

Contemporary National Trends in Major Vascular Surgery Operations Among Octogenarians

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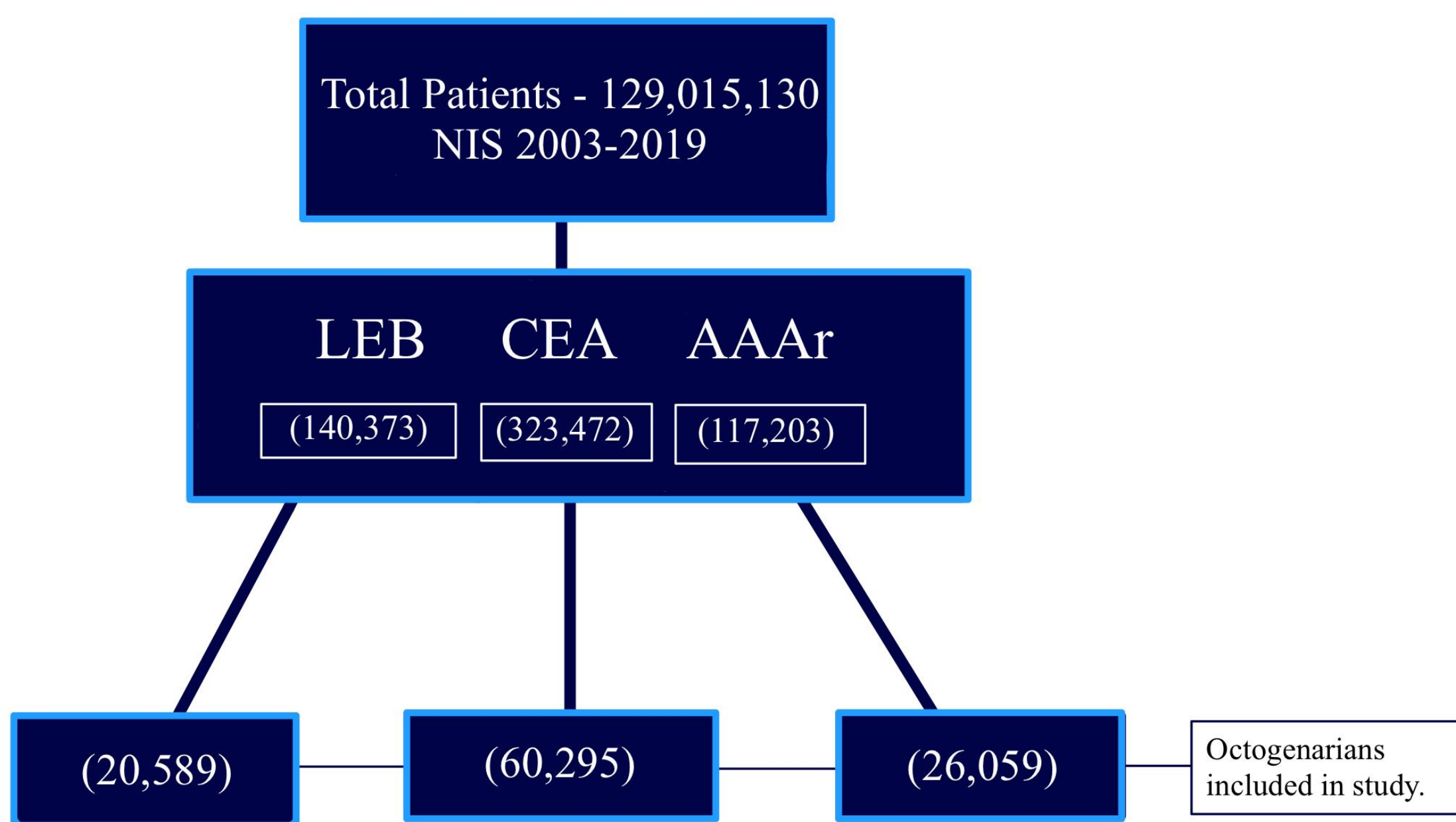
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Background

As the population ages and expands, the demand for vascular procedures continues to rise. Octogenarians (age 80-89) represent a unique subset of patients undergoing major vascular procedures, often presenting with multiple comorbidities, higher frailty index, and an increased risk of perioperative complications. Lower extremity bypass (LEB), carotid endarterectomy (CEA), and abdominal aortic aneurysm repair (AAAr) remain critical interventions for managing peripheral arterial disease, cerebrovascular disease, and aortic pathology, respectively. However, the evolving landscape of vascular surgery, including advances in endovascular techniques specifically endovascular aneurysm repair (EVAR), more aggressive management of vascular risk factor, and shifting treatment paradigms, has influenced procedural trends and likely, patient outcomes in this age group. We aimed to evaluate the trends in utilization and outcomes of octogenarians undergoing LEB, CEA, or AAAr using the National Inpatient Sample (NIS) database.

Methods

The NIS database was queried to identify all patients aged ≥ 80 years but < 90 years who underwent LEB, CEA, open AAAr, or EVAR from years 2003 – 2019. Relevant patients were identified using a combination of International Classification of Diseases (ICD) 9 and 10 codes. Procedures were identified by using ICD-9 and ICD-10 Procedure Coding System (ICD-9-PCS, ICD-10-PCS). Patient comorbidities were quantified using the Charlson Comorbidity Index (CCI). The identified cohorts of patient discharges were analyzed by searching for codes for in-hospital death and discharge disposition, our primary outcome. Gender, reported as percent female sex, along with presence of elective admission was also reported for each year. For discharge disposition, the percent disposition routine reflected the percent of discharges to places other than home (skilled nursing facility, rehabilitation facility, long term acute care, etc.). The CCI was reported as the mean for each year studied. Categorical variables were presented as percentages. Cochran Armitage test was used to describe the trend of outcomes across the years. We considered P-value < 0.05 as significant, and all tests were 2-sided. All analyses were conducted using SAS, version 9.4 (SAS Institute, Cary, NC).



Results

Figure 1. Trends in percentage of sample population that were octogenarian

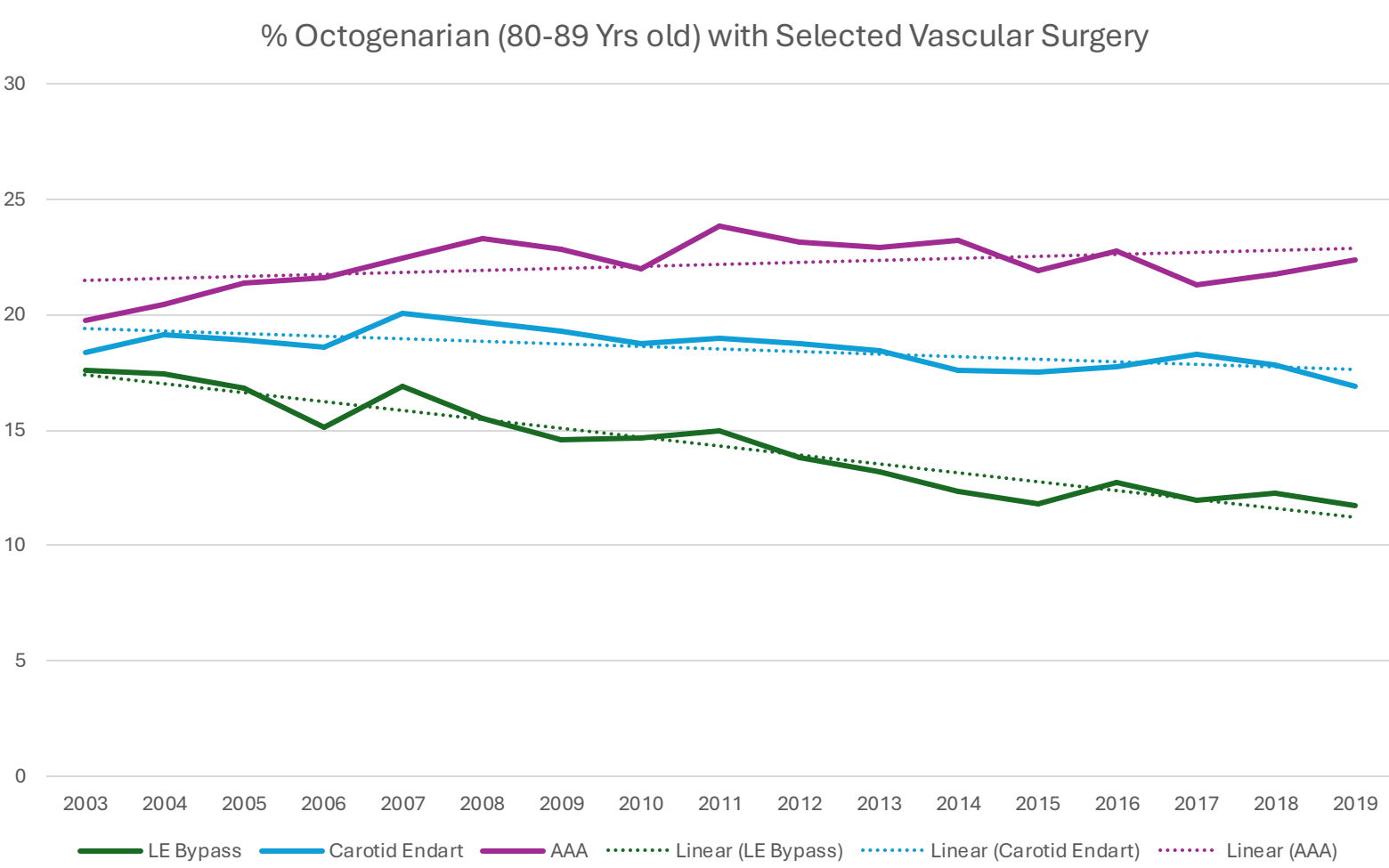


Figure 1: Among the entire sample population, a significant trend to less LEB and CEA being performed on octogenarians was noted (trend p-value < 0.0001) whereas the proportion of AAAr performed on octogenarians increased during the study period (trend p-value < 0.0001). **Figure 2:** In-hospital mortality significantly decreased during the study period in AAAr (trend p-value < 0.0001), LEB (trend p-value < 0.0113), and CEA (trend p-value < 0.0006); largest decline in AAAr. Subgroup analysis showed stable in-hospital mortality following open AAAr but a decrease following EVAR.

Table 1. Subgroup analysis of AAAr, open AAAr

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
% Octogenarian	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
% Disposition Routine	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
% In-hospital Mortality	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6

Table 2. Subgroup analysis of AAAr, EVAR

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
% Octogenarian	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5	16.5
% Disposition Routine	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
% In-hospital Mortality	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6

Trends in Demographics, Treatment Patterns, and Outcomes for Octogenarians Undergoing OAR and EVAR (2003–2019)

- Both OAR and EVAR groups showed an increasing proportion of female patients aged 80-89.
- The proportion of OAR procedures in octogenarians declined from 16.5% in 2003 to 11.5% in 2019.
- In-hospital mortality for OAR remained constant, but the proportion of octogenarians discharged home declined, reaching 29% in 2019.
- EVAR showed a significant decline in in-hospital mortality over the study period.
- Elective EVAR admissions decreased, whereas discharge patterns to non-home locations remained stable.

Figure 2. In-hospital mortality following AAAr, CEA, and LEB

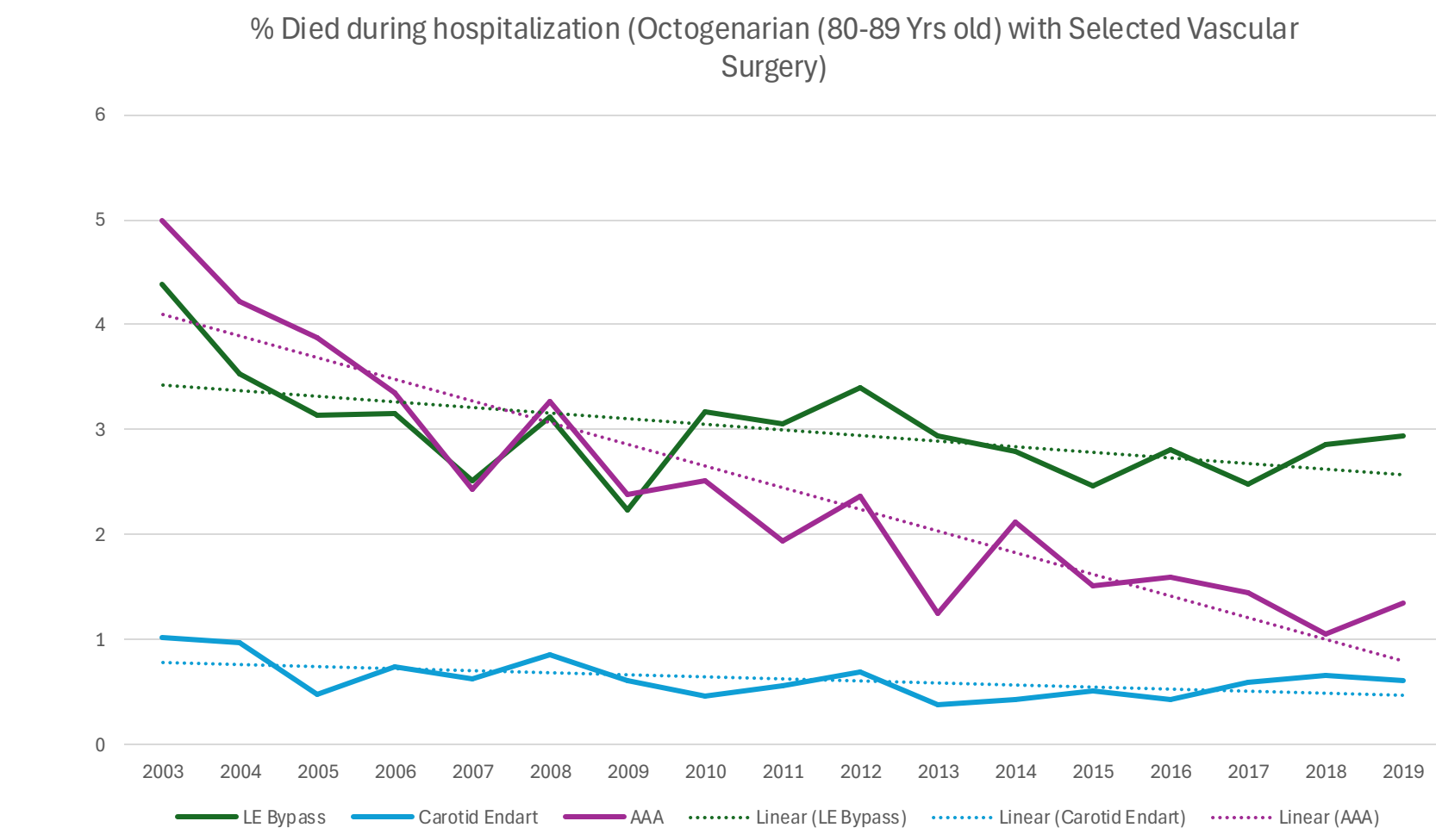


Table 3. CEA trends among octogenarians

Sample years (CEA)	% Octogenarian	CCI	% Disposition Routine	% In-hospital Mortality
2019	16.9	3	75	0.6
2018	17.8	2.9	74.7	0.7
2017	18.3	2.8	75.6	0.6
2016	17.8	2.7	73.9	0.4
2015	17.5	2.4	76.1	0.5
2014	17.6	2.3	75.2	0.4
2013	18.4	2.2	75.1	0.4
2012	18.8	2.2	76.1	0.7
2011	19	2.2	77.5	0.6
2010	18.8	2.1	75.2	0.5
2009	19.3	2.1	78.6	0.6
2008	19.7	2.1	78.2	0.9
2007	20.1	2	79.4	0.6
2006	18.6	2	80.5	0.7
2005	18.9	1.9	81.2	0.5
2004	19.1	1.8	80	1
2003	18.4	1.8	82.4	1
Trend p-value	< 0.0001	< 0.0001	0.0006	

Table 4. LEB trends among octogenarians

Sample years (LEB)	% Octogenarian	CCI	% Disposition Routine	% In-hospital Mortality
2019	11.8	3.8	23.0	3.0
2018	12.3	3.6	25.6	2.9
2017	12.0	3.7	24.2	2.5
2016	12.8	3.5	22.9	2.8
2015	11.8	3.3	25.0	2.5
2014	12.3	3.1	23.6	2.8
2013	13.2	3.0	25.7	2.9
2012	13.8	3.1	23.8	3.4
2011	14.9	3.1	25.9	3.1
2010	14.7	2.9	25.5	3.2
2009	14.6	2.8	27.1	2.2
2008	15.5	2.7	27.0	3.1
2007	16.9	2.7	28.5	2.5
2006	15.1	2.8	28.7	3.2
2005	16.8	2.7	29.6	3.1
2004	17.4	2.7	27.2	3.5
2003	17.6	2.6	30.8	4.4
Trend p-value	< 0.0001	< 0.0001	0.0113	

- Highest proportion of CEA procedures in octogenarians was in 2007 (20.1%), while the lowest was in 2019 (16.8%).
- Proportion of female patients undergoing CEA decreased from 48% in 2003 to 42% in 2019.
- Charlson Comorbidity Index (CCI) increased from 1.8 in 2003 to 3.0 in 2019.
- Fewer patients were discharged home.
- Elective admissions for CEA remained stable at ~80% throughout the period.

- LEB utilization in octogenarians showed the most significant decline among the four interventions.
- Proportion of female patients undergoing LEB decreased from 52% in 2003 to 42% in 2019.
- Mean Charlson Comorbidity Index (CCI) increased among octogenarians undergoing LEB.
- Fewer patients were discharged home over time.
- Elective admissions for LEB remained stable at ~65% throughout the 17-year period.

Discussion

This study highlights evolving trends in vascular surgery among octogenarians using national data from the NIS. Our findings reveal a nationwide decline in the proportion of LEB and CEA performed on octogenarians from 2003 to 2019, while the proportion of abdominal aortic aneurysm repair (AAAr) increased. A significant decrease in in-hospital mortality was observed across all three procedures despite an increase in comorbidity burden. Discharge to home decreased for CEA and LEB, whereas AAAr showed an increase in home discharge, driven by the rise in EVAR.

The decline in LEB utilization aligns with increasing adoption of endovascular interventions. Similarly, the reduction in CEA may reflect evolving guidelines and best medical therapy for asymptomatic carotid disease. The high perioperative mortality/discharge disposition associated with OAR raises questions about current intervention thresholds in octogenarians. These findings emphasize the need for individualized treatment strategies incorporating frailty assessment and life expectancy considerations to optimize patient outcomes.

Conclusion

Over 17 years, vascular intervention trends among octogenarians shifted significantly. LEB and CEA utilization declined, while AAAr increased, particularly in elective settings. Despite rising comorbidities, in-hospital mortality decreased across all procedures, most notably for AAAr and EVAR. OAR mortality remained stable, but fewer patients were discharged home. These trends reflect a growing preference for minimally invasive approaches and evolving risk-benefit considerations, emphasizing the need for careful patient selection and perioperative optimization in this high-risk population.

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