



RESEARCH ARTICLE

ROLE OF IMAGE GUIDED FINE NEEDLE ASPIRATION CYTOLOGY IN DIAGNOSIS OF
RETROPERITONEAL LESIONS- A STUDY AT A TERTIARY CARE CENTRE

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Abbreviations

CT: Computer tomography
FNAC: Fine needle aspiration cytology
IDC: Infiltrating ductal carcinoma
NH: Non hodgkins lymphoma
USG: Ultrasonography

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ABSTRACT

Introduction: Image guided fine needle aspiration biopsy of retroperitoneal masses is an increasingly common diagnostic procedure in oncology (Porter, 1981). It has brought a revolution in the field of cytopathological diagnosis of a less accessible site like retroperitoneum. **Aims and Objectives:** The aim of our study was to assess efficiency of image guided FNAC in pre-operative diagnosis and management of retroperitoneal lesions. **Material and Methods:** The study was conducted over a period of three years from June 2014 to June 2017. It included analysis of 108 patients who presented clinically and radiologically with retroperitoneal lesions. **Results:** Out of the total 108 retroperitoneal lesions studied with majority of the patients belonging to the age group of 51-60 years (39.13%). The study revealed a male predominance (58.3%). The malignant lesions predominated and constituted a total of 61 (56.4%) cases. Majority of the cases were from the pancreas (62.9%) followed by kidney (23.2%). Among the pancreatic lesions adenocarcinoma (63.9%) was the most common tumor. RCC constituting 47.4% of the renal lesions was the most common. Among the retroperitoneal lymph nodes also metastatic adenocarcinoma (40%) was the most common lesion. Histopathological correlation could be done in 38 cases and all 38 cases were compatible with the cytological diagnosis. **Conclusion:** The study revealed that image guided FNAC is an excellent diagnostic modality and shows high accuracy and high sensitivity in diagnosing retroperitoneal lesions with minimal complications

INTRODUCTION

Image guided fine needle aspiration biopsy of retroperitoneal masses is an increasingly common diagnostic procedure in oncology (Porter, 1981). It has brought a revolution in the field of cytopathological diagnosis of a less accessible site like retroperitoneum (Ghazala Mehdi *et al.*, 2013). The problem with dealing retroperitoneal masses is due primarily to their uninhibited growth with no facial boundaries often leading to the large size attained before the development of symptoms and the establishment of a diagnosis (Murtaza *et al.*, 2008) The proximity to vital vascular and neural structures as well as intra-abdominal organs add to the problem (Murtaza *et al.*, 2008). In the majority of cases, there is a known history of malignancy, and FNAC is performed either to confirm or exclude the presence of metastasis (Agarwal *et al.*, 1997; Mondal, 2002). Fine Needle Aspiration Cytology is a simple, safe, inexpensive and rapid procedure which renders surgical intervention and exploratory laprotomy unnecessary (Langlois, 1999). Amongst the various imaging modalities, many prefer the speed of ultrasound guidance being (versatile, inexpensive,

no ionising radiation while others are reassured by the greater resolution of computed tomography (Langlois, 1999). The aim of our study was to assess efficiency of image guided FNAC in pre-operative diagnosis and management of retroperitoneal lesions. Our objectives were to assess the cytomorphological features, anatomic site wise distribution, age and sex distribution of the patients with retroperitoneal lesions, to classify the malignant lesions and non malignant lesions, and to correlate the histopathological diagnosis with cytological diagnosis wherever possible.

MATERIAL AND METHODS

Ours was an observational study conducted in the department of pathology, SKIMS for a period of three years from June 2014 to June 2017. It included analysis of 108 patients who presented clinically and radiologically with retroperitoneal lesions. Aspirations were performed using 18-22 gauge needles of suitable length. The aspirate was forcibly ejected on the glass slide to check the onspot adequacy using the diff quick method. Whenever the material was found inadequate for

evaluation, the procedure was repeated. The remaining slides were stained with May Graunwald Giemsa or fixed in 95% alcohol and stained by Papanicolaou's stain. Special stains like gram stain/Zeihl Neelson were done whenever required. Histopathological correlation was done wherever feasible.

RESULTS

Site and gender: Out of the total 108 retroperitoneal lesions studied majority of the cases were from the pancreas (62.9%) followed by kidney. The site wise distribution and gender distribution of lesions is given in Table 1 and Table 2 respectively.

Age distribution and behaviour of lesions: Majority of the patients were (39.13%) seen in the 5th decade of life and the malignant lesions were more common (Table 3). Histopathological correlation could be done in 38 cases and all the 38 cases were compatible with the cytological diagnosis (Table 4)

Table 1. Site wise distribution of lesions

Site	No. of cases	Percentage
Pancreas	68	62.9
Renal	25	23.2
Retroperitoneal n.	10	9.2
Adrenal	5	4.6
Total	108	

Table 2. Gender distribution of lesions

Sex	No. of cases (%)
Males	63 (58.3)
Females	45 (41.6)

Table 3. Age distribution and behaviour of lesions

Age group	Malignant	Suspicious	Benign	Total (%)
1-10	1	0	0	1(1.08)
11-20	1	0	1	2(2.17)
21-30	1	0	3	4(4.34)
31-40	3	0	5	8(8.69)
41-50	17	1	8	26(28.2)
51-60	26	6	4	36(39.13)
61-70	10	2	1	13(14.13)
71-80	2	0	0	2(2.17)
	61	9	22	92

Table 4. Correlation of cytodiagnosis with histopathological diagnosis

Cytodiagnoses	No. of cases	Compatible	Incompatible
Malignant	38	38	0

Pancreas: A total of 68 cases (62.9%) with pancreatic lesions were seen with a mean age of 55 years (Table 5). 36 were males and 32 were females (Table 6). A good cellularity was obtained in 61 cases, 7 cases however were inadequate for any cytological diagnosis (Table 6). Most of the cases were malignant which included a total of 42(61.7%) cases whereas 5(7.35%) cases were diagnosed suspicious for malignancy. 14(20.5%) cases showed a benign cytological picture. Among the malignant tumors adenocarcinoma constituted 63.9% (39) of the cases (Table 5).

Kidney: Renal lesions contributed to 23.2% of the total cases. Out of the total 25 cases, 19 showed adequate cellularity. Malignant lesions were more common (57.8%) than non

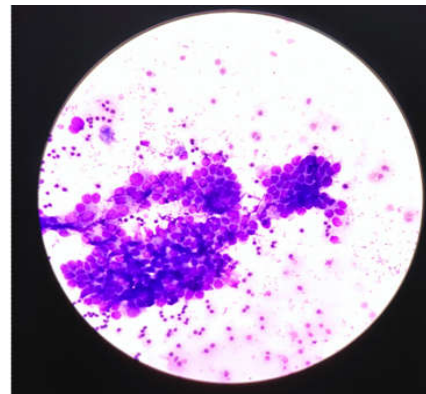


Fig 1. Metastatic adenocarcinoma showing cluster of Pleomorphic cells with high N:C ratio and prominent nucleoli (40X)

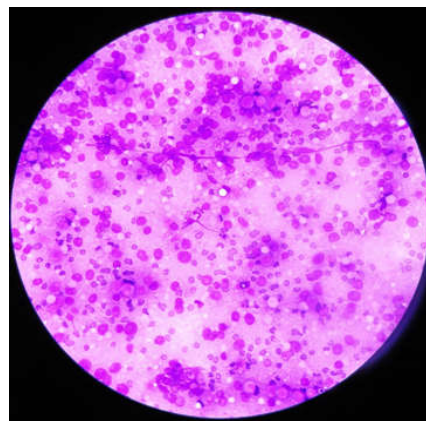


Fig 2. Dispersed large atypical cells with round or very irregular nuclei and single or multiple nucleoli and scant cytoplasm in a case of NHL (40X)

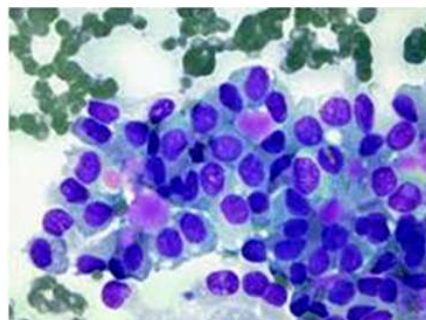


Fig 3. Hypercellular smears showed papillae formation, acinar arrangements and pseudorosettes in a case of solid pseudopapillary neoplasm

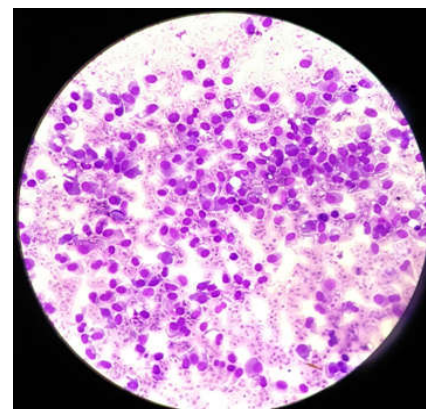


Fig 4. Abundant dispersed cells and dyscohesive cell clusters; minimal nuclear pleomorphism and rosette formation in a neuroendocrine tumor (40X)

Table 5. Age distribution in patients with pancreatic lesions

Age	adenoca		SCP		Neuro		NHL		Suspicion malignancy		Benign	
	M	F	M	F	M	F	M	F	M	F	M	F
0-10	0	0	0	0	0	0	0	0	0	0	0	0
11-20	0	0	0	1	0	0	0	0	0	0	0	1
21-30	0	0	0	0	0	0	0	0	0	0	0	1
31-40	0	1	0	0	0	0	0	0	0	0	3	1
41-50	7	6	0	0	0	1	0	0	1	0	3	1
51-60	12	3	0	0	0	0	0	1	1	2	2	1
61-70	3	5	0	0	0	0	0	0	0	1	0	1
71-80	1	1	0	0	0	0	0	0	0	0	0	0
Total	23	16	0	1	0	1	0	1	2	3	8	6
	39		1		1		1		5		14	

Table 6. Gender distribution in patients with pancreatic lesions

Fnac diagnoses	Freq	%age	Males		Females	
			Freq	% age	Freq	% age
Adeno	39	63.9	23	37.7	16	26.2
Solid pseudopapillary	1	1.6	0	0	1	1.6
Neuroendocrine	1	1.6	0	0	1	1.6
NHL	1	1.6	0	0	1	1.6
Suspicious fr malignancy	5	8.19	2	3.27	3	4.9
Benign	14	22.9	8	13.11	6	9.8
TOTAL	61	100	36	59	32	52.45

Table 7. Age distribution of patients with renal lesions

Age	RCC		Wilms		Mets		Suspicious		Benign	
	M	F	M	F	M	F	M	F	M	F
1-10	0	0	0	1	0	0	0	0	0	0
11-20	0	0	0	0	0	0	0	0	0	0
21-30	0	0	0	0	0	0	0	0	2	0
31-40	0	1	0	0	0	1	0	0	1	0
41-50	1	0	0	0	0	0	0	0	2	1
51-60	3	3	0	0	0	0	1	0	0	0
61-70	1	0	0	0	0	0	1	0	0	0
71-80	0	0	0	0	0	0	0	0	0	0
total	5	4	0	1	0	1	2	0	5	1
	9		1		1		2		6	

Table 8. Gender distribution of patients with renal lesions

Fnac diagnoses	Frequency	% age	Males		Females	
			freq	% age	freq	% age
RCC	9	47.4	5	26.3	4	21
WILMS	1	5.3	0	0	1	5.3
METS	1	5.3	0	0	1	5.3
SUSPICIOUS	2	10.5	2	10.5	0	0
BENIGN	6	10.5	5	26.3	1	5.3
TOTAL	19	100	12	63.15	7	36.8

Table 9. Age distribution of patients with Retroperitoneal node lesions

Age	Mets adeno		Pheochromo		NHL		Reactive		Suspicious	
	M	F	M	F	M	F	M	F	M	F
11-20	0	0	0	0	0	0	0	0	0	0
21-30	0	0	0	1	0	0	0	0	0	0
31-40	0	0	0	0	0	0	0	0	0	0
41-50	0	1	0	0	0	1	0	0	0	0
51-60	2	0	0	0	0	1	1	0	0	0
61-70	0	1	0	0	0	0	1	0	1	0
total	2	2	0	1	0	2	2	0	1	0
	4		1		2		2		1	

malignant lesions (31.5%). Among the malignant lesions RCC was the most common diagnosis (Table 7) constituting 47.4% (n=9) of the total cases with the mean age of 55 years and a male predominance (Table 7,8).

Lymph Node: The most common cause of retroperitoneal lymphadenopathy was metastatic adenocarcinoma seen in 4 patients followed by non hodgkins lymphoma in 2 patients (Table 9)

Adrenal: USG guided aspiration of 5 adrenal lesions revealed pheochromocytoma in three, NHL in one and one was diagnosed as suspicious for malignancy

DISCUSSION

Our study was an observational study conducted in the department of pathology, SKIMS, Soura for a period of three years from June 2014 to June 2017. A total of 108 guided aspirations were done for retroperitoneal lesions. 101 cases were done under ultrasound guidance and 8 cases were done under CT guidance. CT scan was used in those cases in which mass localisation was not possible by USG and repeated USG guided FNAC failed to yield enough material. Majority of the patients presented with chief complaint of abdominal pain or discomfort; other symptoms included abdominal mass, weight loss, fever and hematuria. P Gupta (Gupta *et al.*, 2017) and Chakrabarti *et al.* (2014) described similar clinical presentation in their studies. Out of the total 108 retroperitoneal lesions studied majority of the cases were from the pancreas (62.9%) followed by kidney (23.2%), retroperitoneal lymph nodes (9.2%) and adrenal (4.6%) These results were similar to study done by P Gupta *et al.* (2017). However contradictory to this, some studies (Misra *et al.*, 2015; Sengupta *et al.*, 2014) had kidney while a few others (Chakrabarti *et al.*, 2014; Gangopadhyay *et al.*, 2012) had lymph nodes as the most common site of retroperitoneal lesions in their studies. The study revealed a male preponderance that included 63(58.3%) males and 45 (41.6%) females. This was in concordance with studies done by Suman *et al.* (2015) and Aziz *et al.* (2008). Cases from all the age groups were analysed and it was observed that majority of the patients belonged to the age group of 51-60 years (39.13%). A similar age range was observed by P Gupta⁷ and Namshikhar (Aparna Amogh Naik Namshiker, 2016) in their studies. The findings of the study were grouped as malignant, suspicious for malignancy and benign. The malignant lesions predominated and constituted a total of 61(56.4%) cases. These results are comparable with the findings of Mangal *et al.* (2009). Out of 108 cases, 16 cases showed scant cellularity and material could not be aspirated even after multiple passes. Hence, a proper cytological diagnosis was not possible in these cases.

Pancreas: A total of 68 cases (62.9%) with pancreatic lesions were seen and most of the cases were malignant which included a total of 42(61.7%) cases. Among the malignant tumors adenocarcinoma constituted 63.9% (39) of the cases a finding that was similar to that observed by Mehdi *et al.* (2013) and Jorda *et al.* (1992) in their studies. Smears were highly cellular showing cells arranged in sheets, clusters, three dimensional aggregates and microglandular pattern. The background varied from clean, necrotic, inflammatory to cystic. Individual cells were large, discohesive and hyperchromatic. Histopathological correlation was obtained in 22 cases and there was 100% cytohistological agreement. A single case of solid pseudopapillary neoplasm was diagnosed in a 13 year old female. Smears were moderate to hypercellular and showed papillae formation, acinar arrangements and pseudorosettes. The patient underwent surgical resection of the pancreatic mass and histopathological correlation was established. On IHC, tumor cells were strongly positive for progesterone receptors. The patient, a 53-year-old female who was a known case of non Hodgkins lymphoma had a large tumor in the head of the pancreas. Serum LDH levels were raised, CA19-9 levels were however normal. FNAC smears

showed large atypical cells with round or very irregular nuclei, with single or multiple nucleoli and scant cytoplasm, or round/irregular nuclei with a single prominent nucleolus and evident cytoplasm. A diagnosis of non Hodgkins lymphoma was made. The tumor was invading the duodenum and pancreaticoduodenectomy was performed. This tumor was identified, by histopathology and immunohistochemistry, as diffuse mixed type lymphoma with a B-cell phenotype. Ueda *et al.* (2000) and Anastasia Shnitser *et al.* (2016) also found pancreatic involvement by NHL in their studies. FNAC of A 48 yr old female who presented with a 3x3cm heterogeneous mass with areas of cystic and necrotic change on CT showed a cellular aspirate; abundant dispersed cells and discohesive cell clusters; minimal nuclear pleomorphism, infrequent mitotic figures; fine, evenly dispersed nuclear chromatin with inconspicuous nucleoli; a scant-moderate amount of amphophilic, well-defined cytoplasm; perivascular arrangement of tumor cells leading to pseudorosette formation. A cytological diagnosis of neuroendocrine tumor was made. N al-Kaisi (1992) found a similar cytological picture of neuroendocrine tumors in their study. Histopathological correlation could not be done in this patient. Histopathological correlation was possible in two out of five cases diagnosed as suspicious for malignancy and both were found out to be cases of adenocarcinoma. Similar findings were seen in study done by S C Krishnamurthi *et al.* (1993). The sensitivity and specificity for image guided pancreatic FNACs in our study was 100% each. US or CT guided FNA of pancreatic tumors has an average sensitivity and specificity of 80% and 90% respectively (Afifi *et al.*, 2003). A total of 14 cases (22.9%) were diagnosed as benign. Fareeha, (2009) *et al* also found a similar percentage of benign tumors in their study. Out of the 14 benign cases, 6 cases were that of an abscess and 5 cases were of chronic pancreatitis. 1

Case was a benign cystic lesion and 2 cases showed normal acinar and ductal cells with a few inflammatory cells only.

Kidney: Renal lesions contributed to 23.2% of the total cases and malignant lesions were more common (57.8%) than non malignant lesions (31.5%). Among the malignant lesions RCC was the most common diagnosis constituting 47.4% of the total cases. RCC was also the most common malignant tumor in studies done by Mehdi *et al.* (2013) Aziz *et al.* (2008) and Mondal *et al.* (2002) USG-guided percutaneous FNAC of renal masses was first reported by Kristensen *et al.* (1972) Renal aspirates in RCC showed cellular smears with tumor cells having abundant, fragile, vacuolated cytoplasm, mild nuclear pleomorphism and occasional intranuclear inclusions in a necrotic background. All the 9 patients underwent nephrectomies and histopathological correlation was established in all the cases. Ahmad SS *et al.* (2006) and Pilloti *et al.* (1988) revealed similar results in their studies as well. Hence with regard to renal FNACs, we had a sensitivity and specificity of 100%. The sensitivity was 80% and specificity was 100% for image guided FNA of renal masses in the study conducted by Nicefro *et al.* (1993). Wilms tumor was diagnosed in a 10 yr old female in whom the the FNAC smears showed small round cells with raised NC ratio, scant cytoplasm with occasional epithelial and mesenchymal components. Histopathological correlation was obtained in the same case. A 38 yr old female who was a known case of infiltrating ductal carcinoma and had undergone mastectomy presented with 2 cm cortical, regularly demarcated, hypoechoic solid mass in the right kidney on USG. She was

diagnosed with metastatic deposits of IDC in the kidney. Renal metastasis from breast cancer is a rare entity and was reported by Akin, (2012) and Asim Armagan Aydin (2016) in their studies. 2 cases diagnosed as suspicious for malignancy were diagnosed as clear cell RCC on histopathology. 6 (10.5%) cases were diagnosed with benign lesions. Brierly, (2000) showed a similar percentage of benign tumors in their study. Out of the six benign cases three were that of an abscess and 3 were benign cystic lesions revealing benign degenerating epithelial cells and scattered macrophages in a clear background.

Lymph node: Out of the 10 cases of retroperitoneal lymph nodes 4 cases, two males and two females showed metastatic deposits of adenocarcinoma. Among these, two were known cases of pancreatic adenocarcinoma, and one was of cholangiocarcinoma. In one patient, primary malignancy was not detected clinically. Ganghopadhyay *et al.* (2011) also had metastatic adenocarcinoma as the most common diagnosis in retroperitoneal lymph nodes in their study. The cytodiagnostic accuracy of Hodgkins lymphoma by FNA is high, approaching 90% but it is much lower for NHL. However, an accuracy rate greater than 80% has been reported in some recent series of NHL. In our study cytological diagnosis of NHL was made in 2 patients whose age ranged from 40-60 yrs. Smears were cellular and revealed a diffuse population of large, pleomorphic cells with abundant cytoplasm, prominent nucleoli and a good number of mitotic figures. Biopsy was done in one patient and the diagnosis of NHL as diffuse large B cell lymphoma was confirmed on histopathology. Follow up was lost in the other patient.

A thirty year old female was diagnosed with metastatic deposits of pheochromocytoma. The patient had a concomitant adrenal lesion which had invaded the adjacent structures. FNA smears showed loosely cohesive clusters and scattered tumor cells with prominent anisokaryosis, abundant eosinophilic granular cytoplasm and irregular cell borders, background showed hemorrhage and fragments of blood vessels. Although rare but whenever pheochromocytoma metastasize, lymph nodes are one of the common sites (Michael, ?). In their study done by Park *et al.* (2011) 1 out of the 17 malignant pheochromocytomas studied metastasized to the lymph node. Among the two benign cases in one patient who was a 50 yr old male, USG guided aspirate was thick, caseous and blood mixed. CT revealed solid enhancing lesion in the rt iliac fossa. Exploratory laparotomy was done and the intraoperative findings confirmed tuberculosis. Other case showed non specific reactive hyperplasia only. Certain authors (Chakrabarti, 2014; Nirmal Kumar Bhattacharya, 2011; Nahar Siakia, 2003) found tuberculosis as the most common benign lesion in their studies. Our study had lesser number of lymphadenopathy cases as compared to other studies (Gupta, 2017; Chakrabarti, 2014; Gangopadhyay, 2011; Mehar aziz, 2008; Mangal, 2009) with lymph node being the most common organ involved in some of them (Chakrabarti, 2014; Gangopadhyay *et al.*, 2011).

Adrenal: USG guided aspiration of 5 adrenal lesions revealed pheochromocytoma in three, NHL in one and one was diagnosed as suspicious for malignancy. This was in contrast to studies done by Aziz *et al.* (2008) and Namshilkar *et al.* (2016) which had neuroblastoma and P Gupta *et al.* (2017) which had adrenocortical carcinomas as most common adrenal lesions. Histopathology could be done in three cases of

pheochromocytoma and that confirmed the FNAC diagnosis. For evaluating 39 cases statistical analysis showed 100% sensitivity and 100% specificity. There were no false positive or false negative cases. However with regard to typing of malignant lesions diagnostic accuracy was 93.54%.

Conclusion

The study revealed that image guided FNAC is an excellent diagnostic modality and shows high accuracy and high sensitivity in diagnosing retroperitoneal lesions with minimal complications. With the use of FNAC, an accurate pre-operative diagnosis of retroperitoneal lesions is possible and the need for surgical exploration may be obviated in a large number of cases facilitating initiation of appropriate therapy as well as saving manpower and cost of hospitalisation.

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REFERENCES

- Afifi AM, al-Khafaji BM, Kim B, Scheiman JM. 2003. Endoscopic ultrasound –guided fine needle aspiration of the pancreas. Diagnostic utility and accuracy. *Acta Cytol.*, 47(3):341-8
- Agarwal PK, Goel M, Chandra T, Agarwal S. 1997. Predictive value of fine needle aspiration cytology of bone lesions. *Acta Cytol.*, 41: 659-65.
- Ahmad SS, Akhtar K, Akhtar SS, Alia Nasir AA, Khalid M, Mansoor T. 2006. Ultrasound guided fine needle aspiration biopsy of abdominal masses. *JK Science.* 8: 200-04.
- Akin Y., Basara I. 2012. Kidney metastasis of invasive ductal breast carcinoma mimicking renal cell carcinoma. *Saudi Med J.*, 33:1346-1349
- Al-Kaisi N, Weaver MG, Abdul Karim FW, Siegler E. 1992. Fine needle aspiration cytology of neuroendocrine tumors of the pancreas. A cytologic, immunocytochemical and electron microscopic study. *Acta Cytol.*, 36(5):655-60
- Anastasia Shnitser, Dina Halegoua –De Marzio, David E. Loren. 2016. Primary pancreatic lymphoma presenting as acute pancreatitis. *Gastroenterol Hepatol.*, 12(7):456-458
- Aparna Amogh Naik Namshiker, Premila De Sousa Rocha, Roque G.W. Pinto. 2016. Role of Fine Needle Aspiration Cytology in the Assessment of Intra-Abdominal and Retroperitoneal Lesions-A Comparative Study. *National Journal of Laboratory Medicine.* 5(3): 31-37
- Aydin AS, Gunduz UR, Yalcinkaya S, Kayikcioglu E, Alparslan AS, *et al.* 2016. A Rare Case of Primary Breast Cancer with Isolated Renal Parenchymal Metastasis Mimicking Primary Renal Cell Carcinoma. *J Clin Case Rep.*, 6: 724.
- Brierly RD, Thomas PJ, Harrison NW, Fletcher MS, Nawrocki JD, Ashton Key M. 2000. Evaluation of fine needle aspiration cytology for renal masses. *BJU Int.*, 85(1):14-8
- Chakrabarti I, Bhowmik S, Sinha MG, Bera P. 2014. Ultrasound-guided aspiration cytology of retroperitoneal masses with histopathological corroboration: a study of 71 cases. *J Cytol.*, 31:15–9.
- Fareeha A, Sabiha R. 2009. Guided percutaneous cytology of pancreatic masses a cytohistological correlation. *Annals* 15:141-143

- Gangopadhyay M, Bhattacharyya NK, Ray S, Chakrabarty S, Pandit N. 2011. Guided fine needle aspiration cytology of retroperitoneal masses – our experience. *J Cytol.*, 28:20–4.
- Ghazala Mehdi, Veena Maheshwari, Sheerin Afzal, Hena A Ansari, Ibne Ahmad. 2013. Image-guided fine-needle aspiration of retroperitoneal masses: The role of the cytopathologist. *J Cytol.*, Jan-Mar; 30(1): 36–41.
- Gupta P, Rajwanshi A, Nijhawan R, Srinivasan R, Gupta N, Saikia UN *et al.* 2017. Fine needle aspiration in retroperitoneal lesions. *APMIS* 125: 16–23.
- Jorda M, Essenfeld H, Gracia E, Ganjei P. 1992. The value of fine needle aspiration cytology in the diagnosis of inflammatory pancreatic masses. *Diagn Cyto pathol.*, 8:65-67
- Junsoo Park, Cheryn Song, Myungchan Park, Sangjun Yoo, Se Jun Park, Seokjun Hong *et al.* 2011. Predictive Characteristics of Malignant Pheochromocytoma. *Korean J Urol.*, 52:241-246
- Kazumitsu Ueda, Yukihiko Nagayama, Kazuhiro Narita, Mitsuo Kusano, Maria Mernyei, Masuzo Kamiya. 2000. Pancreatic involvement by non-Hodgkin's lymphoma. *J Hepatobiliary Pancreat Surg.*, 7:610–613
- Krishnamurthi SC, Soni M, Jagannath KS, DeSouza LJ. 1993. Intraoperative fine needle aspiration cytology of pancreas: a study of 97 cases. *Indian J Gastroenterol.*, 12(1):14-5.
- Kristensen JK, Holan HH, Rasmussen SN, Barlebo H. 1972. Ultrasonically guided percutaneous puncture of renal masses. *Scand J Chrol Nephrol.*, 6:49-56.
- Langlois SP. 1999. Imaging methods for guidance of aspiration cytology. In: Orell SR, Sterret GF, Walters MN, Whitaker D, editors. *Manual and atlas of fine needle aspiration cytology*. 3rd ed. Edinburgh London:Churchill Livingstone .p.30
- Mangal N, Sharma VK, Verma N, Agarwal AK, Sharma SP, Aneja S. 2009. Ultrasound guided fine needle aspiration cytology in the diagnosis of retroperitoneal masses: a study of 85 cases. *J Cytol.*, 26:97–101.
- Mehar Aziz, Nishat afroz, Eram kakhshan, Ibne ahmad, Tariq mansoor. 2008. Radiologically guided fine needle aspiration cytology of retroperitoneal and spinal lesions. *Journal of cytology*, 25(4) :123-127
- Michael H Johnson, R Sherburne Figenshau. Malignant and metastatic pheochromocytoma: Case report and review of literature
- Misra RK, Mitra S, Jain RK, Vahikar S, Bundela A, Misra P. 2015. Image-guided fine needle cytology with aspiration versus non-aspiration in retroperitoneal masses: is aspiration necessary? *J Pathol Transl Med.*, 49:129–35.
- Mondal A, Kundu B, Ray CK, Saha DK, Biswas J, Misra DK. 2002. Utility of imaging modalities in diagnostic FNAC. *J Cytol.*, 19:123-38.
- Murtaza B, Saeed S, Khan NA, Malik IB, Mahmood A, Sharif MA, *et al.* 2008. Retroperitoneal masses: Different clinical scenarios. *J Ayub Med Coll Abbottabad.*, 20:161–4
- Nahar Siakia U, Khirdwadkar N, Saikia B, Sood B, Goldsmith R, Dey P. *et al.* 2003. Image guided fine needle aspiration cytology of deep seated enlarged lymph nodes. *Acta Radiol*, 43;230-4
- Nicefro J, Coughlin BF. 1993. Diagnosis of renal cell carcinoma: value of fine needle aspiration cytology in patients with metastasis or contraindications to nephrectomy. *AJR Am J Roentgenol.*, 161(6):1303-5
- Nirmal Kumar Bhattacharya, Subrata Chakrabarty, Mimi Gangopadhyay, Narayan Pandit, Sailes Ray. 2011. Guided fine needle aspiration of retroperitoneal masses-Our experience. *Journal of cytology*, 28(1):20-24
- Pilloti S, Rilke F, Alasio L, Garbagnati F. 1988. The role of fine needle aspiration in the assessment of renal masses. *Acta Cytol.*, 32:1-10
- Porter B, Karp W, Forsberg L. 1981. Percutaneous cytodiagnosis of retroperitoneal masses by USG guided FNAB. *Acta Radiol.*, 22 : 663-8.
- Sengupta S, Pal S, Biswas BK, Chakrabarti S, Bose K, Jana S. 2014. Fine-needle aspiration cytology of retroperitoneal lesions: a 5-year experience with an emphasis on cytohistological discrepancy. *Acta Cytol.*, 58(2):138-44
- Suman BS, Muniyappa B. 2015. Ultrasonography guided fine needle aspiration cytology with preparation of cell blocks in the diagnosis of intraabdominal masses. *JCDR.*, 9(12):EC08-21.
