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Original Research Article

Real time ultrasound guided fine needle aspiration cytology of intra-abdominal and intra-pelvic masses- synergistic approach of radiologist and cytopathologist for better cellular yield

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ABSTRACT

Background: Real time ultrasound guided fine needle aspiration cytology (FNAC) of non-palpable, intra-abdominal and intra-pelvic masses are easily performed and reported rapidly. Needle tip can be visualized and manipulated on real time aspirations. It increases the sensitivity due to high diagnostic yield from target areas.

Materials and Methods: The present study is a retrospective study of 161cases, where real time ultrasound guided FNAC of intra-abdominal and intra-pelvic masses were done from 1st July 2018 to 31st December 2019 in a tertiary cancer center. Aspirations from ovary and other pelvic masses-18 gauge, liver/gall bladder-22- 23 gauge and kidney-23 gauge spinal needles were taken respectively.

Results: Total 161 cases of intra-abdominal lesions- ovary- 73 cases, liver-45 cases, kidney-27 cases, gall bladder-07 cases, colon (caecum+descending colon)-03 cases and pelvis mass- 03cases, pancreas- 02 cases and retroperitoneal lymph node-01 case were retrieved and studied. Ultrasound guided aspirates were conclusive for reporting in 145 cases, inconclusive for reporting in 10 cases and acellular/ haemorrhagic in 06 cases. There was high sensitivity and specificity of 90.9% and 100% respectively.

Conclusion: Real time image guided FNAC is the method of choice for intra-abdominal masses with better cell yield and minimal complication. It permits precise localization and targeting of lesions safely. The localization is good in most of the masses but, it's challenging in few locations. Complication like needle track seedling, discussed in many studies, was not seen in the present study.

Keymessage: Image guided FNAC is very rewarding in diagnosis of intra-abdominal masses. USG guided FNAC is easy, causes minimal radiation, rapid reporting, less complication and needle tip can be easily visualized and manipulated in any direction, thus aids in faster planning if the treatment.

1. Introduction

Fine needle aspiration cytology (FNAC) is relatively less painful, easily performed, rapid reporting, less expensive, highly sensitive and specific for superficial lesion as well as deep seated intra-abdominal and intra-pelvic masses.[1–7] Radiological guidance helps in locating the intra-abdominal masses especially the solid component in cases with large mass with both solid and cystic components. The diagnosis given by FNAC may at times substitutes for surgical procedures like diagnostic laparotomy.[5] Image guided FNAC sampling can be done by either ultrasound or computerized tomography scan (CT).[7,8] As compared to CT scan, real time imaging by ultrasound is better as there is no ionizing radiation, less complication, faster, less costly[9–11] and needle tip can be easily visualized and manipulated in any direction saving the vital structures.[11,12] (Figure 1). Diagnosis from the aspirated material aids in screening benign cases and at times helps the clinician in deciding the best line of management. Despite the obvious

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advantages, debate and controversies continues for its use in diagnosis of ovarian neoplasms.

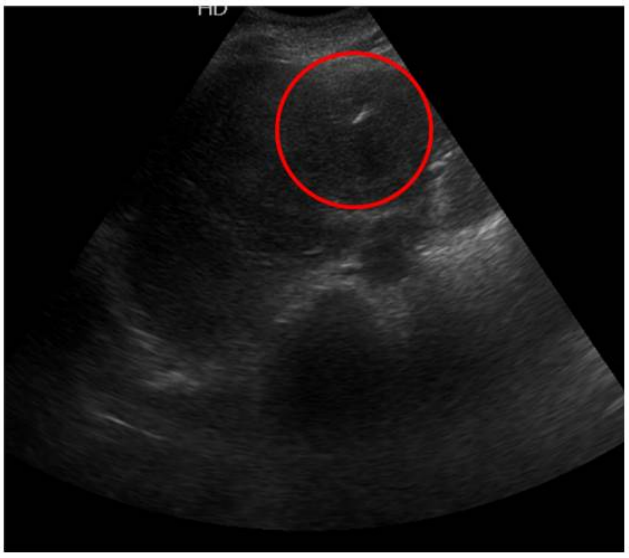

Fig. 1: Real time ultrasound guided FNAC from liver nodule showing needle tip in the target lesion.

2. Aims and Objectives

The main aims and objectives of the study were-

1. To assess the usefulness and utility of ultrasound guided FNAC in initial evaluation of intra-abdominal and intra-pelvic masses and its incremental role against unguided approach.
2. To define tumour type in solid tumours, early diagnosis of malignancy in partly solid and partly cystic tumors and exclusion of malignancy in cystic tumors by ultrasound guided FNAC.
3. To rule out non-malignant from malignant cases.

3. Material and Methods

The present study is a retrospective study of 161cases reported during the period of 1st July 2018 to 31st December 2019 in a tertiary cancer center. The data were retrieved from diagnosed cases of intra-abdominal and intra-pelvic masses which were evaluated by cytology with real-time ultrasonography. Ultrasound guided FNAC from other sites and failure to reach the target mass due to overlying solid organs were excluded. Coagulation and screening profiles were routinely done before the procedure. FNAC were done only for patients with normal coagulation profile. Special precautions were taken for HIV, HCV and HBSAg positive cases, as per the NABH guidelines. Lumber puncture needles of various sizes were taken for various abdominal organs. For ovary and other pelvic masses- 18-gauge, liver/gall bladder- 22-23 gauge and kidney-23-gauge spinal needles were taken respectively. All samples were obtained by per abdomen real-time ultrasound guided aspirations under aseptic precautions with aspiration done by 5 ml or 10 ml disposable syringes. Generally, 1-2 aspirations were done. If required, repeat aspirations were done later. Aspirations up to 4 times were done.

Aspirates were smeared on the slides and wet- fixed in 95% alcohol fixative immediately and in cases of serous or mucinous fluids, smears were made from the sediments obtained from centrifugation of fluid in cytospin. Haematoxylin and Eosin (H&E) and Pap stains were done as routine. Rapid H&E and May Grunwald Giemsa (MGG) stains were done occasionally. Special stains like Zeil Neelson stains for Acid fast bacilli were done as and when Koch's etiology was suspected. In cases of pus aspiration, collection was done in sterile containers and sent for culture and sensitivity.

Histopathological correlation was done on needle core biopsy and surgically operated cases.

4. Results

The age group varied from 18 years to 76 years with female: male ratio of 2:1. Among 161 cases of intra-abdominal lesions- ovary- 73 cases, liver- 45 cases, kidney- 27 cases, gall bladder- 07 cases, Colon (caecum and descending colon)- 03 cases and pelvis mass- 03 cases, pancreas- 02 cases and retroperitoneal lymph node- 01 case were studied. The cases were categorized into non-neoplastic and neoplastic. The neoplastic lesions were further divided into benign and malignant. (Table 1) Ultrasound guided aspirates were conclusive for reporting in 145 cases, inconclusive for reporting in 10 cases and acellular/ haemorrhagic in 06 cases. Inconclusive cases were those neoplastic cases where definitive diagnosis of benign/ borderline/malignant could not be interpreted even after repeating the aspirations. Most inconclusive cases were from ovary- 08 cases and liver /kidney- 01 case each. All acellular/ haemorrhagic aspirates were from kidney- 05cases. (Table 2)

Kidney aspirations were done with 23 gauge spinal needles as they are highly vascular. Aspirations of these kidney masses were done with minimal negative pressure to avoid excess blood, which dilutes the cells and hinders reporting.

For tumours with solid and cystic component, localization of the solid component was done. In cases of ovarian cyst with solid and cystic component, malignant cell yield was better if aspirated from solid area. In cases of deep seated solid areas best effort was given to reach the target site. In one case of recurrent carcinoma ovary, trans-abdominal approach did not yield good sample as the lesions was located deep in pelvis. Transvaginal approach was attempted in this case for better localization of solid area and yield. (Figure 2)

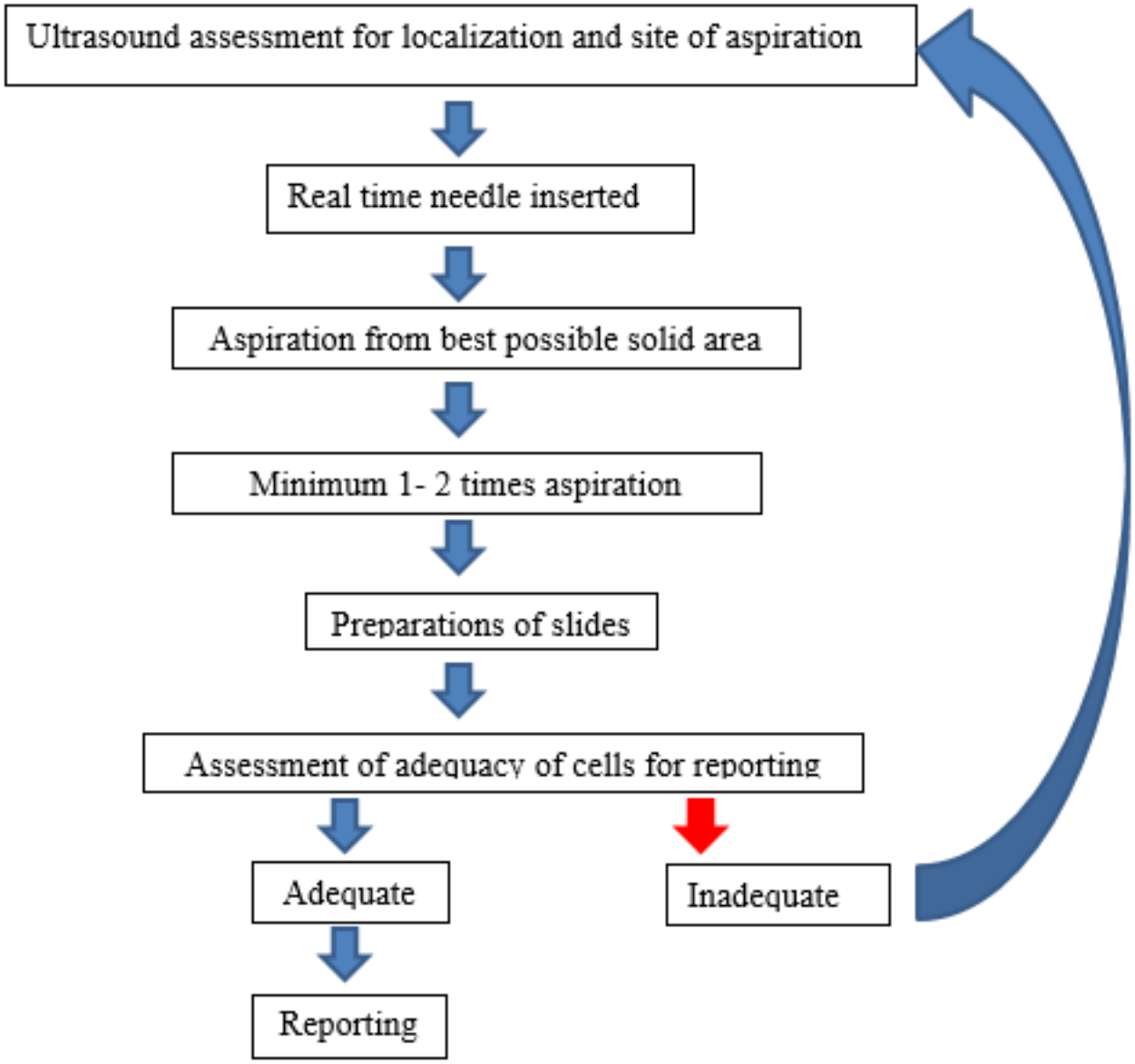

Chart 1: Flow chart showing the procedure done for real time ultrasound guided FNACs of intra-abdominal and intra-pelvic masses

Out of 73 cases of ovary, non-neoplastic- 03 cases, benign- 10 cases, malignant- 52 cases and inconclusive for benign/ malignant- 08 cases were studied. (Table 3) Three cases of non- neoplastic ovary aspirates were pus. These were collected in sterile containers and sent for culture and sensitivity. One case was treated medically. Laparotomy was done for two cases and tubo-ovarian mass were excised. These were confirmed by histopathology. Among benign cases of ovary, brown color fluid was aspirated in three cases and showed features of endometriotic cyst and were correlating with the histopathology findings. Other 06 cases of benign serous/ mucinous cystadenomas were also confirmed by histopathology. (Figure 3)

Six cases of carcinoma ovary were malignant germ cell tumour. Serum β HCG, AFP and LDH and immunohistochemistry were done for each cases. (Table 4)

In the present study liver masses were 45 cases, out of which there were chronic liver disease-01 case, benign (hemangioma)-04 cases, malignant (Hepatocellular carcinoma-16 cases and Cholangiocarcinoma- 02 cases)-18 cases, metastatic deposits- 20 cases, inconclusive- 01 case and acellular- 01 case. (Table 3) Metastetectomy

of one case with single liver deposit was done. It was a case of oligometastasis from adenocarcinoma rectum. Histopathology findings were correlating with that of cytology. (Figure 4)

In the present study kidney masses were 27 cases with malignancy in 21 cases, inconclusive in 01 case and acellular in 05 cases.(Table 3) Out of 27 malignant cases, 26 cases were reported as renal cell carcinoma and 01 case was reported as transitional cell carcinoma. On histopathology of nephrectomy specimens, clear cell renal cell carcinoma- 22 cases and chromophobe renal cell carcinoma- 01 case, papillary renal cell carcinoma- 01 case, and one case was reported as benign pheochromocytoma were seen. One case of transitional cell carcinoma arising from the renal pelvis and extending to renal cortex was non-operable. (Figure 5) Acellular aspirates were seen in 05 cases, where repeat aspirations also could not yield adequate material.

In the present study gall bladder masses were 07 cases. Three cases were in stage IV and four cases were in stage I. Radical cholecystectomy was done for the cases in stage I. Histopathology findings were correlating with that of cytology. (Figure 6 a).

One case of retroperitoneal lymph node was reported as Non-Hodgkin lymphoma on cytology and histopathology and was categorized as diffuse large B-cell lymphoma on immunohistochemistry. (Figure 6 b).

One old operated case of carcinoma stomach presented with pancreatic mass. Guided FNAC followed by core biopsy was reported as adenocarcinoma. It was confirmed as metastasis from stomach on immunohistochemistry. (Figure 6 c).

In the present study colon masses was aspirated in two cases and reported as adenocarcinoma on cytology. (Figure 6 d). Both cases were non-operable, stage IV disease.

One case of squamous cell carcinoma with ilio- psoas collection was aspirated under ultrasound guidance.

One case of post radiotherapy carcinoma vault, presented with pelvic mass. Real time aspiration was done and reported as recurrent squamous cell carcinoma deposit.

Out of 161 cases surgery was done for 110 cases. Histopathology and cytology diagnosis were correlated. Diagnosis for histopathology and cytology were correlating in 108 cases. One case of fibroma ovary was given as malignant on cytology and one case of renal benign pheochromocytoma was reported as carcinoma on cytology. (Table 5)

5. Discussion

Intra-abdominal and intra-pelvic masses are well visualized by radiological techniques. But these techniques fail to delineate benign and malignant lesions.[10] An accurate morphological diagnosis is essential for planning definitive treatment and staging of tumours. FNAC of intra-abdominal non-palpable masses cannot be performed blindly. Radiological assistance by ultrasound/ CT is needed for these lesions. Ultrasound is preferred over CT as it is rapid, less expensive, without ionizing radiation and does not require injection of contrast medium.[9–11] (Table 6) The procedure is easy to perform, easy to visualize the forwarding tip of spinal needle and easily repeated when necessary.[11,12] The diagnostic yield of USG guided aspiration is better than CT scan guided aspiration. Comparative study of diagnostic yield was done by Lee et al.,[10] Jarmakani et al.[11] and Khosla R et al.[13] (Table 7)

A skilled radiologist and cytopathologist is the best combination as it provides a combined consultation between the pathologist and the radiologist and acquiring better cellular yield.[1,9,17] This is beneficial for the patient and also a very rewarding and intellectually stimulating activity for the cytopathologist.[19] The outcome of combined efforts also depends on patient co-operation, sub-optimal acoustic shadow and skill developed for aspirations.

Puncture of the cystic ovarian tumours could be hazardous, due to leakage and a potential tumour-cell implantation in the case of malignant tumours. Kjellgren has suggested trans-vaginal or a trans-rectal aspiration approach to avoid the risk of such implantation.[17] In the present study, though the approach was trans-abdominal in all the cases except one, no such complications were encountered. The common complications like mild pain and discomfort were seen. The vast amount of literature supports the safety of FNAC.[15] No report on complications like tumour seeding of the needle tract as a result of FNAC in the 20 papers were reported on around 20,000 patients, including those of the present study.[5] No such complication of haemorrhage or needle track seeding was seen in study done by Kouli R.[20]

The localization is good in most of the masses but, it is really challenging in few locations. (Table 8)

Few challenging conditions faced during the study where aspirations were not satisfactory. These cases were correlated with either biopsy or serum tumour markers or radiological images. Reasons for non-targeting the lesions were as follows-

1. Liver lesion localized in the subcapsular portion of segment VII, close to the diaphragm. Target lesion was not able to localize due to hampering by diaphragmatic movement.
2. Enlarged adrenal mass located behind the kidney necessitating piercing and ensuing contamination of renal tissue with adrenal tumour mass.
3. Small ovarian cyst located behind the retroverted uterus precluding unhampered targeting of the intervening uterus and urinary bladder.

The first work-up to be done after radiological report of large masses is to exclude benign from malignant lesions. FNAC aids in the delineation of benign from malignant in

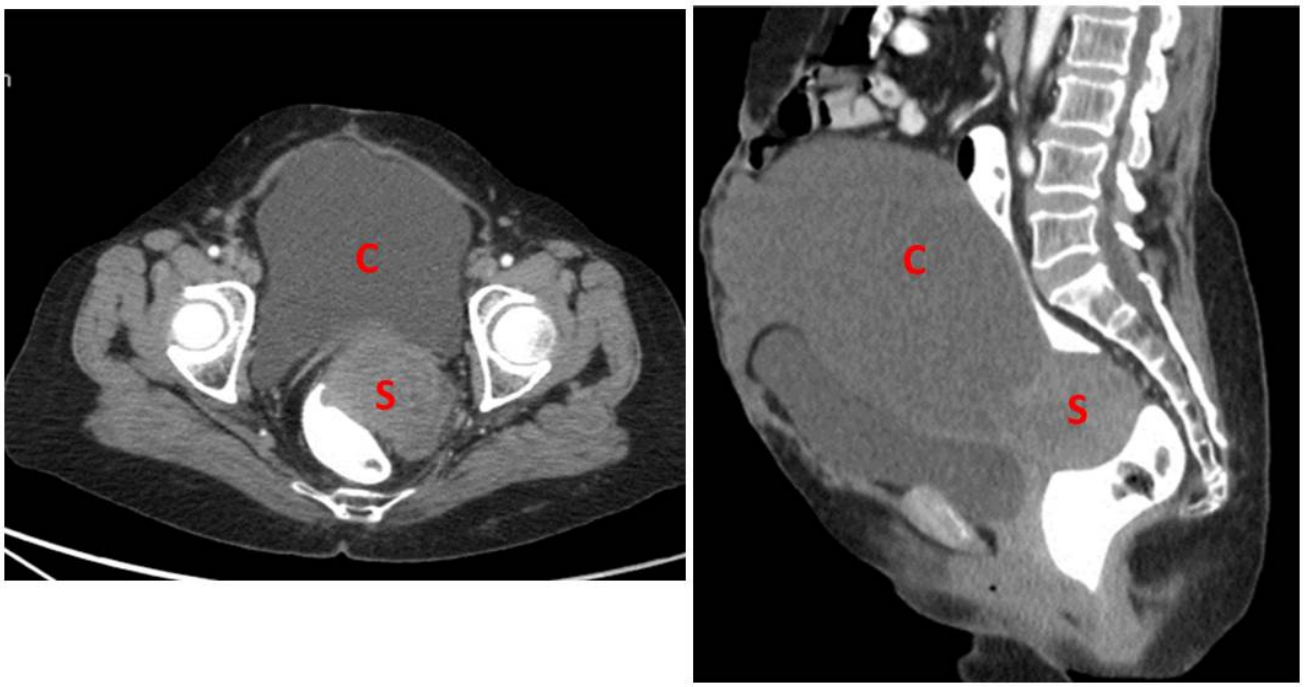

Fig. 2: CT scan image showing large pelvic mass with cystic (C) and small deep seated solid component (S). Aspiration was done by transvaginal approach.

Table 1: Outcome of ultrasound guided FNAC

Site	Non-neoplastic	Neoplastic			Acellular/ haemorrhagic	Total cases n=161
		Benign	Malignant	Inconclusive		
Ovary	03	10	52	08	Nil	73
Liver	01	04	38	01	01	45
Kidney	Nil	Nil	21	01	05	27
Gall bladder	Nil	Nil	07	Nil	Nil	07
Colon	Nil	Nil	03	Nil	Nil	03
Pelvic mass	01	Nil	02	Nil	Nil	03
Pancreas	Nil	Nil	02	Nil	Nil	02
Retroperitoneal lymph node	Nil	Nil	01	Nil	Nil	01
	05	14	126	10	06	Total- 161

Table 2: FNAC results

FNAC result	No. of cases	Percentage %
Conclusive	145	90.03%
Inconclusive*	10	6.24%
Acellular	06	3.73%
Total	161	100

*Tumours where benign/ borderline/malignant could not be interpreted

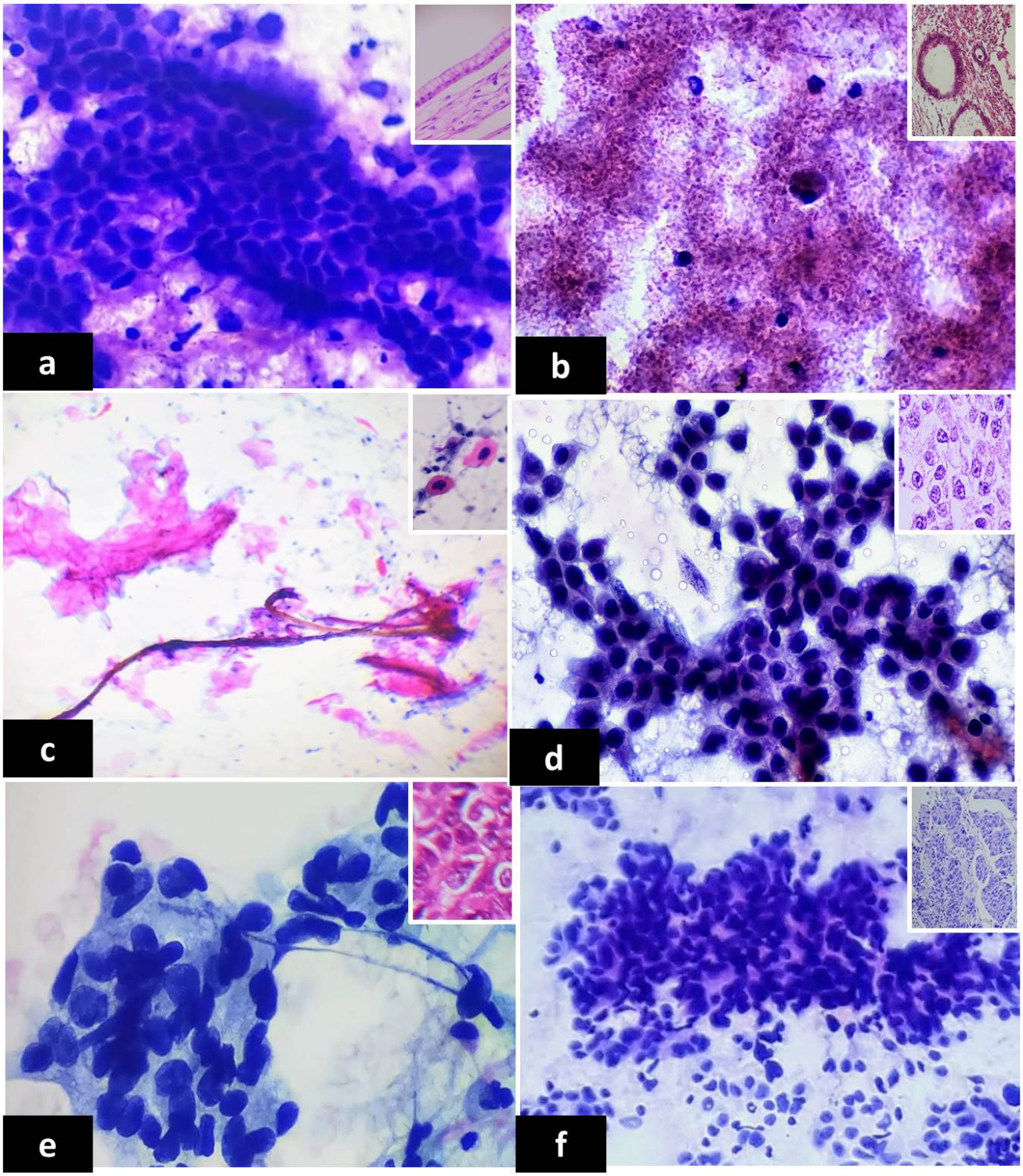

Fig. 3: Cytology and corresponding histopathology from ovary; **(a)** Benign mucinous ovarian **cystadenoma**- Sheets and clusters of small, round epithelial cells and small relatively uniform nuclei. (H&E, 25x). **INSAT**- Microphotograph of histopathology of the corresponding ovary cyst wall, **(b) Endometriotic cyst-** Haemosiderin laden macrophages in the background of altered blood. (H&E, 25x). **INSAT**- Microphotograph of histopathology of the corresponding ovary,
(c) Teratoma ovary- Keratin and hair follicle. (Pap, 25x). **INSAT**- Microphotograph showing keratinized squamous cells,
(d) Mixed Germ cell ovarian tumour (Dysgerminoma-95% and Embryonal carcinoma-05%)- Poorly cohesive malignant cells, fragile cytoplasm, vesicular nuclei with prominent nucleoli and nuclear smudging with few lymphocytes. (Pap, 40x). **INSAT**- Microphotograph of histopathology of the corresponding ovary, **(e)Mucinous ovarian cystadenocarcinoma-** Clusters of pleomorphic malignant glandular cells with a background of mucus**.** (Pap, 40x), **(f)Serous ovarian cystadenocarcinoma**- Papillary tissue fragment of crowded atypical glandular cells, scanty pale cytoplasm, large overlapping nuclei. (Pap, 40x).

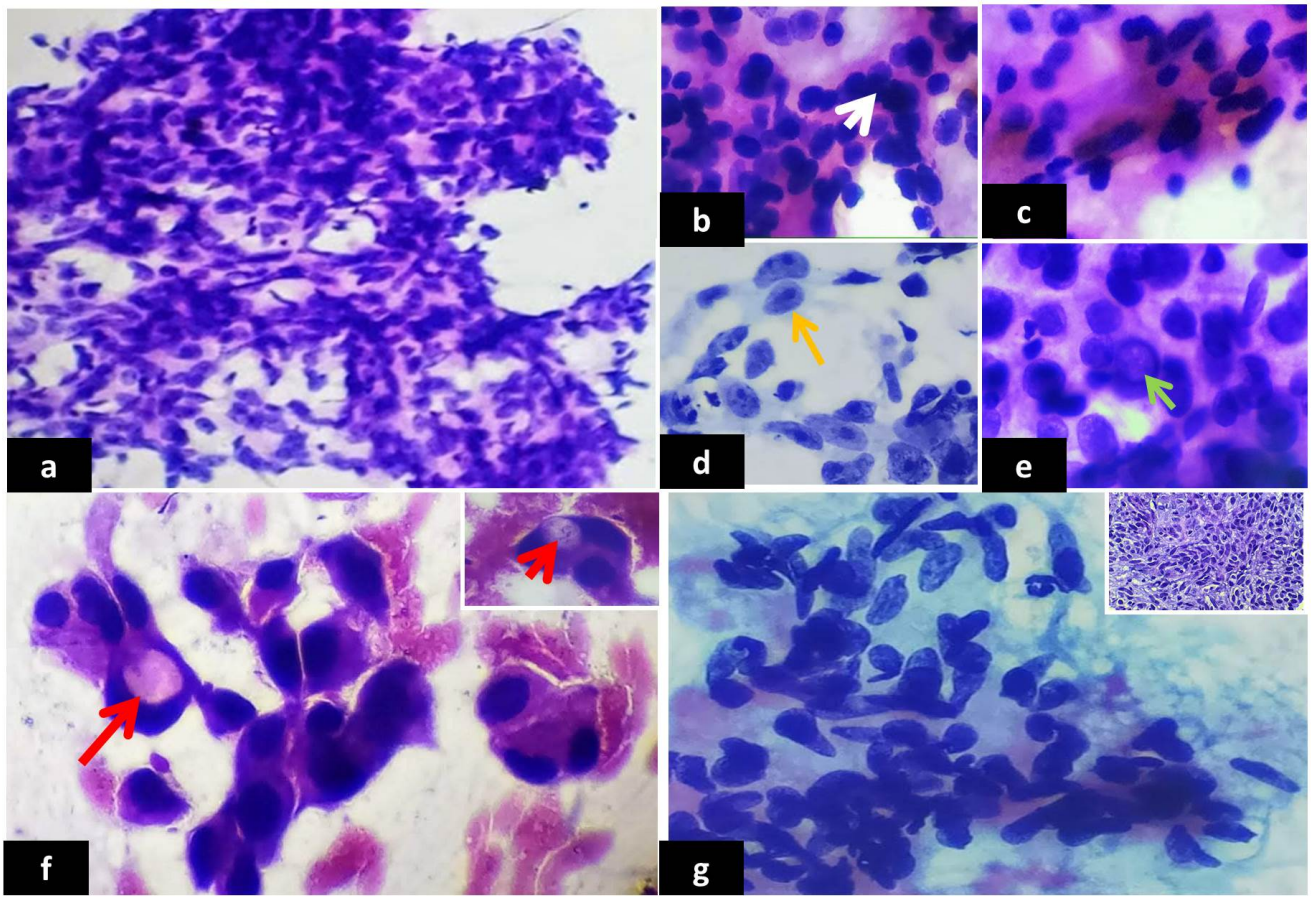

Fig. 4: Cytology and corresponding histopathology (if available) from liver; (a) Hepatocellularcarcinoma - Cellular smears with irregular large fragments, clusters and dispersed cells with capillaries transgressing clusters of tumor cells (H&E, 25x). **(b) Hepatocellularcarcinoma** - Neoplastic cells forming pseudo acini (yellow arrow),
(c)Hepatocellularcarcinoma - Intracytoplasmic bile pigment,
(d) Hepatocellularcarcinoma - Cells with macronucleoli,
(e) Hepatocellularcarcinoma - Intranuclear cytoplasmic inclusion,
(f) Livermetastasisofadenocarcinoma showing cytoplasmic vacuoles (red arrow). (H&E, 40x) and
(g) Livermetastasisofgastrointestinalstromal tumor- Cohesive cluster of haphazardly arranged spindle cells showing mild anisoncleosis and tapered cytoplasm (Pap, 40x)**.**

most of the cases. In the present study of radiologically diagnosed cases of masses, where real time guided FNAC had excluded malignancy were as follows:

1. Liver mass suspicious for hepatocellular carcinoma was diagnosed as hemangioma on FNAC which was confirmed by non-FDG uptake lesion on PET CT scan.
2. Large ovarian masses in two situations where dilemma for benign and malignant lesion on CT scan was suggestive of benign ovarian cystadenomas on guided FNAC. Cytology diagnosis of both cases were correlating with the diagnosis at histopathology.
3. Three cases of medium-sized solid ovarian masses were suggestive of abscess on guided FNAC. Two cases on laparotomy showed tubo-ovarian mass which was confirmed on histopathology. Pus culture and sensitivity was done for third case and accordingly treated with medical management.

As the present study is done at tertiary cancer centre, these patients were referred from outside facility with a suspicion of malignancy. Ultrasound guided FNAC aided in an early diagnosis of these suspicious lesions as benign or infective.

The age of patients in the present study was 18-76 years. In the study by Parajuli S et al [21] and Tan KB et al [22] age of patients were between 19- 83 years and 11-82 years respectively.

Out of 161 cases, guided FNAC were conclusive in 90.03% cases, inconclusive in 6.24% cases and acellular in 3.73%. The study done by Sheikh M [14]Reyaz TA [15], Tuladhar AS,[8] Vasilj A [12] and Namshiker AAN [6] also gave conclusive diagnosis in 93.4%, 90.5%, 86.6%, 82.3% and

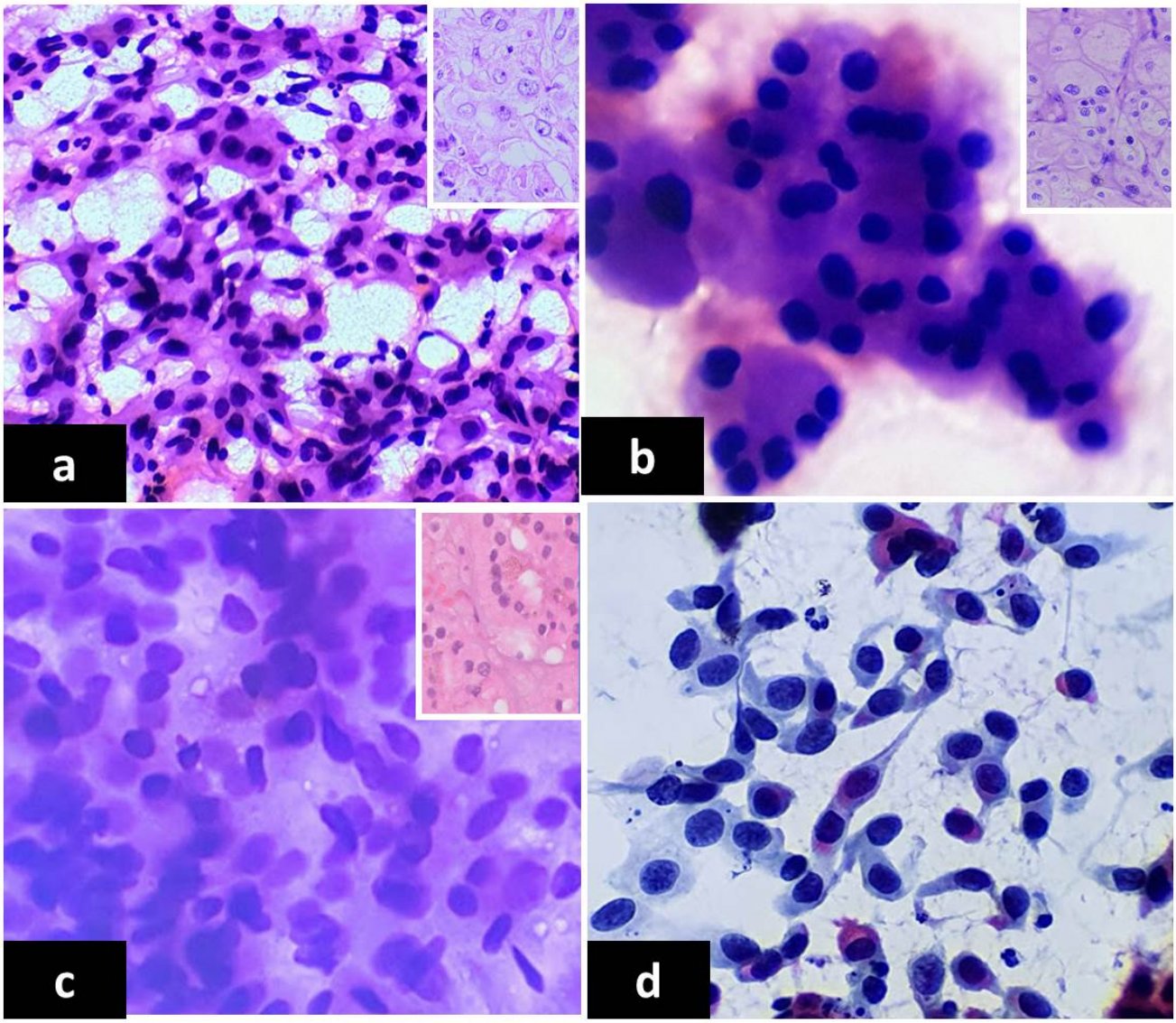

Fig. 5: Cytology and corresponding histopathology (if available) from kidney; **(a) Renal cell carcinoma, clear cell type-** Loosely cohesive cell clusters, abundant fragile, vacuolated cytoplasm, mild pleomorphic small nuclei, inconspicuous nucleoli with few endothelial cells. (H&E, 40x) and **INSAT**- Microphotograph of histopathology of the corresponding kidney, **(b)Renal cell carcinoma, chromophobe type-** Clustered cells, majority with abundant granular and vacuolated cytoplasm, some much smaller cells, moderate anisokaryosis, cytoplasm condensed peripherally, perinuclear pale area. (H&E, 40x) and **INSAT**- Microphotograph of histopathology of the corresponding kidney, **(c) Papillary renal cell carcinoma-** Clustered small epithelial cells, mainly basophilic, with low-grade uniformly small nuclei (H&E, 40x), and **INSAT**- Microphotograph of histopathology of the corresponding kidney, **(d) Transitional cell carcinoma, renal pelvis-** Cells dispersed singly with a nucleated globular body and a unipolar non tapering cytoplasmic process the ends of which are bulbous or flattened. These cells are called CERCARIFORM cells. (Pap, 40x)

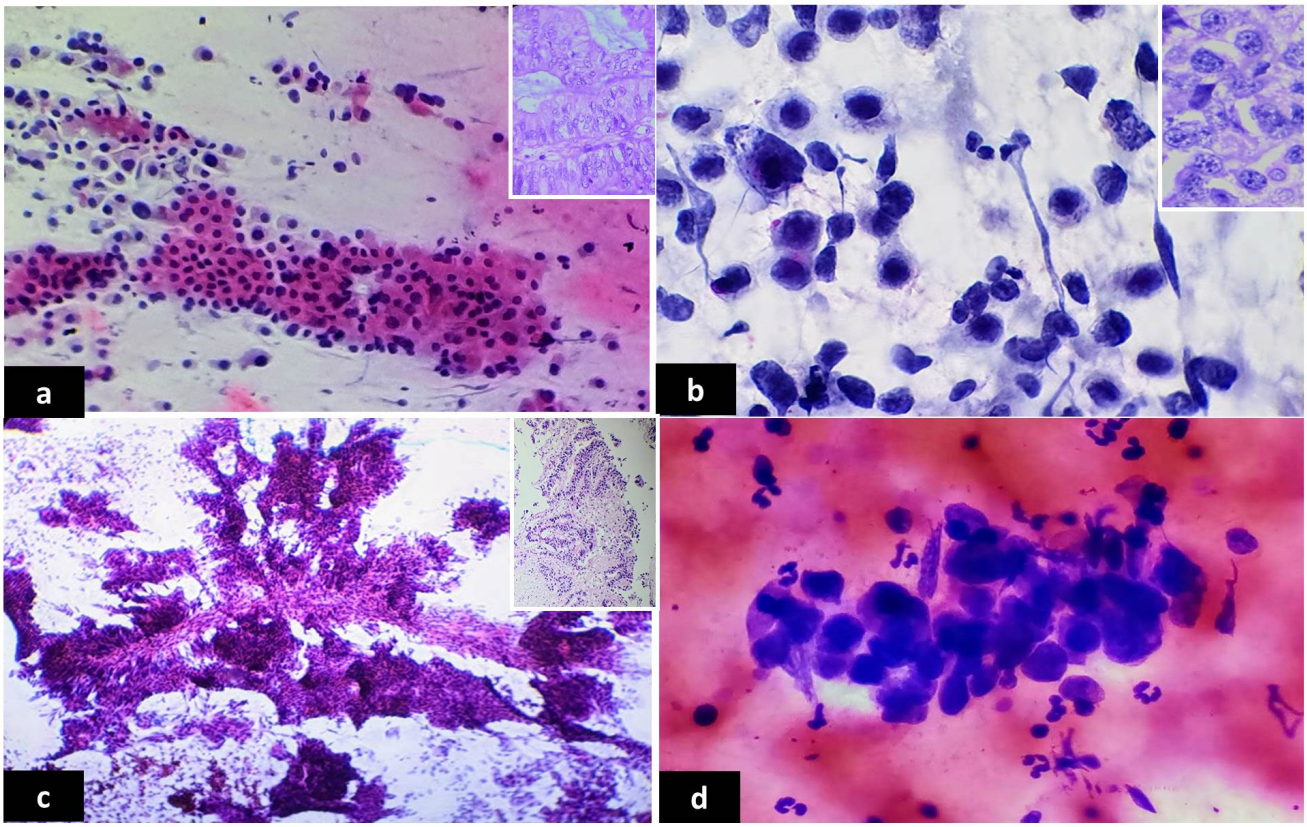

Fig. 6: (a) Adenocarcinoma (gall bladder)- Well-differentiated adenocarcinoma with pleomorphic hyperchromatic nuclei and mucin in the background. (Pap, 40x), **(b) Non- Hodgkin lymphoma -Diffuse large B-cell (retroperitoneum)**- Large atypical lymphocytes with pale nuclei, scanty cytoplasm and multiple nucleoli (H&E, 40x), **(c) Adenocarcinoma pancreas, metastasis from stomach** (H&E, 25x) and **(d) Adenocarcinoma (caecum)-** Tumour cells showing minimal cytoplasm, high nucleo-cytoplasmic ratio, hyperchromatic and pleomorphic nuclei. (H&E, 40x).

72.0%respectively. (Table 9)

Ultrasound guided FNAC has high sensitivity and specificity with high diagnostic yield and low complication rate. The sensitivity and specificity in the present study were 90.9% and 100% respectively. The study done by Satarkar R,[16] Momota N,[3] Reddy S,[5] Hemalatha AL,[17] Mangal N,[2] Stewart CJR,[18] and showed sensitivity as 97.1%, 95.0%, 94.1%, 94.1%, 94.0% and 86% respectively. (Table 10)

Guided FNAC of intra-abdominal organs like liver, kidney, lymph nodes and other pelvic masses are well appreciated, with no adverse impact on prognosis. The point of controversy exists for ovary FNAC, especially cystic ovarian masses.[7] Historically FNAC from ovarian masses were discouraged due to expected risk of spillage and possible upstaging.[23,24] On the other hand preoperartive pathological diagnosis is very important to plan neoadjuvant chemotherapy.[25] It can be done either by FNAC or trucut biopsy of ovary. In these cases risk ofseedling or spillage into peritoneal cavity can be prevented by using thin bore needle and avoiding multiple passes.[26]

To ascertain the complication rate associated with ultrasound guided puncture of gynecologic lesions, Zanetta et al[27] did study of 838 cases of ovarian masses. No life-threatening complications were recorded. This study concluded that complication rates depend on the type of lesion. It is low in cases of serous cysts, solid tumors, and mixed tumors of ovary.

1. The study done by Dordoni et al. show no complications, except one case of persistent hematuria.[28]

However, puncture induced seedling of malignant cells by FNAC of ovarian masses is not supported by adequate and conclusive literature,[29,30] although the problem appears real.[31] Larger trials should be targeted to address the issue of seedling/ spillage of malignant cells during the procedure are needed to prove or disprove its debatable role in diagnosis. The procedure, on the other hand, may help in avoiding unnecessary surgery or laparotomy and making decisions. In the present study out of 03 cases of tubo-ovarian masses 01 case was treated medically. Similarly the study done by Zanetta et al. also concludes that FNAC can decrease the need for surgery in many cases.[27] Preventing

Table 3: Distribution of cytologic diagnosis according to organs and site

Site	FNAC diagnosis		No. of cases		Total
Ovary	Non- neoplastic	Abscess	03		73 cases
		Endometriotic cyst	03		
	Benign	Benign cyst	01	10	
		Benign serous/ mucinous cystadenoma	06		
	Malignant	Germ cell tumour	06	52	
		Serous/ mucinous adenocarcinoma	46		
	Inconclusive for benign/ malignant			08	
Liver	Non- neoplastic	Chronic liver disease		01	45 cases
	Benign	Hemangioma		04	
	Malignant	Hepatocellular carcinoma	18	38	
		Metastatic deposit	20		
	Inconclusive for benign/ malignant			01	
Kidney	Acellular			01	27 cases
	Malignant	Renal cell carcinoma		21	
	Inconclusive for benign/ malignant			01	
	Acellular			05	
Gall Bladder	Malignant	Adenocarcinoma		07	07 cases
Colon	Malignant	Adenocarcinoma		03	03 cases
Pelvic mass	Non- neoplastic	Abscess		01	03 cases
	Malignant	Squamous cell carcinoma		01	
		Gastrointestinal stromal tumour		01	
Pancreas	Malignant	Adenocarcinoma		02	02 cases
Retroperitoneal lymph node	Malignant	Non Hodgkin Lymphoma		01	01 cases
n= 161					

Table 4: Incidence, serum tumour markers, cytology and histopathology diagnosis of Malignant Germ Cell Tumours of ovary

Case	Malignant Germ Cell Tumour Of Ovary (Gct)						
	Age (years)	Serum tumour markers				Cytology diagnosis	Histopathology diagnosis
		β HCG	AFP	LDH	CA 125		
01	45	Normal	Elevated	Elevated	Normal	Malignant GCT	Yolk sac tumour
02	23	Elevated	Elevated	Elevated	Elevated	Malignant GCT	Mixed germ cell tumour
03	21	Elevated	Normal	Elevated	Normal	Malignant GCT	Mixed germ cell tumour
04	33	Elevated	Elevated	Elevated	Elevated	Malignant GCT	Mixed germ cell tumour
05	21	Elevated	Normal	Elevated	Normal	Dysgerminoma	Dysgerminoma
06	34	Normal	Elevated	Normal	Normal	Teratoma	Immature Teratoma

surgeries can also aid in preserving the reproductive ability in young females.[29,32] Specific clinical scenarios where ovarian FNAC may represent the preferred approach are:[23]

1. Medically unfit patient for open surgery, needle biopsy represents a safer and non-invasive diagnostic tool.
2. In patients that present with a clinically advanced malignancy, when primary or neoadjuvant chemotherapy may be appropriate.
3. Needle aspiration of an adnexal cyst may be used to facilitate removal utilizing a minimally invasive approach.

Despite many controversial views regarding its safety, aspiration cytology of ovarian masses has been accepted as an innocuous procedure and it can be accomplished with minimal discomfort or complications.[33] Minor complications such as pain or discomfort can be alleviated by analgesics.

In the present study any major complication or tumour seedling/ spillage were not seen in any case, of ovarian FNACs. Studies done by Hemalatha A L et al.,[17] Kouli

Table 5: Histopathology and ultrasound guided FNAC diagnosis correlation

Site	No. of cases	Cases were cytology and histopathology were done		Correlation
		Ultrasound guided FNAC diagnosis	**Histopathology diagnosis**	
Ovary	02 cases	Non-neoplastic	Non-neoplastic	100%
	10 cases	Benign	Benign	100%
	52 cases	Malignant (52 cases)	Malignant (51 cases)	98%
	08 cases	Inconclusive for benign/ malignant	Malignant	
Liver	01 case	Malignant	Malignant	100%
Kidney	27 cases	Malignant	Benign Pheochromocytoma (01 case)	95.3%
			Malignant (26 cases)	
Gall bladder	05 cases	Malignant	Malignant	100%
Pelvic mass	02 case	Malignant	Malignant	100%
Pancreas	02 case	Malignant	Malignant	100%
Retroperitoneal lymph node	01 case	Malignant	Malignant	100%
Total 110 cases				

Table 6: Comparison of radiation, complication, time taken for procedure and cost of ultrasound and CT scan

Character	Technique	Radiation	Complication	Time taken	Cost
Ultrasound		Nil / Minimal	Less	Less	Less
CT		More	More	More	More

Table 7: Comparison of diagnostic yield of ultrasound and CT scan

Technique	Study	Diagnostic yield	
		Ultrasound (%)	CT (%)
Khosla et al.[13]		92.1	91.8
Jarmakani et al.[11]		87	65
Lee et al.[10]		85	76

Table 8: Challenges in localization of target area

Impediments of ultrasound guided intrabdominal FNAC
Overlying rib
Deep seated pelvic lesion
Mid pelvic lesion
Proximity of vascular structure
Overlying solid organ

Table 9: Comparison of studies for conclusive FNAC diagnosis

Studies	Conclusive FNAC diagnosis
Sheikh M[14]	93.4%
Tasleem Ahmad[15]	90.5%
Present study	**90.03%**
Tuladhar AS[8]	86.6%
Vasilj A[12]	82.3%
Namshiker AAN[6]	72.0%

Table 10: Comparison of sensitivity and specificity with other studies

Studies	Sensitivity	Specificity
Satarkar R [16]	97.1%	100%
Momota N [3]	95.0%	100%
Reddy S [5]	94.1%	100%
Hemalatha AL [17]	94.1%	100%
Mangal N [2]	94.0%	100%
Present study	**90.9%**	**100%**
Stewart CJR [18]	86%	100%

R,[20] Virkar M et al [29] and Pranab Dey et al.[30] also did not reveal any case of tumour seedling.

6. Conclusion

Imaging can precisely localize the masses located intra-abdominally. But, imaging cannot delineate neoplastic from non-neoplastic lesions. Pathologists are well trained in performing and reporting FNACs of palpable masses. Challenge is to get good cellular yield from non-palpable masses where ultrasound guidance is required. Good hand eye co-ordination with ultrasound probe may help to reach the target areas. Synergistic approach of ultrasound and FNAC plays a very crucial role in diagnosing and delineating non-neoplastic from neoplastic lesions, without radiation, minimal pain and minimal cost. Early detection with appropriate therapy can be initiated rapidly, thus guiding clinicians in staging and planning the treatment of intra-abdominal masses.

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None.

8. Conflict of Interest

The authors declare no conflict of interest.

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