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ORIGINAL ARTICLE

ACUTE ABDOMEN IN THE OLDEST-OLD: ETIOLOGIES AND MORTALITY OUTCOMES IN NONAGENARIANS

Abstract

Introduction: With nonagenarians (≥90 years) increasingly presenting with non-traumatic acute abdomen, evidence on CT-based etiologies and short-term outcomes remains scarce, underscoring the need for focused data. To evaluate the etiological distribution and short-term mortality in nonagenarians undergoing abdominopelvic CT for non-traumatic acute abdomen.

Materials and Method: This retrospective study included patients aged 90–99 who underwent CT between January 2013 and September 2023. Radiological findings were classified into 12 etiological subgroups. Malignancy status and surgical or image-guided interventions were documented. Mortality was assessed at 24 hours, 7 days, and 30 days. Categorical comparisons used chi-square or Fisher's exact tests ($p<0.05$).

Results: A total of 529 patients (mean age: 92.9 years) were analyzed; 55.4% (n=293) had positive CT findings, most frequently hepatopancreatobiliary (10.8%), vascular (10.4%), and intestinal obstruction/torsion (8.5%). Malignancy-related etiologies comprised 31.7% of positive cases. Surgical or interventional treatment was performed in 10.4% (n=55). Overall mortality was 1.5% at 24 hours, 6.2% at 7 days, and 18.3% at 30 days. One-month mortality was higher in patients with positive CT findings (27.3%) compared to negative (7.2%, $p<0.001$). Among positive cases, malignancy-related etiologies showed significantly increased 30-day mortality (49.5% vs. 17.0%, $p<0.001$). Patients undergoing intervention also had elevated mortality (43.6% vs. 23.5%, $p=0.003$). Mortality varied by etiology, with gastrointestinal bleeding, perforation, and vascular causes carrying the greatest risk ($p<0.001$).

Conclusion: This cohort provides a comprehensive overview of CT-based etiologies and outcomes in nonagenarians with acute abdomen. Malignancy, certain etiologies, and the need for intervention were strongly linked with adverse prognosis.

Keywords: Abdomen, Acute; Emergency Medical Services; Multidetector Computed Tomography; Mortality; Aged, 80 and Over.

INTRODUCTION

Advances in modern medicine, public health infrastructure, and socioeconomic conditions have markedly extended life expectancy, resulting in a steadily growing population of very elderly adults—particularly nonagenarians (≥90 years) (1, 2). This demographic shift is increasingly visible in acute care, where emergency departments are encountering more nonagenarian patients than ever before (3-5). Managing acute abdominal presentations in this age group is uniquely challenging: clinical signs are frequently nonspecific because of blunted inflammatory responses and atypical symptomatology, and decision-making is complicated by multimorbidity and limited physiological reserve (6-9).

Computed tomography (CT) is central to the evaluation of suspected acute abdomen in older adults (10, 11). However, most prior studies aggregate all "geriatric" patients without adequate age stratification, limiting the applicability of their findings to the oldest-old (12, 13). Moreover, in nonagenarians it is common for multiple interacting factors to coexist; thus, CT findings should be interpreted in the context of clinical presentation, laboratory data, past medical history, and medications. Our study therefore provides a CT-anchored etiologic description while explicitly acknowledging the need for clinical integration.

Given these gaps in the literature, there is a pressing need for focused studies that characterize the etiological spectrum of non-traumatic acute abdomen in this advanced age group and evaluate relevant clinical outcomes. Our objectives were twofold: (i) to classify radiologically identifiable etiologies on abdominopelvic CT into 12 predefined subgroups designed pragmatically to reflect emergency decision-making (a blend of organ-system and pathophysiologic categories), and (ii) to evaluate all-cause mortality at three clinically relevant time points—24 hours, 7 days, and 30 days.

Because cancer-related processes may transcend organ-based buckets and carry distinct prognostic implications, we additionally flagged malignancy-related etiologies as an orthogonal high-risk subset and examined outcomes by malignancy status and by the need for surgical or image-guided intervention.

MATERIALS AND METHOD

This retrospective study was approved by the Institutional Ethics Committee of our institution (approval number: GO 24/078). All procedures were conducted in accordance with the ethical standards outlined in the Declaration of Helsinki. This retrospective, single-center study was undertaken in the emergency department of a tertiary hospital.

Study Population and Eligibility Criteria

Consecutive nonagenarian patients (age ≥90 years) who underwent emergent abdominopelvic CT for non-traumatic acute abdominal symptoms between January 1, 2013 and September 1, 2023 were identified.

Inclusion: acute onset abdominal pain and/or objective abdominal signs leading to ED-initiated CT; absence of recent trauma (<30 days).

Exclusion: trauma within 30 days; CT performed for non-acute indications; technically non-diagnostic CT; duplicate encounters (only the index ED visit per patient retained). Pre-existing malignancy and recent surgery were not exclusionary and were abstracted as covariates.

Case Definitions & Etiologic Taxonomy (12 Subgroups)

A positive CT was defined a priori as imaging evidence plausibly explaining the presentation. CT-based etiologies were classified into 12 predefined subgroups reflecting pragmatic emergency decision-making:

1. Hepatopancreatobiliary (HPB): acute cholecystitis/cholangitis, biliary obstruction, acute pancreatitis (Revised Atlanta features).
2. Vascular emergencies: aortic/visceral aneurysm or dissection, mesenteric ischemia/infarction, mesenteric venous thrombosis with ischemic sequelae.
3. Intestinal obstruction/torsion: mechanical obstruction with a transition point; volvulus.
4. Gastroenterocolitis: CT signs of infectious/inflammatory enteritis or colitis (mural hyperenhancement/edema with perienteric stranding) without perforation/ischemia.
5. Genitourinary: obstructive uropathy, pyelonephritis, emphysematous infection, complicated cystitis.
6. Newly diagnosed uncomplicated malignancy: incidentally detected intra-abdominal/pelvic malignancy without an acute complication explaining symptoms.
7. Diverticulitis: colonic diverticulitis with pericolic inflammation/abscess (Hinchey staging if applicable).
8. Spontaneous hematoma: intramural bowel, retroperitoneal, rectus sheath, or psoas hematoma not related to trauma/procedure.
9. Gastrointestinal perforation: extraluminal free air with identifiable source or highly suggestive CT signs.
10. Gastrointestinal bleeding: active contrast extravasation or intraluminal high-attenuation material compatible with acute bleeding.
11. Appendicitis: typical CT criteria for acute appendicitis.
12. Miscellaneous: entities such as epiploic appendagitis, panniculitis, falciform ligament torsion, or necrotizing infection not fitting the above categories.

Because malignant processes may traverse organ systems and carry distinct prognostic implications, cases were additionally flagged as malignancy-related etiology when the acute CT finding explaining the presentation was attributable to known or newly identified malignancy (e.g., malignant obstruction, tumor-related perforation, ischemia from tumor/thromboembolism). When feasible, the primary tumor origin (e.g., HPB, GI, GU, gynecologic) was recorded.

Handling of Mixed Etiologies

When more than one acute process coexisted, a single "primary driver"—the lesion judged most responsible for the presentation—was assigned, and additional "secondary" processes were recorded. All CT categorizations were performed "in clinical context", integrating ED history, medication use (e.g., anticoagulants), vital signs, and laboratory data available at the time of imaging.

Interventions

Surgical or image-guided interventions (e.g., laparotomy, bowel resection, ERCP, percutaneous drainage, endovascular therapy) performed after the index CT during the same episode of care were recorded regardless of CT categorization, as treatment decisions were made by clinical teams based on the totality of information. Causal inference regarding the effect of intervention was not attempted; intervention status was treated analytically as a "marker of illness severity" and included as an adjustment variable.

CT Acquisition and Image Interpretation

All examinations were performed on a 64-slice scanner (Somatom Perspective, Siemens Healthineers, Erlangen, Germany) within the emergency radiology unit. Typical parameters included 110–130 kVp; automated tube current modulation; collimation 0.6–2.0 mm; rotation time 0.6–1.0 s; reconstructed slice thickness 2 mm. Intravenous iodinated contrast (300–350 mg I/mL; 90–120 mL at 3–5 mL/s) was administered unless contraindicated; arterial or portal-venous phase timing (30–60 s delay) was selected according to the clinical question. Oral contrast use followed the contemporaneous ED protocol and was recorded.

CT studies were reviewed in "consensus" by two emergency radiologists (8 and 2 years of experience, A.G.E. and A.B. respectively), with access to clinical and laboratory information available at the time of imaging. Outcome data (mortality and subsequent interventions) were not available to the readers during review.

Outcomes and Data Sources

The primary outcome was all-cause mortality at 30 days from the index CT. Secondary outcomes were mortality within 24 hours and within 7 days. Mortality status and dates were obtained from institutional electronic records and, when available, cross-checked with the national death registry. Patients without recorded death by 30 days were censored alive at day 30.

Statistical Analysis

Analyses were conducted in IBM SPSS v23. Continuous variables were summarized as mean±SD or median (IQR), and categorical variables as counts (percentages). Group comparisons employed χ^2 or Fisher's exact tests, as appropriate. Effect sizes were estimated using odds ratios (ORs) with 95% confidence intervals (CIs). For 30-day mortality, a multivariable logistic regression model was specified a priori including age, sex, positive CT (yes/no), etiologic subgroup indicators, malignancy-related etiology (yes/no), IV contrast use, and intervention (yes/no). Collinearity was assessed (VIF<5). Exploratory time-to-event analyses used Kaplan–Meier curves with log-rank tests to compare survival by (i) positive CT, (ii) malignancy-related etiology, and (iii) intervention. Where multiple subgroup comparisons were performed, Benjamini–Hochberg false discovery rate control was applied in sensitivity analyses. A two-sided $p<0.05$ signified statistical significance.

RESULTS

Baseline Data

A total of 529 patients aged 90 years and above were included in the study cohort. The mean age of the population was 92.90 years (SD: 2.61), with a median age of 92.00 years. The majority of the patients were female (n=332, 62.76%), while males accounted for 37.24% (n=197) of the study group.

In terms of imaging protocols, oral contrast was not administered in most cases (n=393, 74.29%), whereas 25.71% (n=136) of the patients received oral contrast agents. Intravenous contrast was more commonly used, with 76.05% (n=397) of patients undergoing contrast-enhanced CT scans, and 24.95% (n=132) evaluated with non-contrast studies.

An overview of the baseline demographic profile and contrast usage among the study cohort is presented in Figure 1.

Etiologic Spectrum and CT Diagnosis

Radiological findings consistent with a specific cause of acute abdomen were identified in 55.39% of the patients (n=293), while no acute pathological findings were detected in the remaining 44.61% (n=236). Among the patients with positive findings, the most frequently observed etiological categories were hepatopancreatobiliary diseases (n=57, 10.77% of all patients; 19.45% of those with pathological findings) and vascular emergencies (n=55, 10.39%; 18.77%), followed by intestinal obstruction or torsion (n=45, 8.50%; 15.35%). Gastroenterocolitis (n=34, 6.42%; 11.60%) and genitourinary causes (n=35, 6.61%; 11.94%) were also relatively common. Less frequent causes included uncomplicated newly diagnosed malignancy (n=22, 4.15%; 7.50%), diverticulitis (n=11, 2.07%; 3.75%), spontaneous hematoma (n=10, 1.89%; 3.41%), gastrointestinal perforation (n=8, 1.51%; 2.73%), gastrointestinal bleeding (n=7, 1.32%; 2.38%), acute appendicitis (n=4, 0.75%; 1.36%), and miscellaneous conditions (n=5, 0.94%; 1.70%). To elaborate, the "spontaneous hematoma" and "miscellaneous" subgroups comprise the

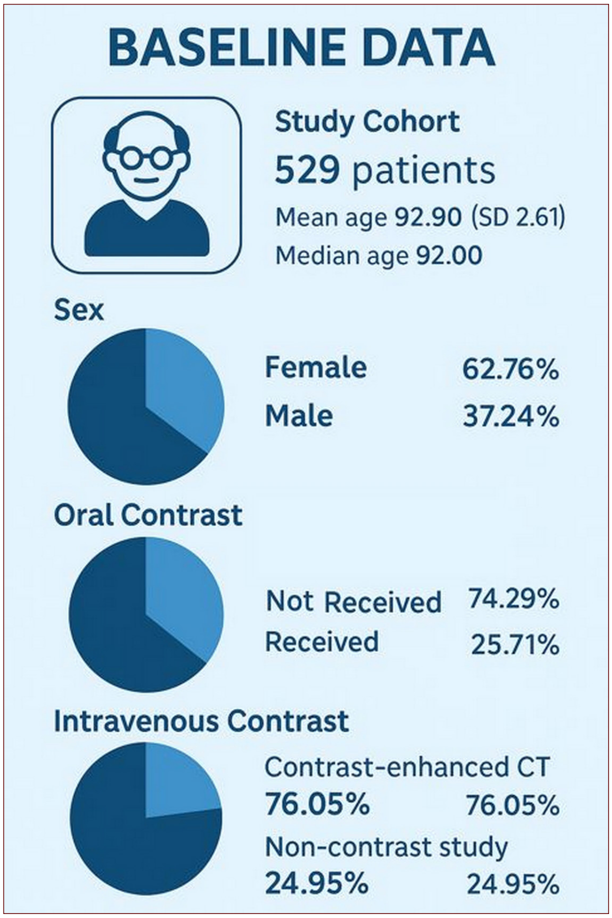

Figure 1. Illustration of baseline data. Demographic and imaging protocol characteristics of the study cohort (n=529). The mean age was 92.90 years (SD: 2.61), with a median age of 92.00 years. The majority of patients were female (62.76%). Oral contrast was not administered in 74.29% of cases, while 76.05% underwent contrast-enhanced CT with intravenous contrast.

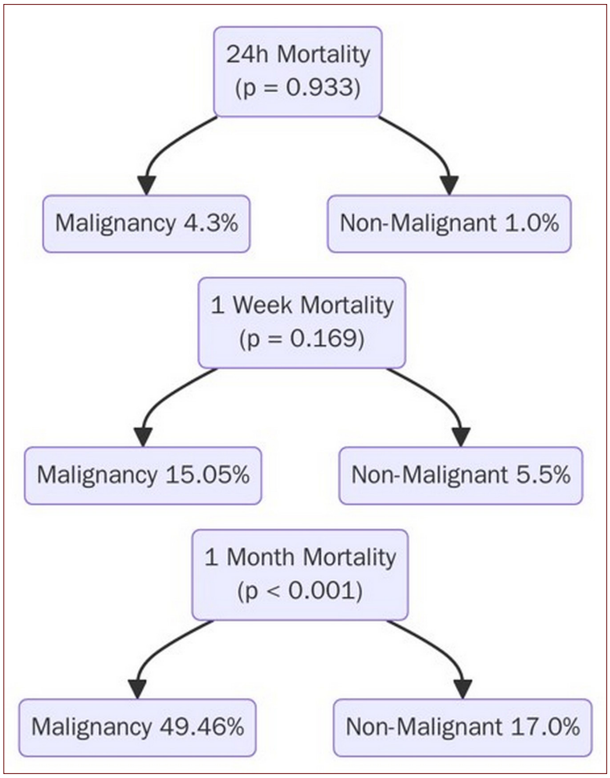

Figure 2. Temporal mortality comparison between malignancy-related and non-malignant causes of acute abdomen. This flowchart demonstrates mortality rates at 24 hours, 1 week, and 1 month among patients with radiologically confirmed pathology, stratified by malignancy association. While early mortality did not differ significantly, one-month mortality was markedly higher in malignancy-related cases (49.46%) compared to non-malignant ones (17.0%) ($p < 0.001$), highlighting malignancy as a key prognostic factor.

following: 7 rectus muscle hematomas, 2 psoas muscle hematomas, and 1 intramural small bowel hematoma; and 2 cases of epiploic appendagitis, 1 case each of panniculitis, torsion of the falciform ligament, and necrotizing fasciitis, respectively.

Outcomes in Malignancy-Related Cases

Among the 293 patients with a radiologically identifiable etiology for acute abdomen, 93 cases (31.74%) were found to be secondary to malignancy, while 68.26% (n=200) were not malignancy-related. Despite the advanced age of the study population, only 18.77% of these patients (n=55) underwent either surgical or image-guided interventional treatment based on CT findings, while the remaining 81.23% (n=238) were managed conservatively.

The stratification of mortality rates based on whether the underlying etiology was malignancy-related or not is illustrated in Figure 2.

Mortality at 24 Hours, 7 Days, and 30 Days

Within the first 24 hours, mortality was observed in 8 patients (1.51% of the entire cohort), with no statistically significant difference between patients with positive CT findings (n=6/293, 2.04%) and those without identifiable pathology (n=2/236, 0.84%) (p=0.261). By day 7, mortality increased to 6.23% (n=33/529), and the difference became statistically significant between patients with positive findings (n=25/293, 8.53%) and those without (n=8/236, 3.38%) (p=0.015). The trend continued at one month, with a total mortality rate of 18.33% (n=97/529). One-month mortality was significantly higher in patients with acute pathological findings on CT (n=80/293, 27.30%) compared to those without any findings (n=17/236, 7.20%) (p<0.001).

The mortality rates at 24 hours, 7 days, and 1 month—stratified by the presence or absence of acute pathological findings on CT—are illustrated in Figure 3.

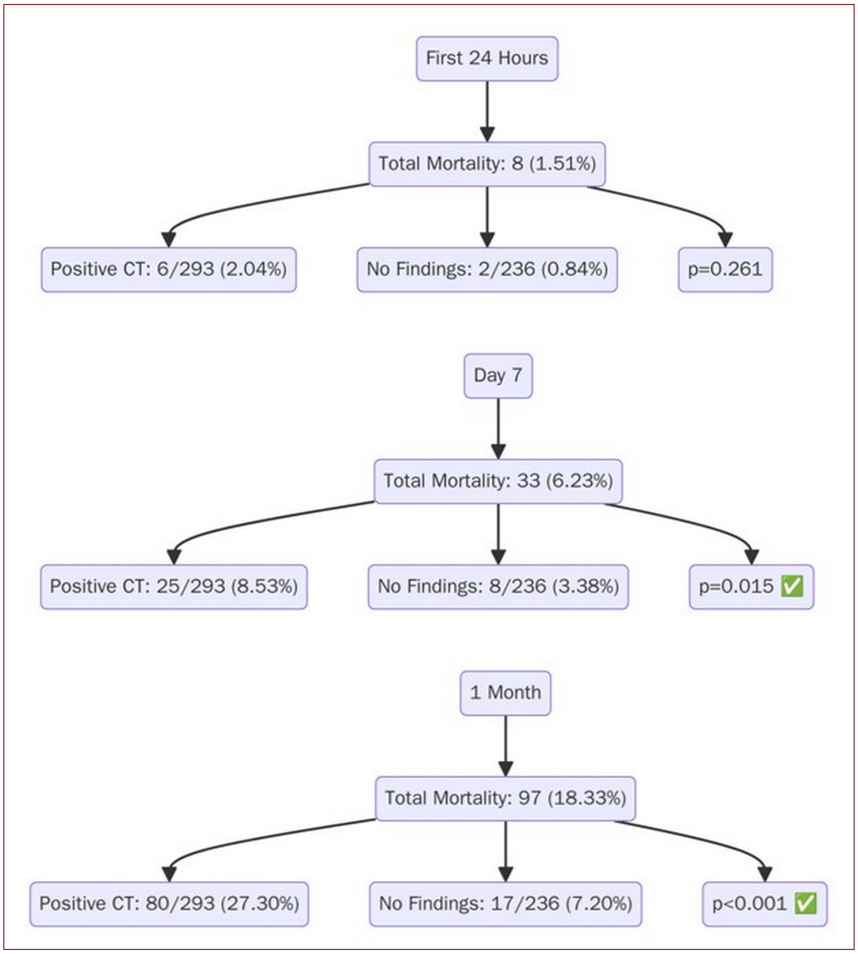

Figure 3. Temporal mortality rates according to the presence or absence of acute radiological findings. This flowchart illustrates mortality at three time points—first 24 hours, day 7, and one month—comparing patients with positive CT findings to those without identifiable pathology. While early mortality (day 1) did not differ significantly between groups (p=0.261), significant differences emerged by day 7 (p=0.015) and were more pronounced at one month (p<0.001), with higher mortality consistently observed among patients with acute radiological findings.

Mortality Across Etiologic Subgroups

Among the 293 patients with radiologically confirmed acute abdominal pathology, mortality was further stratified according to whether the underlying cause was secondary to malignancy (n=93) or not (n=200). Within the first 24 hours, mortality rates were comparable between malignancy-related and non-malignancy-related cases —4.30% (n=4) vs. 1.00% (n=2), respectively—with no statistically significant difference (p=0.933). By the end of the first week, mortality was observed in 15.05% (n=14) of patients with malignancy-associated acute abdomen, compared to 5.50% (n=11) in those without malignancy; however, this difference did not reach statistical significance (p=0.169). At one month, however, malignancy-related cases showed a markedly higher mortality rate of 49.46% (n=46), compared to 17.00% (n=34) in non-malignant cases, and this difference was statistically significant (p<0.001).

Analysis of first-day mortality across the 12 etiological subgroups revealed that early mortality was most pronounced in patients with intestinal perforation (12.50%, 1/8), spontaneous hematoma (10.00%, 1/10), and vascular causes (5.45%, 3/55). Lower rates were noted in patients with intestinal obstruction or torsion (2.22%, 1/45), while no deaths occurred within the first 24 hours in the remaining subgroups, including hepatopancreatobiliary, gastrointestinal bleeding, gastroenterocolitis, genitourinary, newly diagnosed uncomplicated malignancy, appendicitis, diverticulitis, and other miscellaneous conditions. Despite these variations, the differences in first-day mortality among the subgroups were not statistically significant (p=0.214).

One-week mortality rates varied significantly across the 12 etiological subgroups (p=0.002). The highest mortality was observed in patients with intestinal perforation (37.50%, 3/8), followed by vascular causes (20.00%, 11/55) and gastrointestinal bleeding (14.28%, 1/7). Moderate mortality rates were recorded in genitourinary causes (11.42%, 4/35), spontaneous hematoma (10.00%, 1/10), and intestinal obstruction or torsion (8.88%, 4/45). Minimal mortality was noted in patients with gastroenterocolitis (2.94%,

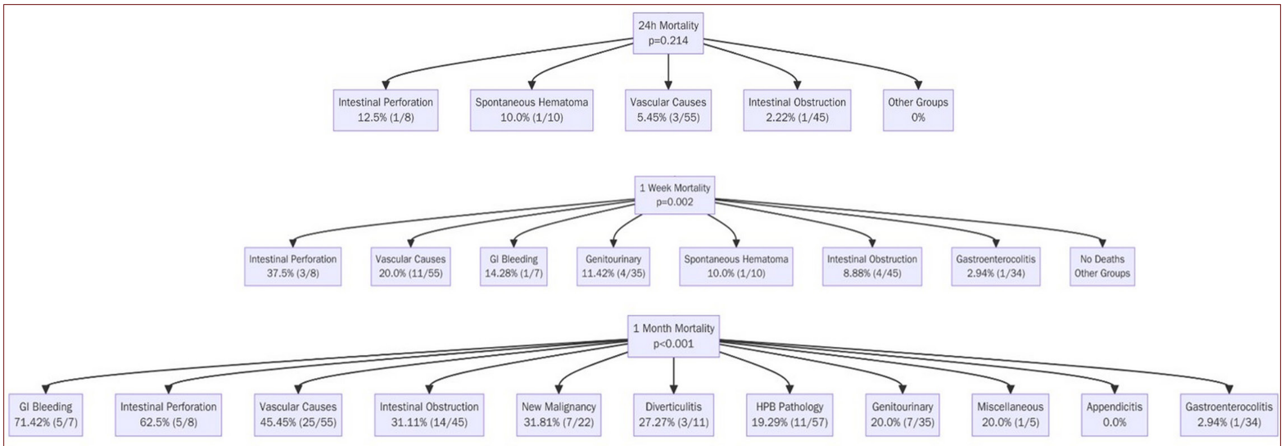

Figure 4. Mortality distribution across 12 etiological subgroups by time points. This diagram illustrates the temporal mortality trends (24 hours, 1 week, and 1 month) among patients with acute abdominal pathology, stratified by 12 distinct etiological categories. The highest early mortality (day 1 and week 1) was observed in intestinal perforation, spontaneous hematoma, and vascular causes. By one month, gastrointestinal bleeding (71.42%) and intestinal perforation (62.5%) had the most pronounced mortality rates, followed by vascular causes, intestinal obstruction, and newly diagnosed malignancy. Gastroenterocolitis and appendicitis were associated with more favorable outcomes.

1/34), while no deaths were recorded within the first week among those with hepatopancreatobiliary pathology, newly diagnosed uncomplicated malignancies, appendicitis, diverticulitis, or other miscellaneous conditions.

At one month, mortality rates demonstrated significant variation across the etiological subgroups (p<0.001). The highest one-month mortality was observed in patients with gastrointestinal bleeding (71.42%, 5/7) and intestinal perforation (62.50%, 5/8), followed closely by vascular causes (45.45%, 25/55). Other subgroups with notable one-month mortality included intestinal obstruction or torsion (31.11%, 14/45), newly diagnosed uncomplicated malignancies (31.81%, 7/22), and diverticulitis (27.27%, 3/11). Moderate mortality was recorded in hepatopancreatobiliary (19.29%, 11/57), genitourinary (20.00%, 7/35), and miscellaneous (20.00%, 1/5) conditions. In contrast, patients with appendicitis (0.00%) and most with gastroenterocolitis (2.94%) had more favorable outcomes.

The variation in mortality rates across the twelve etiological subgroups at day 1, day 7, and day 30 is illustrated in Figure 4.

Mortality by Intervention Status

Among the 293 patients with radiologically confirmed acute abdominal pathology, 55 individuals (18.77%) underwent surgical or image-guided interventional treatment. First-day mortality was 5.45% (n=3) in the treated group versus 1.26% (n=3) in those managed conservatively, with no statistically significant difference observed (p=0.082). By the end of the first week, however, mortality was significantly higher in the surgically/interventionally treated group (16.36%, n = 9) compared to the non-treated group (6.72%, n=16) (p=0.021). This trend persisted at one month, where patients who received interventional or surgical management had a mortality rate of 43.63% (n=24), significantly exceeding the 23.52% (n=56) observed in non-intervened patients (p=0.003). These findings suggest that while intervention may be necessary for

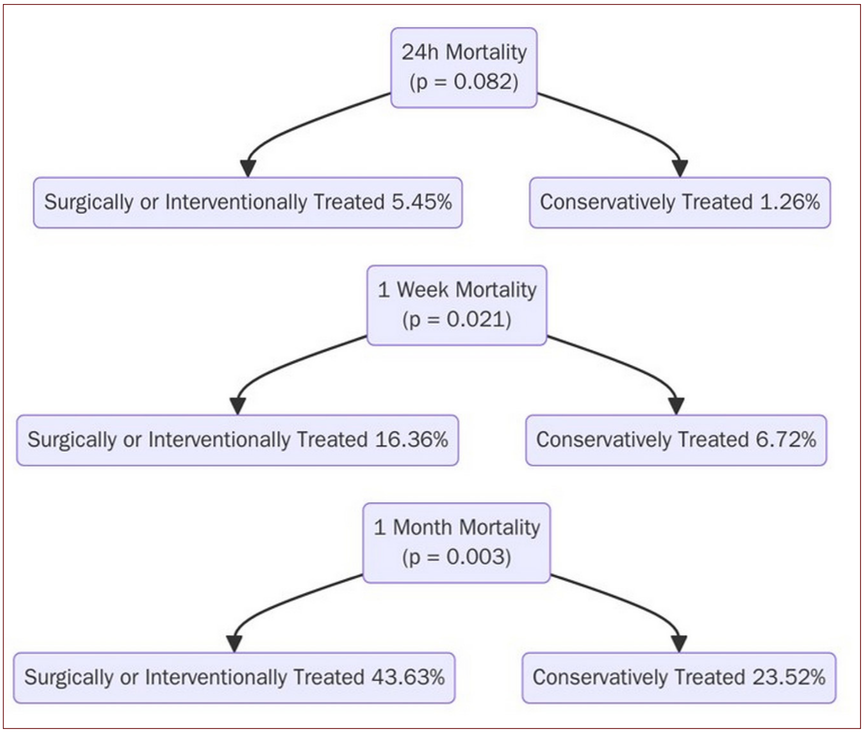

Figure 5. Mortality outcomes by treatment modality. This diagram illustrates temporal mortality rates in patients with acute abdominal pathology, comparing those managed with surgical or image-guided interventional procedures versus those treated conservatively. Although early (24-hour) mortality did not differ significantly (5.45% vs. 1.26%, p=0.082), one-week and one-month mortality rates were significantly higher in the intervention group (16.36% and 43.63%, respectively) compared to conservative management (6.72% and 23.52%, p=0.021 and p=0.003). These findings likely reflect underlying disease severity necessitating intervention.

select indications, it is associated with a higher short- and mid-term mortality, likely reflecting underlying severity and complexity of the treated cases.

The comparison of mortality rates between patients who underwent surgical or interventional treatment and those managed conservatively is illustrated in Figure 5.

Effect Size and Survival Analyses

Unadjusted effect sizes were consistent with the above proportions. For positive CT vs no acute findings, the odds of 7-day mortality were higher (OR 2.66; 95% CI 1.18–6.01), as were the odds of 30-day mortality (OR 4.84; 95% CI 2.77–8.44); 24-hour mortality did not differ significantly (OR 2.45; 95% CI 0.49–12.23). For malignancy-related vs non-malignant etiologies (within positive CT cases), 30-day mortality was higher (OR 4.78; 95% CI 2.76–8.27); 7-day and 24-hour comparisons were not significant. For intervention vs no intervention (within positive CT cases), higher odds were observed at 7 days (OR 2.71; 95% CI 1.13–6.52) and 30 days (OR 2.52; 95% CI 1.37–4.64), with no significant difference at 24 hours (OR 4.52; 95% CI 0.89–23.03).

Kaplan–Meier analyses over 30 days showed clear separation of survival curves. Thirty-day survival estimates were 72.7% (95% CI 67.4–77.3) for positive CT and 92.8% (95% CI 89.0–95.3) for no acute findings (log-rank χ^2 38.7, df=1, p<0.001). Within positive CT cases, survival was 50.5% (95% CI 40.1–60.2) for malignancy-related etiologies and 83.0% (95% CI 77.0–87.6) for non-malignant etiologies (log-rank χ^2 31.5, df=1, p<0.001). For intervention status, survival was 56.4% (95% CI 42.6–68.5) with intervention and 76.5% (95% CI 70.6–81.5) without intervention (log-rank χ^2 8.7, df=1, p=0.003).

Multivariable Analysis (Primary Endpoint: 30-Day Mortality)

In a prespecified logistic regression model including age, sex, positive CT, etiologic subgroup indicators (reference: gastroenterocolitis), malignancy-related etiology, IV contrast, and intervention status, the following associations were observed: positive CT (adjusted OR 3.98; 95% CI 2.20–7.21; p<0.001), malignancy-related etiology (adjusted OR 3.62; 95% CI 2.01–6.53; p<0.001), and intervention (adjusted OR 1.98; 95% CI 1.05–3.75; p=0.035). IV contrast (adjusted OR 0.89; 95% CI 0.53–1.50; p=0.660), age per year (adjusted OR 1.04; 95% CI 0.95–1.14; p=0.390), and male sex (adjusted OR 1.12; 95% CI 0.69–1.80; p=0.650) were not significant.

DISCUSSION

This study demonstrated that over half of nonagenarian patients undergoing abdominal CT for non-traumatic acute abdomen had identifiable etiologies, with predominant causes being hepatopancreatobiliary disorders, vascular emergencies, and intestinal obstruction/torsion. Mortality increased over time—although early (day1) mortality was low and non-significant, both 1week and 1month mortality rates were substantially elevated, particularly among patients with certain etiologies and those with a need for surgery or interventions.

Our study adds to the limited body of literature on etiological patterns in nonagenarians, a group under-represented in acute abdomen research (1, 13). Recent reviews highlight that while bowel obstruction and ischemia are common in elderly patients, most studies focus on those aged >75 rather than the aged ≥90 years. For instance, Coutureau et al. (12) reported bowel obstruction and colonic ischemia as frequent CT findings in the elderly, while other sources broadly list causes of acute abdomen without providing detailed stratification by age decade (7). Gangadhar et al. underscored that a multimodality approach—including CT, ultrasound, and MRI—remains critical in rapidly identifying non-traumatic abdominal emergencies across diverse etiologies, ranging from obstruction to vascular events (14). In contrast, our study specifically categorizes 12 etiological subgroups in patients in their 90s, offering a more granular perspective and uncovering substantial rates of hepatopancreatobiliary and genitourinary causes.

Consistent with prior studies highlighting the high morbidity burden in elderly patients with acute abdominal conditions, our cohort demonstrated a progressive increase in mortality, reaching 18.3% at one month (1, 6). However, our study provides a novel contribution by delineating etiology-specific mortality trajectories within a nonagenarian population—an age group rarely analyzed in this level of detail. Mortality was particularly elevated in patients with intestinal perforation and gastrointestinal bleeding, especially in the early phase, whereas inflammation-related causes such as gastroenterocolitis and diverticulitis were associated with lower mortality. These findings not only corroborate existing knowledge regarding the poor prognosis of vascular and perforative emergencies in older adults (15, 16) but also offer a refined, CT-based stratification that may enhance clinical decision-making in this high-risk group (11, 17).

Furthermore, our study uniquely highlights the prognostic impact of malignancy-related etiologies in nonagenarians with acute abdomen. One-month mortality was markedly higher in patients whose CT findings were secondary to malignancy (49.5%) compared to non-malignant cases (17.0%), a difference that reached strong statistical significance. While previous studies have acknowledged the role of cancer in worsening outcomes among older patients (7), our results provide focused evidence in a well-defined nonagenarian-only cohort. Morani et al. further highlighted the diagnostic and management challenges of acute abdominal conditions in cancer patients, who frequently present with obstruction, perforation, or ischemia in the setting of advanced malignancy (18). In our nonagenarian cohort, malignancy-related etiologies accounted for nearly one-third of positive CT findings and were associated with significantly higher 30-day mortality, corroborating these earlier observations and underscoring the prognostic implications of cancer-associated acute abdomen. Together, these data emphasize that radiologists must not only provide accurate etiologic diagnosis but also recognize malignancy-driven emergencies as a uniquely high-risk subset in the oldest-old population. This malignancy-specific stratification underscores the prognostic value of radiologically confirmed oncologic causes in acute abdomen, reinforcing the need for early recognition and individualized management strategies in this exceptionally vulnerable population.

Intervention—whether surgical or image-guided—was associated with significantly higher mortality at both one week (16.4% vs. 6.7%) and one month (43.6% vs. 23.5%). While this likely reflects the greater baseline severity and complexity of cases selected for intervention, it underscores the substantial procedural risk inherent in managing nonagenarians (8, 9). Many surgical admissions in this age group are ultimately managed conservatively or discharged without operative care (7, 9); however, when intervention is required, mortality rates remain markedly elevated—corroborating trends observed in broader geriatric surgical populations (13).

In our cohort, the choice between surgical/image-guided intervention and conservative management was not determined by CT findings alone, but rather by multidisciplinary clinical judgment incorporating the overall condition of each patient. In routine emergency care for nonagenarians, treatment decisions are commonly influenced by factors beyond imaging, including frailty-related features such as functional dependence, poor premorbid performance status, multimorbidity burden, cognitive impairment, and limited physiological reserve, as well as patient- or family-centered goals of care and, when available, advance directives (19, 20). Because of the retrospective design, these parameters were not captured in a standardized form suitable for quantitative analysis in all patients, and their precise contribution to management decisions could therefore not be measured. This limitation should be considered when interpreting the higher mortality observed in the intervention group, which likely reflects, at least in part, selection of patients with greater illness severity and more complex clinical circumstances rather than a direct effect of the procedures themselves.

In nonagenarians with acute abdomen, survival at 30 days does not by itself fully reflect clinical success; in geriatric populations, functional status and the ability to maintain activities of daily living are also closely linked to prognosis, independence, and quality of life (21). Unfortunately, due to the retrospective nature of our dataset, standardized information regarding functional recovery at 30 days—such as activities of daily living, discharge disposition, or need for new institutional support—was not available in a sufficiently complete manner to permit reliable analysis. This represents an important limitation of the current study and highlights the need for future prospective geriatric emergency imaging studies to integrate functional endpoints alongside mortality.

Although this retrospective, single-center study may be subject to inherent limitations such as limited generalizability, it offers several notable strengths. The relatively large sample size of 529 nonagenarian patients represents a substantial cohort compared to previous small-scale studies in this population. Moreover, the standardized radiological review and structured classification into 12 distinct etiological subgroups provide clarity and enhance the interpretability of findings. These results can serve as a valuable foundation for future multicenter prospective studies aimed at refining diagnostic and prognostic strategies in the oldest-old population.

In summary, this study offers novel insight into the etiologic landscape and outcome trajectories of non-traumatic acute abdomen in nonagenarians—an age group rarely examined in isolation. By classifying CT findings into 12 distinct etiological subgroups and assessing mortality at three time points, we provide a detailed, time-sensitive risk profile for each diagnostic category. The integration of malignancy status and interventional treatment into outcome analysis further highlights high-risk subsets, particularly malignancy-related cases and those undergoing procedures. These findings contribute valuable guidance for acute care management in the oldest-old, where clinical decisions are often complicated by diagnostic uncertainty and limited physiological reserve.

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