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Original Research Article

Cytological Spectrum of Hepatobiliary and Pancreatic Mass Lesions Diagnosed by Image-Guided Fine-Needle Aspiration: A Prospective Study

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Abstract

Background: Hepatobiliary and pancreatic mass lesions include inflammatory, benign, primary malignant and metastatic conditions. Imaging helps localize these lesions, but cytological examination may be required for their classification.

Objective: To determine the cytological spectrum and clinicodemographic distribution of hepatobiliary and pancreatic mass lesions sampled by image-guided fine-needle aspiration cytology (FNAC).

Materials and Methods: This prospective cross-sectional study included 159 patients with radiologically detected hepatobiliary or pancreatic mass lesions referred for image-guided FNAC between October 2023 and September 2024. Aspirations were performed under ultrasonographic or computed-tomographic guidance. Giemsa-stained smears were examined and classified according to their cytological features. Data were summarized as frequencies and percentages. The association of cytological diagnosis with age group and sex was assessed using the chi-square test.

Results: Ofthe 159 participants, 79 (49.7%) were older than 60 years and 90 (56.6%) were female. The liver was the most frequently sampled site (59.1%), followed by the gallbladder (33.3%). Ultrasonography was used to guide FNAC in 95.0% of cases. Cytological examination identified 139 (87.4%) malignant and 20 (12.6%) benign or non-malignant lesions. Adenocarcinoma was the most frequent diagnosis (32.1%), followed by metastatic adenocarcinoma (30.2%), hepatocellular carcinoma (13.2%) and other metastatic carcinomas (11.9%). Cytological diagnosis was not significantly associated with age group (p=0.364), but its distribution differed according to sex (p=0.001).

Conclusion: Malignant lesions formed the majority of hepatobiliary and pancreatic masses sampled by image-guided FNAC. Adenocarcinoma and metastatic adenocarcinoma were the most frequent diagnoses. Image-guided FNAC provided cytological classification of lesions detected on imaging.

Keywords: Fine-Needle Aspiration Cytology; Hepatobiliary Lesions; Pancreatic Lesions; Image-Guided FNAC; Adenocarcinoma; Hepatocellular Carcinoma.

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Introduction

Hepatobiliary and pancreatic mass lesions include inflammatory conditions, cysts, benign neoplasms, primary malignancies and metastatic deposits. Focal liver lesions may be detected during clinical evaluation or abdominal imaging and can arise from hepatocytes, bile ducts, vascular tissue or other mesenchymal components. The liver is also a common site of metastasis from malignancies of the gastrointestinal tract, lung, breast and other organs. Differentiating primary hepatic tumours from metastatic deposits is important because their clinical management differs.[1] Hepatocellular carcinoma (HCC) is the most common primary malignant tumour of the liver. Its risk factors include chronic hepatitis B or C infection, cirrhosis, alcohol consumption, metabolic disorders, obesity, type 2 diabetes mellitus and exposure to aflatoxins.[2] In a non-cirrhotic liver, malignant focal lesions are often metastatic, whereas HCC is more commonly encountered in patients with cirrhosis. Clinical findings, liver-function tests and imaging help narrow the differential diagnosis, but

lesions with similar radiological appearances may require morphological examination.[3] Although viral hepatitis remains an established risk factor, alcohol-related liver disease and metabolic dysfunction-associated steatotic liver disease are being reported with increasing frequency.[4]

Gallbladder cancer is more frequent in some regions of India, particularly northern India. Gallstones, chronic gallbladder inflammation, genetic factors and environmental exposures have been associated with its occurrence.[5]

Biliary tract cancers include gallbladder carcinoma, intrahepatic and extrahepatic cholangiocarcinoma and carcinoma of the ampulla of Vater. Their incidence varies across geographical regions, and many patients present after the disease has progressed because early symptoms are often absent or nonspecific.[6] Depending on the site of origin, patients may present with abdominal pain, jaundice, loss of appetite, weight loss or altered liver-function tests. Hepatobiliary tumours may therefore require clinical, radiological and pathological assessment for classification.[7]

Incidence of pancreatic cancer differs across regions of India, with higher rates reported from some northeastern states.

Tobacco exposure, dietary factors, obesity, physical inactivity, diabetes and chronic pancreatitis have been associated with pancreatic cancer.[8] Pancreatic masses may remain clinically silent during the early stages, and tissue sampling is often required when imaging alone does not establish the diagnosis.

Ultrasonography and computed tomography are used to identify hepatobiliary and pancreatic masses and to assess their size, location, extent and relationship with surrounding structures.

However, imaging may not always distinguish inflammatory or benign lesions from malignant tumours. Image guidance allows a needle to be directed into deep-seated lesions while avoiding major vessels and adjacent organs. Radiological and cytological findings are therefore complementary.

Fine-needle aspiration cytology (FNAC) provides cellular material for microscopic examination and was introduced as a diagnostic technique by Martin and Ellis.[9]

When performed under ultrasonographic or computed-tomographic guidance, FNAC can be used to classify hepatobiliary and pancreatic masses as inflammatory, benign, primary malignant or metastatic. It may also help determine the likely tumour type and guide further investigation or treatment.[10]

The present study was undertaken to determine the cytological spectrum and clinicodemographic distribution of hepatobiliary and pancreatic mass lesions diagnosed by image-guided FNAC, with emphasis on primary and metastatic liver lesions.

Materials and Methods

This prospective cross-sectional study was conducted in the Department of Pathology, Government Medical College and Associated Group of Hospitals, Kota, Rajasthan, from October 2023 to September 2024. Patients with clinically and radiologically suspected liver, gallbladder or pancreatic mass lesions were recruited from New Medical College Hospital and Maharao Bhim Singh Hospital.

Patients of any age and either sex with a radiologically detected hepatobiliary or pancreatic mass who were referred for image-guided fine-needle aspiration cytology (FNAC) were included. Patients with bleeding tendencies or an abnormal coagulation profile, those who were unable to cooperate during the procedure and those with intra-abdominal masses arising from other organs were excluded. Cases that yielded inadequate material for cytological examination were also excluded from the final analysis.

Image-guided FNAC procedure: The procedure was explained to each patient in their preferred language, and written informed consent was obtained before aspiration. The imaging modality was selected according to the size, location and visibility of the lesion. Ultrasonography was used for lesions that could be adequately visualized and approached under real-time guidance, whereas CT guidance was used for deep-seated or poorly visualized lesions. All aspirations were performed in collaboration with a radiologist.

The patient was positioned to provide safe access to the target lesion. After cleaning the puncture site with an antiseptic solution and maintaining aseptic precautions, the lesion was localized by USG or CT. A 22-gauge needle attached to a 10-mL disposable syringe was introduced into the lesion through a suitable needle path determined by the radiologist. For USG-guided procedures, a freehand technique was used under continuous real-time visualization. Once the needle tip was confirmed within the lesion, negative pressure was applied and the needle was moved gently within the target area to obtain adequate cellular material. Excessive movement was avoided to minimize tissue injury. The negative pressure was released before withdrawing the needle.

The aspirated material was immediately expelled onto clean, labelled glass slides. Smears were prepared by spreading the material into a thin and uniform layer. Each slide was labelled with the

patient's identification details and the anatomical site of aspiration.

Fixation, staining and cytological evaluation: The smears were air-dried and fixed in methanol for 15–20 minutes. They were then stained with Giemsa stain freshly diluted with nine volumes of buffered water at pH 6.8. The slides were kept in the staining solution for 10–15 minutes, washed in three to four changes of buffered water and placed upright to dry. After drying, the smears were mounted with coverslips.

The stained smears were examined microscopically by pathologists. Cytological diagnoses were made on the basis of cellular arrangement, nuclear and cytoplasmic features, background material and other relevant cytomorphological findings. Lesions were classified as benign or non-malignant, inflammatory, primary malignant or metastatic, as appropriate. Following the procedure, patients were observed in the radiology department for 1–2 hours. Vital signs were monitored at regular intervals, and patients were assessed for any immediate procedure-related complication.

Statistical analysis: Data were entered into Microsoft Excel and analysed. Categorical variables were summarized as frequencies and percentages. The Pearson chi-square test was used to assess the association of cytological diagnosis with age group, sex and radiological impression. Similar analyses were performed separately for liver and gallbladder lesions, where applicable. All tests were two-sided, and a p-value <0.05 was considered statistically significant. Exact p-values were reported, except for values <0.001.

Results

Table 1: Descriptive characteristics of the study population (N=159)

Characteristic	Category	Frequency	Percentage
Age group (years)	<40	9	5.7
	41–50	18	11.3
	51–60	53	33.3
	>60	79	49.7
Sex	Female	90	56.6
	Male	69	43.4
Chief complaint	Pain abdomen	87	54.7
	Pain abdomen with vomiting	44	27.7
	Fever with pain abdomen	25	15.7
	Abdominal lump	2	1.3
	Pain abdomen, lump and vomiting	1	0.6
Anatomical Site	Liver	94	59.1
	Gallbladder	53	33.3
	Liver and gallbladder	5	3.1
	Pancreas	6	3.8
	Pancreas and liver	1	0.6

[Table-1] Among the 159 participants, 79 (49.7%) were older than 60 years, 53 (33.3%) were aged 51–60 years, 18 (11.3%) were aged 41–50 years and nine (5.7%) were younger than 40 years. The study included 90 (56.6%) females and 69 (43.4%) males. Abdominal pain was the most common presenting complaint, reported by 87 (54.7%) participants, followed by abdominal pain with vomiting in 44 (27.7%) and fever with abdominal pain in 25 (15.7%). An abdominal lump was reported by two (1.3%) participants, while one (0.6%) presented with abdominal pain, a lump and vomiting. The liver was the most frequently sampled anatomical site, accounting for 94 (59.1%) cases, followed by the gallbladder in 53 (33.3%). Pancreatic lesions were sampled in six (3.8%) cases, combined liver and gallbladder lesions in five (3.1%) and combined pancreatic and liver lesions in one (0.6%) case.

Table 2: Viral-marker status, alcohol history, imaging modality, and radiological and cytological findings (N=159)

Characteristic	Category	Frequency	Percentage
Viral-marker status	Negative	149	93.7
	Hepatitis C positive	10	6.3
History of alcohol intake	No	100	62.9
	Yes	59	37.1
Imaging modality used for FNAC	Ultrasonography	151	95
	Computed tomography	8	5
Radiological impression	Metastatic	80	50.3
	Neoplastic	70	44

	Benign	4	2.5
	Inflammatory	4	2.5
	Cholelithiasis	1	0.6
Broad cytopathological classification	Malignant	139	87.4
	Benign/non-malignant	20	12.6

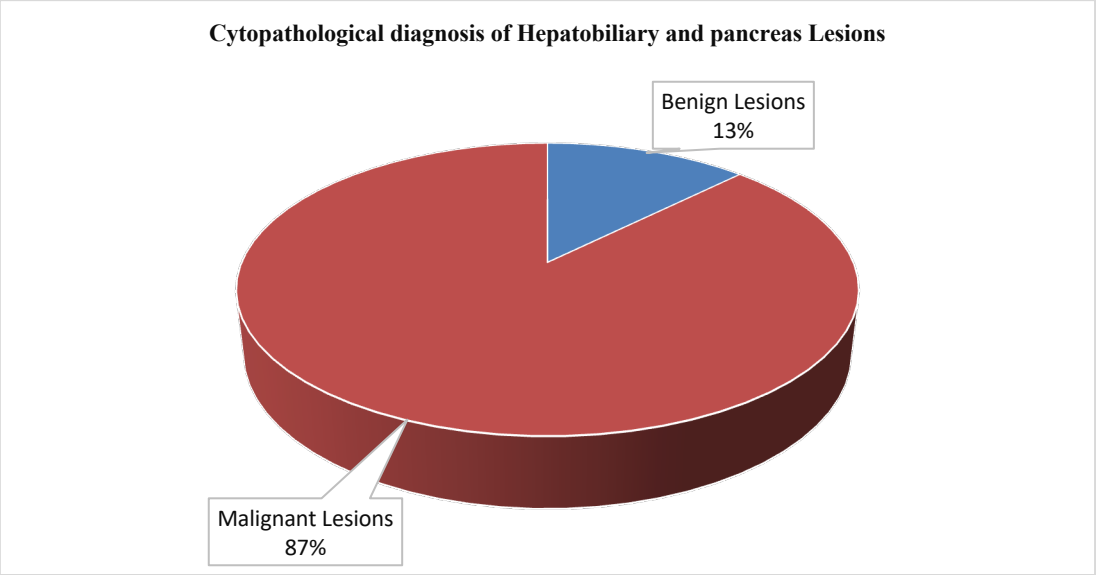

Figure 1: Cytopathological diagnosis of Hepatobiliary and pancreas Lesions

[Table-2] Hepatitis C virus markers were negative in 149 (93.7%) participants and positive in 10 (6.3%). A history of alcohol intake was reported by 59 (37.1%) participants. Ultrasonography was used to guide FNAC in 151 (95.0%) cases, whereas computed tomography was used in eight (5.0%). The radiological impression was metastatic in 80 (50.3%) cases and neoplastic in 70 (44.0%). Four (2.5%) lesions each were classified as benign and inflammatory, while one (0.6%) was associated with cholelithiasis. Cytological examination showed malignant lesions in 139 (87.4%) cases and benign or non-malignant lesions in 20 (12.6%) cases.

Table 3: Cytological diagnoses according to age group among the study population

Cytological diagnosis	<40 years (n=9)	41–50 years (n=18)	51–60 years (n=53)	>60 years (n=79)	Total (N=159)
Abscess	1 (11.1)	0 (0.0)	1 (1.9)	0 (0.0)	2 (1.3)
Acute inflammatory lesion	0 (0.0)	0 (0.0)	2 (3.8)	3 (3.8)	5 (3.1)
Adenocarcinoma	2 (22.2)	6 (33.3)	17 (32.1)	26 (32.9)	51 (32.1)
Benign lesion	1 (11.1)	2 (11.1)	3 (5.7)	3 (3.8)	9 (5.7)
Granulomatous inflammation	0 (0.0)	0 (0.0)	1 (1.9)	0 (0.0)	1 (0.6)
Haemorrhagic smear	0 (0.0)	0 (0.0)	1 (1.9)	0 (0.0)	1 (0.6)
Hepatocellular carcinoma	2 (22.2)	1 (5.6)	4 (7.5)	14 (17.7)	21 (13.2)
Hydatid cyst	0 (0.0)	1 (5.6)	0 (0.0)	0 (0.0)	1 (0.6)
Metastatic adenocarcinoma	2 (22.2)	7 (38.9)	18 (34.0)	21 (26.6)	48 (30.2)
Other metastatic carcinoma	1 (11.1)	1 (5.6)	5 (9.4)	12 (15.2)	19 (11.9)
Xanthogranulomatous cholecystitis	0 (0.0)	0 (0.0)	1 (1.9)	0 (0.0)	1 (0.6)
Total	**9 (100.0)**	**18 (100.0)**	**53 (100.0)**	**79 (100.0)**	**159 (100.0)**

[Table-3] Adenocarcinoma was the most frequent cytological diagnosis, identified in 51 (32.1%) cases, followed by metastatic adenocarcinoma in 48 (30.2%), hepatocellular carcinoma in 21 (13.2%) and other metastatic carcinomas in 19 (11.9%). Among participants older than 60 years, adenocarcinoma was the most frequent diagnosis (32.9%), followed by metastatic adenocarcinoma (26.6%) and hepatocellular carcinoma (17.7%). Metastatic adenocarcinoma was the most frequent diagnosis among participants aged 41–50 years (38.9%) and 51–60 years (34.0%). Cytological diagnosis was not significantly associated with age group (χ^2=32.073, p=0.364).

Table 4: Cytological diagnoses according to sex among the study population

Cytological diagnosis	Female (n=90)	Male (n=69)	Total (N=159)
Abscess	0 (0.0)	2 (2.9)	2 (1.3)
Acute inflammatory lesion	1 (1.1)	4 (5.8)	5 (3.1)
Adenocarcinoma	39 (43.3)	12 (17.4)	51 (32.1)
Benign lesion	6 (6.7)	3 (4.3)	9 (5.7)
Granulomatous inflammation	1 (1.1)	0 (0.0)	1 (0.6)
Haemorrhagic smear	1 (1.1)	0 (0.0)	1 (0.6)
Hepatocellular carcinoma	5 (5.6)	16 (23.2)	21 (13.2)
Hydatid cyst	0 (0.0)	1 (1.4)	1 (0.6)
Metastatic adenocarcinoma	30 (33.3)	18 (26.1)	48 (30.2)
Other metastatic carcinoma	7 (7.8)	12 (17.4)	19 (11.9)
Xanthogranulomatous cholecystitis	0 (0.0)	1 (1.4)	1 (0.6)
Total	**90 (100.0)**	**69 (100.0)**	**159 (100.0)**

[Table-4] Among females, adenocarcinoma was the most frequent diagnosis, accounting for 39 (43.3%) cases, followed by metastatic adenocarcinoma in 30 (33.3%). Among males, metastatic adenocarcinoma was the most frequent diagnosis in 18 (26.1%) cases, followed by hepatocellular carcinoma in 16 (23.2%). Adenocarcinoma and other metastatic carcinomas each accounted for 12 (17.4%) male cases. Adenocarcinoma was more frequent among females, whereas hepatocellular carcinoma and other metastatic carcinomas were more frequent among males. Cytological diagnosis was significantly associated with sex (χ^2=30.938, p=0.001).

Discussion

This prospective study described the cytological findings of 159 hepatobiliary and pancreatic mass lesions sampled under imaging guidance. Most participants were older than 50 years, and females formed a slightly larger proportion of the study population. The liver was the most frequently sampled site, followed by the gallbladder. Malignant lesions accounted for 87.4% of cases, with adenocarcinoma, metastatic adenocarcinoma and hepatocellular carcinoma forming the main diagnostic categories.

The greater number of patients in the older age groups reflects the occurrence of hepatobiliary malignancies with advancing age. The overall female predominance may partly be related to the number of gallbladder lesions in the study population. Previous Indian and international studies have also reported a female predominance among patients with gallbladder carcinoma, although the distribution varies across geographical regions.[3,11,12]

The liver accounted for 59.1% of the sampled lesions. Adenocarcinoma and metastatic adenocarcinoma together formed the largest proportion of cytological diagnoses. The liver is a common site of metastasis from malignancies arising in the gastrointestinal tract, lung, breast and other organs. Previous studies of image-guided hepatic FNAC have also reported metastatic adenocarcinoma as a frequent diagnosis.[8,9,13,14] Hepatocellular carcinoma accounted for 13.2% of the cases and was more frequent among males than females.

Gallbladder lesions constituted one-third of the study population. Adenocarcinoma was more frequent among females, which is consistent with the reported sex distribution of gallbladder carcinoma.[3,10,11,15] However, the present study was not designed to identify the factors responsible for this difference. Pancreatic lesions were uncommon, with only seven cases involving the pancreas either alone or together with the liver. Therefore, conclusions regarding pancreatic lesions cannot be drawn from these data. The use of endoscopic ultrasound-guided sampling for pancreatic lesions may partly explain the small number of percutaneous pancreatic aspirations.[16,17]

Cytological diagnosis was not significantly associated with age group but differed according to sex. These findings should be interpreted cautiously because several diagnostic categories contained small or zero frequencies. The study was conducted at a single tertiary-care centre and included a referred population. Inadequate samples were excluded, and histopathological confirmation and follow-up were not available for all cases. Associations of cytological diagnosis with hepatitis C infection and alcohol intake were also not examined. Despite these limitations, the study describes the pattern of hepatobiliary and pancreatic lesions encountered during image-guided FNAC at a tertiary-care centre. The findings support the use of cytology with clinical and radiological assessment for the initial classification of these mass lesions.

Conclusion

Image-guided FNAC demonstrated a range of hepatobiliary and pancreatic lesions, with malignant

lesions accounting for most cases. The liver was the most frequently sampled site, followed by the gallbladder. Adenocarcinoma and metastatic adenocarcinoma were the most common cytological diagnoses, followed by hepatocellular carcinoma and other metastatic carcinomas. Cytological diagnosis was not significantly associated with age group, although differences were observed according to sex. Image-guided FNAC provides cellular material for classifying radiologically detected masses and helps distinguish benign and inflammatory lesions from primary and metastatic malignancies. The cytological findings should be interpreted with the clinical and radiological features, while histopathology and ancillary tests may be used when further characterization is required. Further multicentre studies with larger samples and histopathological correlation are recommended to confirm these findings and assess the diagnostic performance of image-guided FNAC.

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