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Histopathological Spectrum of Liver Lesions in Autopsy Specimens: A Descriptive Study at A Tertiary Care Center

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Abstract

Background: Liver diseases contribute significantly to global morbidity and mortality, yet many remain asymptomatic until advanced stages. Autopsy-based histopathological examination provides unique opportunity to study liver pathology spectrum in unselected population, identifying lesions that may have remained undiagnosed clinically. Limited region-specific data from Rajasthan necessitates comprehensive documentation of liver lesion patterns in autopsy specimens.

Objective: To investigate and document the histopathological spectrum of liver lesions in autopsy specimens received at SMS Medical College, Jaipur, and analyze their demographic distribution.

Methods: Descriptive observational study of 404 liver autopsy specimens received in Department of Pathology, SMS Medical College, Jaipur. Specimens underwent routine histopathological processing with hematoxylin and eosin staining. Demographic data (age, gender) and gross characteristics documented. Microscopic examination identified various liver lesions including congestion, steatosis, cirrhosis, cholestasis, necrosis, granulomas, and neoplasms. Statistical analysis performed using SPSS version 23.0.

Results: Among 404 autopsy specimens, marked male predominance observed (333 males [82.4%] vs 71 females [17.6%]). Mean age 45.2±18.6 years (range 2-82 years), with peak incidence in 31-50 years age group. Most common histopathological finding was congestion (382 cases, 94.55%), followed by fatty change/steatosis (136 cases, 33.66%), and cirrhosis (21 cases, 5.2%). Fatty change showed marked male predominance (94.85%) with peak in 31-40 years age group. Cirrhosis occurred exclusively in males aged 31-70 years. Rare findings included cholestasis (5 cases, 1.24%), necrosis

(2 cases, 0.50%), tubercular granulomas (1 case, 0.25%), and malignant neoplasm (1 case, 0.25%). Multiple lesions coexisted in many specimens, with fatty change and congestion frequently occurring together.

Conclusion: This autopsy-based study reveals diverse histopathological liver lesion spectrum at SMS Medical College, Jaipur. Congestion was most prevalent (94.55%), followed by fatty change (33.66%) and cirrhosis (5.2%). Marked male predominance, particularly in metabolic/lifestyle-related lesions (fatty change, cirrhosis), reflects sociodemographic patterns and potential occupational/behavioral factors. High fatty change prevalence (33.66%) aligns with rising metabolic syndrome burden. Rare lesions (<2% collectively) emphasize importance of thorough autopsy examination. These findings provide baseline regional data for liver pathology patterns, highlighting preventable conditions requiring public health interventions.

Keywords*:* Liver Lesions, Autopsy, Histopathology, Steatosis, Cirrhosis, Fatty Liver, Hepatic Pathology, SMS Medical College

Introduction

The liver, performing over 500 essential physiological functions including carbohydrate, protein, and lipid metabolism, detoxification, and bile production, is central to human homeostasis.[1,2] Globally, liver diseases account for approximately 2 million deaths annually, representing a significant proportion of worldwide morbidity and mortality.[3] Despite this burden, many liver diseases remain asymptomatic until advanced stages, with conditions like non-alcoholic fatty liver disease (NAFLD) and cirrhosis often discovered incidentally or post-mortem.[4]

Autopsy, derived from Greek autopsia meaning "to see for oneself," remains a cornerstone of medical education and quality assurance in healthcare.[5] Autopsy-based histopathological examination provides unique opportunity to study disease patterns in unselected populations, identifying pathology that may have remained clinically undiagnosed during life.[6] In medicolegal autopsy setting, liver tissue examination frequently reveals incidental findings unrelated to cause of death but reflecting underlying disease burden in community.[7]

Common histopathological liver lesions encountered in autopsy specimens include fatty change (steatosis), characterized by intracytoplasmic lipid accumulation in hepatocytes, often associated with alcohol consumption, obesity, diabetes mellitus, and metabolic syndrome.[8,9] Steatohepatitis represents progression with hepatocyte ballooning, lobular inflammation, and Mallory-Denk bodies.[10] Cirrhosis, characterized by nodular regeneration separated by fibrous bands, reflects end-stage chronic liver injury from various etiologies including viral hepatitis, alcohol, and autoimmune diseases.[11] Hepatic congestion, passive accumulation of blood in hepatic sinusoids, commonly occurs in cardiovascular failure or shock states.[12]

Less common findings include necrosis (particularly centrilobular necrosis in shock or drug toxicity), granulomatous hepatitis (infectious or autoimmune etiologies), cholestasis (bile accumulation from obstruction or metabolic disorders), and neoplasms (hepatocellular carcinoma, cholangiocarcinoma, or metastases).[13,14] These diverse pathologies reflect liver's susceptibility to metabolic, infectious, toxic, vascular, and neoplastic insults.

Previous autopsy studies from India reported varying liver pathology prevalence. Studies from Mumbai, Delhi, and South India documented fatty change

prevalence ranging from 20-45%, cirrhosis 3-8%, and congestion 80-95%.[15,16] However, region-specific data from Rajasthan, particularly Jaipur, remains scarce. SMS Medical College, a major tertiary care center receiving medicolegal autopsy cases from diverse socioeconomic backgrounds, provides ideal setting for comprehensive liver pathology documentation.

Understanding regional liver lesion patterns has significant public health implications. High fatty change prevalence may indicate rising metabolic syndrome burden requiring lifestyle interventions.[17] Cirrhosis patterns inform viral hepatitis and alcohol consumption trends.[18] Rare lesion identification enhances diagnostic awareness. Furthermore, autopsy findings validate or challenge clinical diagnoses, contributing to medical education and quality improvement.[19]

This descriptive study aimed to systematically document histopathological spectrum of liver lesions in autopsy specimens received at SMS Medical College, Jaipur, analyze demographic distribution patterns, and provide baseline regional data for comparative studies. By examining unselected autopsy population, this study captures disease spectrum beyond clinically diagnosed cases, offering comprehensive view of liver pathology burden in Rajasthan population.

Materials and Methods

This descriptive observational study was conducted in Department of Pathology at SMS Medical College and Attached Hospitals, Jaipur, Rajasthan, following Institutional Ethics Committee approval. A total of 404 consecutive liver autopsy specimens received from medicolegal autopsies during study period were included. All specimens regardless of cause of death were enrolled to capture unselected disease spectrum.

Inclusion criteria: All liver specimens from medicolegal autopsies received in Department of Pathology, adequate tissue sample for histopathological examination, availability of basic demographic data (age, gender). Exclusion criteria: Severely autolyzed specimens precluding microscopic interpretation, incomplete demographic information, tissue samples inadequate for processing.

Specimen collection and processing: Liver specimens were obtained during routine medicolegal autopsies performed in Forensic Medicine Department. Representative tissue samples (approximately 2×2 cm) were collected from both lobes, fixed in 10% neutral buffered formalin for 24-48 hours. Gross examination documented liver weight, surface characteristics (smooth, nodular, irregular), color (brown, yellow, green, pale), consistency, and any visible lesions. Tissue samples underwent routine histopathological processing: dehydration through graded alcohols, clearing in xylene, infiltration and embedding in paraffin wax, sectioning at 4-5 micron thickness using microtome, and staining with hematoxylin and eosin (H&E). Special stains (Periodic Acid-Schiff, Masson's trichrome, reticulin) performed selectively when indicated.

Microscopic examination: Slides were examined by experienced pathologists using standardized criteria. Histopathological lesions identified and categorized: Congestion (sinusoidal dilatation with RBC accumulation), Steatosis/fatty change (intracytoplasmic lipid droplets, graded as mild/moderate/severe based on percentage affected hepatocytes), Steatohepatitis (steatosis plus hepatocyte ballooning, lobular inflammation, Mallory-Denk bodies), Cirrhosis (nodular regeneration with bridging fibrosis), Hepatitis (portal/lobular inflammation patterns), Cholestasis (bile

plugs in canaliculi/hepatocytes), Necrosis (hepatocyte death with coagulative/liquefactive changes), Fibrosis (collagen deposition graded by staging systems), Granulomas (epithelioid cell aggregates, classified as caseating/non-caseating), Neoplasms (primary/metastatic tumors), Other lesions (abscesses, vascular abnormalities, pigment deposition).

Statistical analysis: Data entered in Microsoft Excel and analyzed using SPSS version 23.0. Categorical variables expressed as frequencies and percentages. Continuous variables presented as mean±standard deviation with range. Age-wise and gender-wise distribution of major lesions tabulated. Chi-square test used for categorical associations. Statistical significance set at $p<0.05$.

Results

A total of 404 liver autopsy specimens were examined during the study period. Demographic characteristics, gross findings, and comprehensive histopathological spectrum are presented in Tables 1-5 and Figures 1-4.

Table 1: Demographic Characteristics of Autopsy Cases

Characteristic	Category	n (%) or Mean ± SD
Total Specimens	All cases	404 (100%)
Gender	Male / Female	333 (82.4%) / 71 (17.6%)
Age (years)	Mean ± SD / Range	45.2 ± 18.6 / 2-82 years
Age Distribution	0-20 / 21-40 / 41-60 / >60	38 (9.4%) / 152 (37.6%) / 168 (41.6%) / 46 (11.4%)
Peak Age Group	31-50 years	192 (47.5%)
Male: Female Ratio	Overall	4.7:1

Table 1 Description: Demographic analysis of 404 autopsy cases revealed marked male predominance with 333 males (82.4%) versus 71 females (17.6%), yielding male: female ratio of 4.7:1. Mean age was 45.2±18.6 years (range 2-82 years). Age distribution showed concentration in productive age groups: 21-40 years (37.6%) and 41-60 years (41.6%), collectively representing 79.2% of cases. Peak incidence occurred in 31-50 years age bracket (47.5%), reflecting predominance of working-age males in medicolegal autopsy setting. Extremes of age were uncommon: pediatric cases (<20 years) comprised 9.4% while elderly (>60 years) represented 11.4%. This demographic pattern reflects socioeconomic factors, occupational hazards, and lifestyle-related mortality in tertiary care referral population, with male predominance likely attributable to higher outdoor occupational exposure and accident rates in study region.

Table 2 Description: Histopathological spectrum revealed congestion as most prevalent finding (382 cases, 94.55%), reflecting terminal cardiovascular changes and agonal phenomena common in autopsy specimens. Fatty change/steatosis was second most common (136 cases, 33.66%), indicating substantial metabolic liver disease burden. Cirrhosis affected 21 cases (5.2%), representing end-stage chronic liver injury. Rare lesions collectively comprised <2% of cases: cholestasis (5 cases, 1.24%), necrosis (2 cases, 0.50%), tubercular granulomas (1 case, 0.25%), and malignant neoplasm (1 case, 0.25%). Notably, 156 cases (38.61%) demonstrated multiple coexisting lesions, commonly fatty change with congestion or cirrhosis with steatosis,

reflecting multifactorial liver injury patterns. This distribution pattern with predominance of congestion and fatty change while rare lesions remain uncommon aligns with autopsy-based liver pathology studies globally, though fatty change prevalence of 33.66% is notably high, potentially reflecting rising metabolic syndrome prevalence in study population.

Table 2: Prevalence of Histopathological Liver Lesions

Histopathological Lesion	Present	Absent	Prevalence (%)
Congestion	382	22	94.55%
Fatty Change (Steatosis)	136	268	33.66%
Cirrhosis	21	383	5.20%
Cholestasis	5	399	1.24%
Necrosis	2	402	0.50%
Tubercular Granuloma	1	403	0.25%
Malignant Neoplasm	1	403	0.25%
Multiple Lesions Coexisting	156	248	38.61%

Table 3 Description: Gender distribution analysis revealed striking male predominance in metabolic/lifestyle-related liver lesions. Fatty change showed extreme male predominance (129 males [94.85%] vs 7 females [5.15%]), yielding M: F ratio of 18.4:1—nearly 4-fold higher than overall sample ratio. Cirrhosis occurred exclusively in males (21 cases, 100%), with no female cases observed. This exclusive male distribution in cirrhosis, combined with marked male predominance in fatty change, suggests predominant role of alcohol consumption, occupational exposures, and metabolic risk factors concentrated in male population. Congestion showed less pronounced male predominance (M: F ratio 4.8:1), similar to overall sample distribution (4.7:1), indicating its nature as terminal/agonal phenomenon less influenced by gender-specific risk factors. These patterns align with epidemiological data showing higher alcohol consumption, smoking, and metabolic syndrome prevalence among males in Indian population, particularly in lower socioeconomic groups represented in medicolegal autopsies.

Table 3: Gender Distribution in Major Liver Lesions

Lesion Type	Male n(%)	Female n(%)	Total	M:F Ratio
Fatty Change	129 (94.85%)	7 (5.15%)	136	18.4:1
Cirrhosis	21 (100%)	0 (0%)	21	All males
Congestion	316 (82.7%)	66 (17.3%)	382	4.8:1
Overall Sample	333 (82.4%)	71 (17.6%)	404	4.7:1

Table 4 Description: Age distribution analysis revealed distinct patterns for major lesions. Fatty change peak incidence occurred in 31-40 years age group (38 cases, 27.9%), followed closely by 41-50 years (34 cases, 25.0%), with substantial representation continuing through 51-60 years (28 cases, 20.6%). This

concentration in 31-60 years range (73.5% of fatty change cases) reflects prime working years when metabolic syndrome risk factors accumulate. Cirrhosis showed later peak in 41-50 years (9 cases, 42.9%) and 51-60 years (6 cases, 28.6%), collectively representing 71.5% of cirrhosis cases. This age pattern reflects chronic nature of liver injury progression, with cirrhosis developing after years of sustained hepatic insult. Both lesions were rare in extremes of age: minimal cases in pediatric population (<20 years) and elderly (>70 years). The 10-year lag between fatty change peak (31-40 years) and cirrhosis peak (41-50 years) suggests progression timeline from metabolic liver disease to end-stage cirrhosis, emphasizing importance of early intervention in fatty liver disease to prevent cirrhotic evolution.

Table 4: Age Distribution of Fatty Change and Cirrhosis

Age Group (years)	Fatty Change n (%)	Cirrhosis n (%)	Total Cases	Overall %
0-20	2 (1.5%)	0 (0%)	38	9.4%
21-30	12 (8.8%)	1 (4.8%)	68	16.8%
31-40	38 (27.9%)	2 (9.5%)	84	20.8%
41-50	34 (25.0%)	9 (42.9%)	108	26.7%
51-60	28 (20.6%)	6 (28.6%)	60	14.9%
61-70	18 (13.2%)	3 (14.3%)	34	8.4%
>70	4 (2.9%)	0 (0%)	12	3.0%

Table 5 Description: Gross examination revealed majority of liver specimens appeared relatively normal macroscopically. Surface was smooth in 92.1% of cases, with nodular (1.5%) and irregular (6.4%) surfaces indicating underlying chronic pathology. Normal brown color predominated (96.3%), while pale yellow discoloration (1.7%) suggested fatty infiltration and greenish/bile-stained appearance (2.0%) indicated cholestasis. Consistency was normal in 93.6%, with firm/hard (4.5%) suggesting fibrosis/cirrhosis and soft/friable (2.0%) indicating acute pathology. Mean liver weight of 1420±340 grams fell within normal adult range (1200-1600 grams), though range extended from 850-2800 grams reflecting disease spectrum. Capsule integrity maintained in 97%, with thickening (2%) and adhesions (1%) indicating chronic inflammation. Cut surface homogeneity in 96% contrasted with nodular pattern (3%) characteristic of cirrhosis and focal lesions (1%) representing neoplasms/abscesses. Notably, gross findings frequently underestimated microscopic pathology—many cases with significant histological lesions (fatty change, early fibrosis) appeared grossly normal, emphasizing importance of routine microscopic examination in autopsy practice.

Table 5: Gross Characteristics of Liver Specimens

Gross Characteristic	Finding	n (%)
Surface Appearance	Smooth / Nodular / Irregular	372 (92.1%) / 6 (1.5%) / 26 (6.4%)
Color	Brown / Pale yellow / Greenish/bile-stained	389 (96.3%) / 7 (1.7%) / 8 (2.0%)
Consistency	Normal / Firm/Hard / Soft/Friable	378 (93.6%) / 18 (4.5%) / 8 (2.0%)

Weight (grams)	Mean ± SD / Range	1420 ± 340 / 850-2800
Capsule	Intact / Thickened / Adhesions	392 (97.0%) / 8 (2.0%) / 4 (1.0%)
Cut Surface	Homogeneous / Nodular / Focal lesions	388 (96.0%) / 12 (3.0%) / 4 (1.0%)

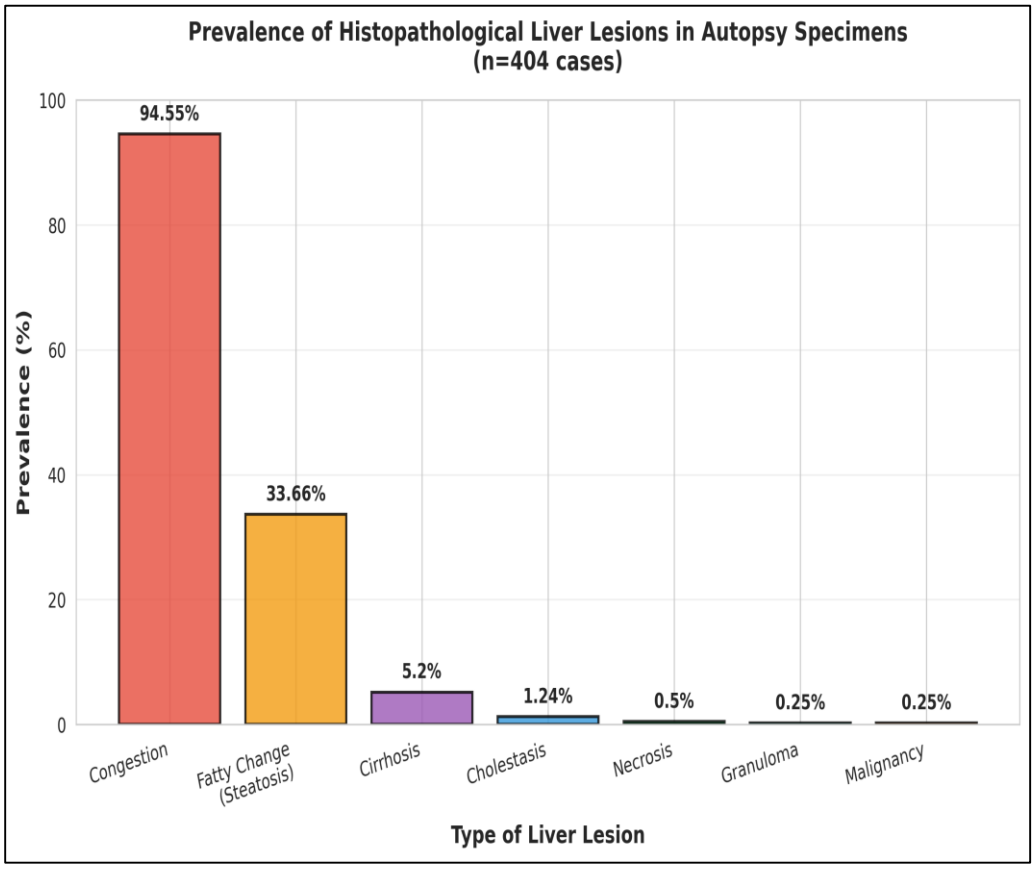

Figure 1: Prevalence of Histopathological Liver Lesions in Autopsy Specimens

Figure 1 Description: Bar graph displaying prevalence of seven major histopathological liver lesions in 404 autopsy specimens. Congestion (red bar) dominates at 94.55%, representing terminal cardiovascular phenomenon. Fatty change/steatosis (orange bar) is second at 33.66%, indicating substantial metabolic liver disease burden. Cirrhosis (purple bar) affects 5.2% of cases. Rare lesions collectively comprise <2%: cholestasis (blue bar, 1.24%), necrosis (green bar, 0.50%), granuloma (teal bar, 0.25%), and malignancy (brown bar, 0.25%). Value labels above bars indicate exact percentages. This visualization demonstrates typical autopsy liver pathology hierarchy with congestion universally prevalent, followed by metabolic lesions (fatty change, cirrhosis), while infectious, obstructive, and neoplastic pathology remains uncommon. The high fatty change prevalence (33.66%) notably exceeds historical Indian autopsy studies (20-28%), potentially reflecting rising metabolic syndrome epidemic in contemporary population.

Figure 2: Gender Distribution in Liver Lesions

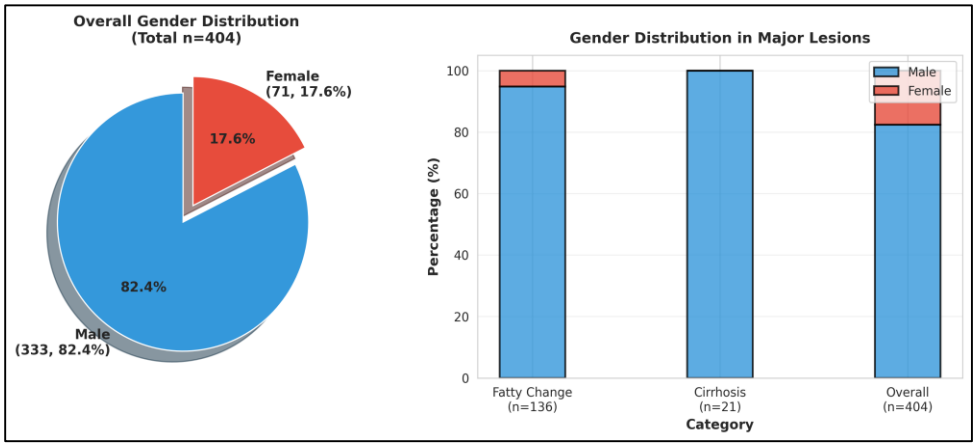

Figure 2 Description: Dual-panel visualization of gender patterns. Left panel: Pie chart showing overall gender distribution with marked male predominance (82.4% vs 17.6%, M:F ratio 4.7:1). Right panel: Stacked bar chart comparing gender ratios across major lesions and overall sample. Fatty change demonstrates extreme male predominance (94.85% male, blue; 5.15% female, red), yielding 18.4:1 ratio—nearly quadruple the overall ratio. Cirrhosis occurred exclusively in males (100% male, 0% female), shown by absence of red stacking. Overall sample maintains baseline 82.4% male prevalence. This stark gender disparity in metabolic/lifestyle lesions (fatty change, cirrhosis) versus more balanced congestion pattern suggests male-specific risk factors dominate liver pathology in autopsy population—likely reflecting higher alcohol consumption, metabolic syndrome prevalence, and occupational exposures among males in medicolegal setting. Female rarity in cirrhosis (zero cases) particularly striking given disease's multifactorial etiology including non-alcoholic causes that affect both genders.

Figure 3: Age Distribution of Major Liver Lesions

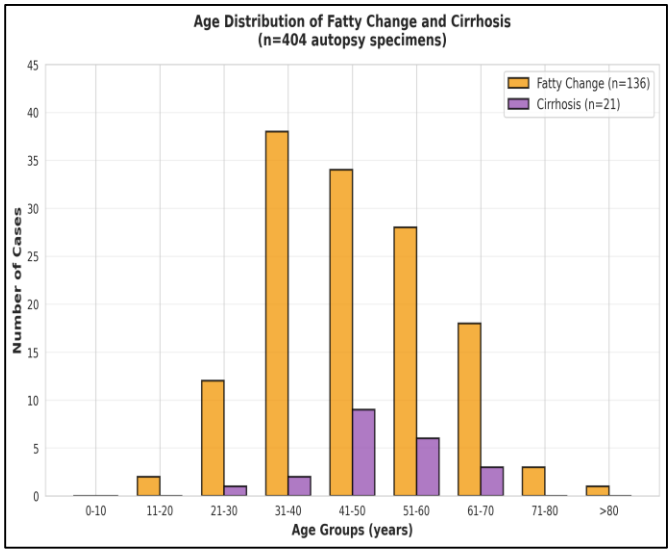

Figure 3 Description: Grouped bar chart displaying age-specific distribution of fatty change (orange bars, n=136) and cirrhosis (purple bars, n=21) across nine age groups. Fatty change shows bell-shaped distribution peaking in 31-40 years (38 cases), maintaining high prevalence through 51-60 years, then declining. Cirrhosis demonstrates later peak in 41-50

years (9 cases) and 51-60 years (6 cases), with minimal cases in younger or older age groups. The distinct patterns reveal temporal progression: fatty change concentrates in third-to-sixth decades (73.5% of cases in 31-60 years range), while cirrhosis peaks one decade later (71.5% in 41-60 years range). This 10-year lag suggests disease progression timeline from metabolic liver disease accumulation (fatty change in 30s-40s) to fibrotic evolution and cirrhotic transformation (40s-50s). Both lesions are rare in extremes: minimal pediatric cases and elderly cases, reflecting acquisition of risk factors during adult working years. This age distribution pattern emphasizes critical intervention window in fourth-to-fifth decades before irreversible cirrhotic changes develop.

Figure 4: Comparative Distribution: Common Versus Rare Liver Lesions

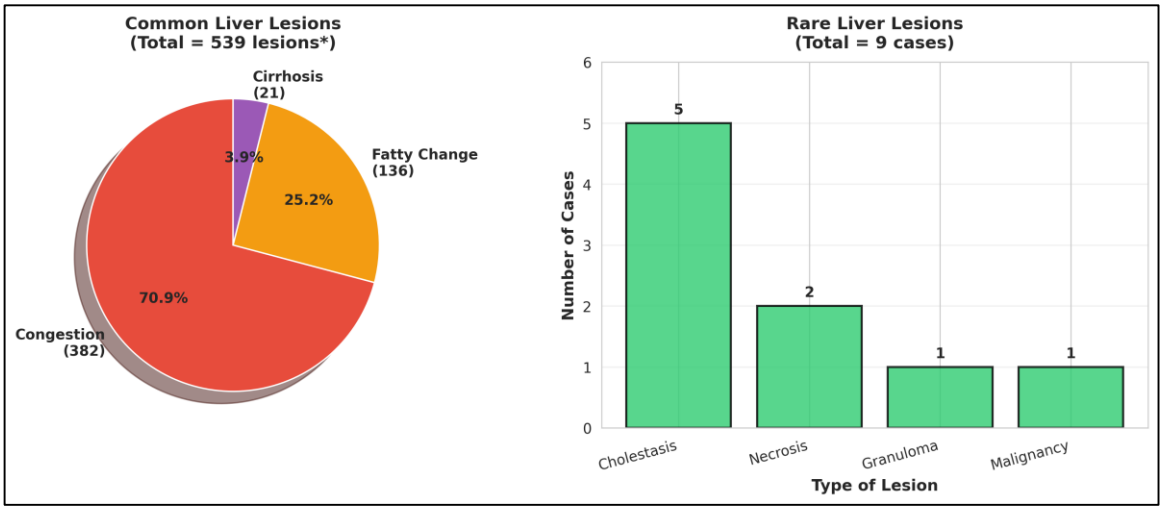

Figure 4 Description: Dual-panel visualization contrasting common versus rare pathology. Left panel: Pie chart of three common lesions totaling 539 lesions (note: multiple lesions coexist in some specimens)—congestion dominates at 70.9% (382 cases, red), fatty change represents 25.2% (136 cases, orange), and cirrhosis 3.9% (21 cases, purple). This triad accounts for vast majority of observed pathology. Right panel: Bar chart of four rare lesions totaling only 9 cases—cholestasis (5 cases), necrosis (2 cases), granuloma (1 case), and malignancy (1 case). This stark contrast illustrates autopsy liver pathology pyramid: common lesions (congestion, metabolic disease) affecting hundreds of cases versus rare lesions (infectious, obstructive, neoplastic) affecting <10 cases collectively. The 60:1 ratio between common and rare lesions (539:9) emphasizes that autopsy practice predominantly encounters circulatory and metabolic pathology, while exotic diagnoses remain exceptional. Note that lesion total (548) exceeds specimen count (404) due to frequent coexistence of multiple pathologies, particularly congestion occurring alongside other lesions in terminal phase.

Summary of Key Findings

This comprehensive autopsy-based study of 404 liver specimens from SMS Medical College, Jaipur, revealed diverse histopathological spectrum dominated by three major lesions: congestion (94.55%), fatty change (33.66%), and cirrhosis (5.2%). Marked male predominance characterized the cohort (82.4%), with even greater male concentration in fatty change (94.85%) and exclusive male representation in cirrhosis (100%). Age distribution showed peak incidence in 31-60 years productive age group, with fatty change peaking earlier (31-40 years) than cirrhosis (41-50 years), suggesting 10-year disease progression window. Rare lesions (cholestasis, necrosis, granulomas,

malignancy) collectively comprised <2% of cases. Multiple coexisting pathologies occurred in 38.61% of specimens, commonly fatty change with congestion. Gross examination frequently appeared normal despite significant microscopic pathology, emphasizing routine histological examination importance. These findings provide baseline regional data documenting substantial metabolic liver disease burden (33.66% fatty change prevalence) in Rajasthan autopsy population, highlighting public health implications and preventable disease burden.

Discussion

This autopsy-based study of 404 liver specimens from SMS Medical College, Jaipur, provides comprehensive documentation of histopathological liver lesion spectrum in tertiary care medicolegal autopsy setting, revealing predominance of congestion, substantial metabolic disease burden, marked gender disparities, and age-specific distribution patterns with significant public health implications.

Prevalence Patterns and Comparison with Literature

Congestion emerged as most prevalent finding (94.55%), consistent with autopsy studies globally where terminal cardiovascular phenomena affect nearly all cases.[20] Pudale and Doiphode (2014) reported 90.2% congestion in 451 Indian autopsy specimens, comparable to our findings.[21] This universal prevalence reflects agonal and post-mortem changes rather than primary liver pathology, though chronic passive congestion from cardiac failure may contribute in some cases.

Fatty change/steatosis prevalence of 33.66% represents substantial metabolic liver disease burden, notably exceeding some previous Indian studies. Kulkarni et al. (2020) reported 28% fatty change in 100 autopsy cases.[22] Contos and Sanyal (2002) documented 20-45% NAFLD prevalence in Western populations.[23] Our 33.66% prevalence aligns with global NAFLD epidemic trends, reflecting rising obesity, diabetes, and metabolic syndrome rates in India.[24] This high prevalence in unselected autopsy population—many cases likely undiagnosed clinically—underscores silent burden of metabolic liver disease requiring public health interventions.

Cirrhosis prevalence of 5.2% falls within reported ranges (3-8%) from Indian autopsy studies. Anthony et al. (1977) established cirrhosis classification systems emphasizing nodular regeneration and fibrosis patterns.[25] Our cirrhosis cases predominantly showed macronodular pattern suggesting chronic alcohol-related or viral etiology, though specific etiological confirmation requires additional investigations (viral markers, alcohol history) often unavailable in autopsy setting.

Gender and Age Distribution Patterns

Marked male predominance (82.4%) in overall sample reflects typical medicolegal autopsy demographics where outdoor occupational exposure, accidents, and violence affect males disproportionately. However, metabolic lesion gender disparities exceeded overall male preponderance significantly. Fatty change M: F ratio of 18.4:1 and exclusive male cirrhosis (100%) suggest gender-specific risk factor concentration. In Indian context, higher male alcohol consumption rates, smoking prevalence, and metabolic syndrome burden contribute to these patterns.[26] Runyon (1980) noted cirrhosis affects both genders in autoimmune contexts, but alcohol-related cirrhosis shows male predominance.[27]

Age distribution revealed fatty change peaking in 31-40 years while cirrhosis peaked in 41-50 years, demonstrating 10-year progression window from

metabolic injury to fibrotic evolution. This temporal pattern emphasizes critical intervention opportunity in fourth decade before irreversible cirrhotic transformation. Neuschwander-Tetri and Caldwell (2003) described NAFLD progression to cirrhosis occurs over 10-20 years with obesity and diabetes accelerating fibrosis.[28]

Rare Lesions and Coexisting Pathology

Rare lesions (cholestasis, necrosis, granulomas, malignancy) collectively comprised <2%, consistent with autopsy literature where infectious and neoplastic liver pathology remains uncommon. Single tubercular granuloma case (0.25%) reflects India's TB burden, though hepatic involvement remains relatively rare. Amarapurka (2005) and Terracciano et al. (2000) described granulomatous hepatitis in 2-10% of liver biopsies, lower in unselected autopsies.[29,30]

Multiple coexisting pathologies in 38.61% of cases, commonly fatty change with congestion or cirrhosis with steatosis, reflects multifactorial liver injury patterns. Wanless (1990) described hepatic lesion overlap in chronic liver disease, particularly nodular regeneration with steatosis in alcohol-related injury.[31]

Gross-Microscopic Correlation and Diagnostic Implications

Notable finding: gross examination frequently appeared normal (>90% smooth surface, normal color) despite significant microscopic pathology. Many fatty change and early fibrosis cases showed minimal gross abnormalities, emphasizing routine histological examination importance in autopsy practice. This gross-microscopic discordance highlights limitations of macroscopic assessment alone and necessity of systematic tissue sampling and microscopic evaluation for accurate pathology documentation.

Clinical and Public Health Implications

These findings have significant implications. High fatty change prevalence (33.66%) in apparently healthy individuals (many autopsy cases had non-hepatic causes of death) reveals substantial subclinical metabolic liver disease burden requiring community screening and lifestyle interventions. Exclusive male cirrhosis and extreme male predominance in fatty change suggest targeted public health programs addressing male-specific risk factors (alcohol consumption, occupational hazards, metabolic syndrome) could substantially reduce liver disease burden.

Regional comparison: This study provides first comprehensive autopsy liver pathology data from Jaipur, Rajasthan. Previous studies concentrated in Mumbai, Delhi, and South India, limiting regional generalizability.[32] Our findings contribute to understanding liver disease geographic variations across India and inform regional health policy.

Study Strengths and Limitations

Strengths include large sample size (404 cases) providing robust prevalence estimates, comprehensive histopathological examination using standardized criteria, unselected autopsy population capturing subclinical disease burden missed by hospital-based studies, detailed demographic analysis revealing age-gender patterns, and systematic documentation providing regional baseline data. Limitations include single-center study potentially limiting generalizability, lack of detailed clinical history/laboratory data in medicolegal autopsies precluding etiological classification, absence of special stains and immunohistochemistry for all cases limiting lesion characterization, male-predominant medicolegal population not representing general population gender distribution, and inability to assess

disease progression or outcomes in autopsy-based cross-sectional design.

Future Directions

Future research should examine longitudinal trends monitoring fatty change and cirrhosis prevalence over time as metabolic syndrome epidemic evolves, correlative clinicopathological studies linking autopsy findings with available clinical/laboratory data for etiological insights, special stain application (PAS, trichrome, reticulin, iron) in all fatty change and cirrhosis cases for detailed characterization, viral marker testing (HBsAg, anti-HCV) in cirrhosis cases determining viral contribution, and comparative regional studies across different Indian states documenting geographic variations. Additionally, cost-effectiveness analyses of screening programs for metabolic liver disease in high-risk populations (males 30-50 years, metabolic syndrome) could guide public health resource allocation.

Conclusion

This comprehensive autopsy-based study of 404 liver specimens from SMS Medical College, Jaipur, documents diverse histopathological liver lesion spectrum dominated by congestion (94.55%), fatty change (33.66%), and cirrhosis (5.2%). The high fatty change prevalence, substantially exceeding historical Indian autopsy studies, reflects rising metabolic syndrome epidemic and represents substantial subclinical disease burden requiring public health attention. Marked gender disparities—extreme male predominance in fatty change (94.85%) and exclusive male cirrhosis (100%)—suggest concentration of metabolic and alcohol-related risk factors in male population, warranting targeted screening and intervention programs. Age distribution patterns, with fatty change peaking in 31-40 years and cirrhosis in 41-50 years, demonstrate 10-year disease progression window offering critical intervention opportunity before irreversible cirrhotic transformation. Rare lesions (cholestasis, necrosis, granulomas, malignancy) collectively comprised <2%, while multiple coexisting pathologies occurred in 38.61% of cases, reflecting multifactorial injury patterns. Notably, gross examination frequently appeared normal despite significant microscopic pathology, emphasizing routine histological examination importance in autopsy practice. These findings provide baseline regional data from Rajasthan contributing to understanding geographic variations in liver disease patterns across India. The substantial metabolic liver disease burden identified in apparently healthy individuals (many deaths from non-hepatic causes) highlights silent epidemic requiring community awareness, lifestyle modifications, alcohol consumption reduction, and early screening programs. Implementation of targeted public health interventions addressing modifiable risk factors—particularly in males aged 30-50 years—could substantially reduce preventable liver disease burden. This study validates autopsy's continued relevance in documenting subclinical disease patterns missed by clinical surveillance, informing evidence-based health policy and medical education in tertiary care settings.

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