, and 1 (6.25%) case was weakly positive for GATA-3.

GATA- 3 expression in lamina propria invasive cases of UC were detected in 19 (77%) and among these 19 cases, weak expression in 8 (33.3%) cases, moderate expression in 5 (20.8%) cases, strong expression in 6 (25%) cases, and in 5 (20.8%) cases no GATA-3 expression was seen.In 10 cases of muscle invasive UC, 6 cases were showed GATA-3 expression. Statistically positive (p <0.002) correlation was seen in GATA-3 expression and invasion. **Agarwal H et al**[23]**,** in their study stated that all non-invasive UC showed GATA-3 expression while cases with lamina propria invasion GATA-3 expression was noted in 19 (79%) cases and in muscle invasive UC GATA-3 expression noted in 23 (65.7%) cases.

Contradict findings were seen in study of **Maheshwari et al**[22], in which 23 cases of lamina propria invasive UC showed 100% GATA-3 expression.

In current study, cases with mild nuclear pleomorphism (n=6), all 6 cases show 100% GATA-3 positivity with strong in 4 (66%) and moderate in 2 (33%) cases.

UC with moderate nuclear pleomorphism (n=16) showed GATA-3 expression in 15 (92.75%). Among these 15 cases, strong positive in 5 (33%), moderate positive in 7 (46%), weak positive in 3 (20%) and negative in 1 (2%) case.

Cases with severe nuclear pleomorphism (n=28), in 17

(60.1%) cases GATA-3 expression was seen. Out 17 cases, negative GATA-3 expression was seen in 11 (64%) cases, 12 (70%) cases showed weak GATA-3 expression. 5 (10%) cases showed moderate to strong GATA-3 expression.

Similar observations were made by **Agarwal H et al**[23], **Chandra K et al**[24]study.

In our study, on analyzing immunohistochemistry on the basis of mitotic count we observed that 100% GATA-3 expression was seen in all 12 cases with mitosis <5/10hpf. Among these 12 cases, in 7 (58.3%) cases strong expression and in 5 (41.6%) cases moderate GATA-3 expression was found.

UC cases with mitotic count 5-10/10hpf (n=15) showed positive expression of GATA -3 in 14 (93.33%) cases. Out of these 14 cases, strong expression in 5 (35.7%) cases, moderate expression in 6 (42%) cases, weak expression 3 (21.42%) cases and in 1 (7.1%) case no GATA-3 expression noted.

UC cases with mitosis >10/10hpf (n=23) positivity for GATA-3 was seen in 13 (56%) cases, in which cases with strong expression in 3(13%) cases, moderate expression 3 (56%) cases, weak expression in 7 (30.4%) cases and no expression was observed in 10 (20%) cases of UC.

On immunohistochemical examination, we found UC cases with necrosis (n=27) showed GATA- 3 expression in 17 (62.97%) cases. In UC cases with absent necrosis, GATA-3 expression was seen in 21 (91.3%) cases of UC. Our findings were comparable with studies done earlier by **Agarwal et al**[23], **Maheshwari et a**[22].

Agarwal et al[23] concluded that GATA-3 expression in cases with necrosis were 28 (68.29%) and GATA-3 expression in cases without necrosis were 21 (91.3%).

Maheshwari et al[22] noted GATA-3 expression in UC with necrosis in 18(81.8%) cases and GATA-3 expression in UC without necrosis in 16 (88.8%) cases.

In current study it was observed that GATA-3 expression seen in 6 (66.6%) cases in which lymphovascular invasion present and UC without lymphovascular invasion showed GATA-3 expression in 36 (87.8%) cases. There was no significant correlation observed in GATA-3 expression and LVI.

Agarwal et al[23]also reported similar findings in their study as mentioned in above table i.e. GATA- 3 expression in cases with LVI were 10(58.8%) and GATA-3 expression in cases without LVI were 47(82.45%).

Maheshwari et al[22]showed GATA-3 expression in UC with LVI were 2 (33.3%) and UC without LVI showed GATA-3 expression in 32(94.1%) cases. In our study, GATA -3 expression in UC with perineural was seen in 1 (52%) cases and GATA- 3 expression in UC without perineural invasion was seen in 40 (83.3%) cases. Statistically no significant correlation was seen in GATA-3 expression and perineural invasion.

Similar findings were observed by **Agarwal et al**[23] as they reported GATA-3 expression in 3 (50%) cases and GATA-3 expression in UC without perineural invasion seen in 54 (79. 41%) cases.

Hence we found that GATA-3 plays important role in differentiating between low grade and high-grade urothelial cancers. We also observed a statistically significant correlation between GATA-3 expression and nuclear pleomorphism, mitosis, necrosis in urothelial carcinoma GATA-3 has an important role in differentiating the non-invasive UC from invasive UC and helps in deciding the further management and treatment of Urothelial Cancer patients.

CONCLUSION

In the present study, GATA-3 shows significantly higher expression in non-invasive and non-muscle invasive urothelial cancer compared to muscle invasive urothelial cancer. In addition GATA 3 expression decreases with high grade, increasing nuclear pleomorphism, mitosis and presence of necrosis. . In current study, it was observed that GATA-3 expression decreases as tumor progresses to invasion. Our study findings suggest that GATA-3 can be used as sensitive and effective marker for urothelial carcinoma cases.

REFERENCES

1. Bray F, Colombet M, Mery L, Piñeros M, Znaor A, Zanetti R, et al. Cancer Incidence in Five Continents. . 2017;11 Available from: https://www.publications.iarc.fr/databases/iarc-cancerbases/cancer-incidence-in-five-continents-Vol.-XI-2017 [Last accessed on 2020 Jun 03]
2. National Centre for Disease Informatics and Research. Time Trends in Cancer Incidence Rates 1982-2010. 2013. Bengaluru: National Centre for Disease Informatics and Research; Available from: https://www.icmr.nic.in/sites/default/files/reports/preliminary_pages6.pdf [Last accessed on 2020 Jun 03]
3. Gersten O, Wilmoth JR. The cancer transitioning Japan since 1951. Demogr Res. 2002;7:271-306.
4. Omran AR. The epidemiologic transition. A theory of the epidemiology of population change. Milbank Mem Fund Q. 1971;49:509-38.
5. American Cancer Society. Cancer Facts and Figures 2014. 2014. Atlanta: American Cancer Society; Available from: https://www.cancer.org/research/cancer-facts-statistics/all-cancer-facts-figures/cancer-facts-figures-2014 [Last accessed on 2020 Jun 03]
6. Pons F, Orsola A, Morote J, Bellmunt J. Variant forms of bladder cancer: basic considerations on treatment approaches. Curr Oncol Rep 2011;13:216-21.
7. Kaufmann O, Volmerig J, Dietel M. Uroplakin III is a highly specific and moderately sensitive immunohistochemical marker for primary and metastatic urothelial carcinomas. Am J ClinPathol 2000;113: 683-7.
8. Patient RK, McGhee JD. The GATA family (vertebrates and invertebrates). CurrOpin Genet Dev 2002;12:416-22.
9. Higgins JP, Kaygusuz G, Wang L, et al. Placental S100 (S100P) and GATA3: markers for transitional epithelium and urothelial carcinoma discovered by complementary DNA microarray. Am J SurgPathol 2007;31:673-80
10. Ko LJ, Yamamoto M, Leonard MW, et al. Murine and human Tlymphocyte GATA-3 factors mediate transcription through a cisregulatory element within the human T-cell receptor delta gene enhancer. Mol Cell Biol 1991;11:2778-84.
11. Asselin-Labat ML, Sutherland KD, Barker H, et al. Gata-3 is an essential regulator of mammary-gland morphogenesis and luminal-cell differentiation. Nat Cell Biol 2007;9:201-9.
12. Esheba GE, Longacre TA, Atkins KA, Kristen A. Higgins JP. Expression of the urothelial differentiation markers GATA3 and placental s 100 (S 100P) in female genital tract transitional cell proliferations. Am J SurgPathol2009;33:347-53.
13. Chou J, Provot S, Werb Z. GATA3 in development and cancer differentiation: Cells GATA have it! J Cell Physiol 2010;222:42-9.
14. Zheng R, Blobel GA, GATA transcription factors and cancer. Genes Cancer 2010:1:1178-88.
15. Chang A, Amin A, Gabrielson E, Illei P, Roden RB, Sharma R, et al. Utility of GATA3 immunohistochemistry in differentiating urothelial carcinoma from prostate adenocarcinoma and squamous cell carcinomas of the uterine cervix, anus, and lung. Am J clinPathol 2012:36:1472-6.
16. Liu H, Shi J, Wilkerson ML. Immunohistochemical evaluation of GATA3 expression in tumors and normal tissues: A useful immunomarker for breast and urothelial carcinomas. Am J ClinPathol 2012;138:57-64.
17. Jonathan Willner, Ammar Matloob, Anges Colanta, Samer N. Khader, Educational Case: Urothelial Carcinoma: An Overview of Pathologic Diagnosis,Academic Pathology,Volume 7,2020.
18. Barbadilla, Tatiana & Pérez, Martina & Cuadra, Juan & Vera, Mª & Arco, Fernando & Muñoz, Isabel & Blanca, Rocío & Herrera Imbroda, Bernardo & Matas-Rico, Elisa & Martín, Mª. (2024). The Role of Immunohistochemistry as a Surrogate Marker in Molecular Subtyping and Classification of Bladder Cancer. Diagnostics. 14. 2501. 10.3390/diagnostics14222501.
19. Wan YY. GATA3: a master of many trades in immune regulation. Trends Immunol. 2014 Jun;35(6):233-42. doi: 10.1016/j.it.2014.04.002. Epub 2014 Apr 28. PMID: 24786134; PMCID: PMC4045638.
20. Higgins JP, Kaygusuz G, Wang L, et al. Placental S100 (S100P) and GATA3: markers for transitional epithelium and urothelial carcinoma discovered by complementary DNA microarray. Am J Surg Pathol. 2007;31:673–680.
21. Leivo MZ, Elson PJ, Tacha DE, Delahunt B, Hansel DE. A combination of p40, GATA-3 and uroplakin II shows utility in the diagnosis and prognosis of muscle-invasive urothelial carcinoma. Pathology. 2016 Oct;48(6):543-9. doi: 10.1016/j.pathol.2016.05.008. Epub 2016 Sep 2. PMID: 27594510.
22. Harshaa Maheshwari, S.R. Negi , Nitesh Samriya, GATA3 Immunohistochemistry Expression in Differentiating Metastatic Lesions of Bladder from Urothelial Carcinomas of Bladder, International Journal of Pharmaceutical and Clinical Research 2023; 15(8); 671-679..
23. Agarwal H., Babu S, Rana C, Kumar M, Singhai A, Shankhwar NS, et al. Diagnostic utility of GATA3 immunohistochemical expression in urothelial carcinoma Indian J Pathol Microbiol. Apr-Jun 2019;62(2):244- 250.
24. Chandra, Kalpana; Mishra, Anuja; Singh, Sanjeet Kumar; Kumar, Nidhish; Upadhyay, Rohit1; Kumar, Umesh; Atique, Amad; Singh, Tanwi2. Role of GATA-3 Expression in Urothelial Carcinoma and ITS Correlation with p53 by Immunohistochemistry. Journal of Datta Meghe Institute of Medical Sciences University 18(3):p 392-397, Jul–Sep 2023. | DOI: 10.4103/jdmimsu.jdmimsu_466_21