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Is There an Association Between Living in a Rural Area and the Incidence of Postoperative Complications or Hospital Readmissions Following Left Ventricular Assist Device (LVAD) Implantation, Compared to Urban LVAD Recipients?

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Is there an association between living in a rural area and the incidence of postoperative complications or hospital readmissions following left ventricular assist device (LVAD) implantation, compared to urban LVAD recipients?

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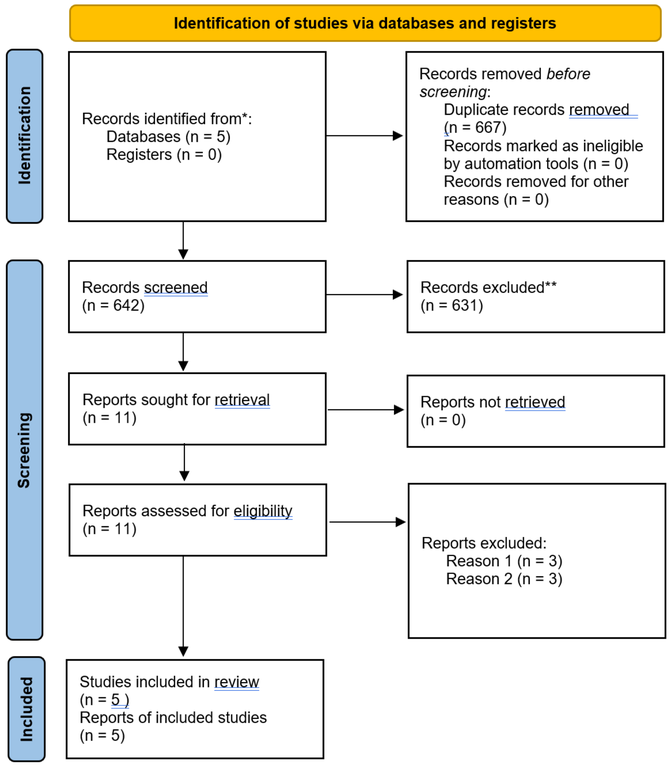
Introduction

A left ventricular assist device, commonly referred to as a LVAD, is a battery powered device that aids in pumping blood out of the lower left ventricle to the rest of the body. The inflow cannula portion of the LVAD is attached to the left ventricular apex. Blood from the lungs enters the left side of the heart where the LVAD device pumps the blood through the outflow canal into the ascending aorta where it is then distributed to the rest of the body. The pump and battery are controlled outside of the body and the driveline portion enters the skin to control the device. LVADs are particularly helpful in patients with end-stage heart failure. In the United States, over 6.5 million people have heart failure and this number continues to grow. Due to lengthy transplant lists and organ availability, LVADs have become a mainstay for maintaining heart function in patients waiting for transplants or patients who have tried multiple rounds of medical therapy. Patients who have received a CF-LVAD are shown to have a 1-year survival of 84%. This is a substantial increase in comparison to the 53% 2-year survival rate in heart failure patients on medical therapy. Despite increased patient and physician education, as well as advancements in the actual LVAD mechanics, up to 60% of patients will experience an LVAD related complication by six months post surgery. Complications of LVAD implantation are well documented and studied. Approximately 50-85% of patients experience bleeding requiring blood transfusion, 30% of patients experience bleeding requiring reoperation, and 50% of patients will contract infections. Additionally, there is a 2-9% rate of pump thrombosis, 15-25% rate of right heart failure, and 10-15% rate of stroke. As LVAD implantation rates continuously grow, it is increasingly important that complications are monitored in all capacities. To date, there are few studies examining the epidemiological factors affecting complication rates due to LVAD transplantation. Rural populations, areas with fewer than 2000 housing units and 5000 residents, are more likely to experience health problems and are less likely to have medical services available to them. In contrast, urban populations, areas with greater than 2000 housing units and 5000 residents, have greater access to medical services and physicians. This review compares rates of adverse effects due to LVAD implantation in rural hospital settings versus urban hospital settings.

Methods



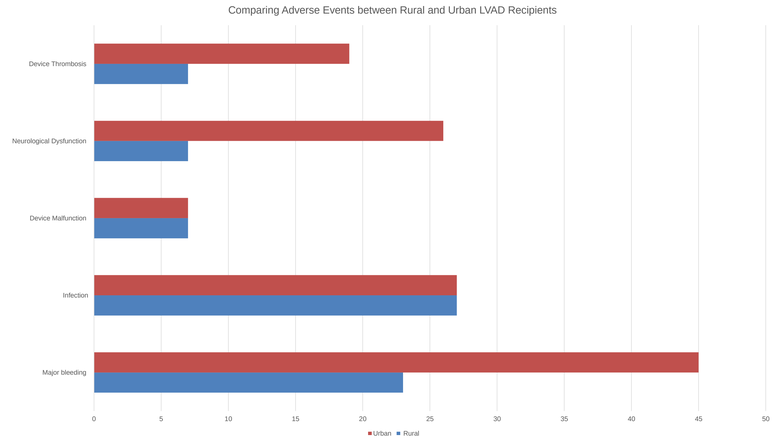
Objective

The aim of this systematic review is to evaluate whether rural left ventricular assist device (LVAD) recipients have a higher risk of adverse events and hospitalizations compared to their urban counterparts.

Results

Author/ Year	Title	Methodology	Results
Alonso, Hupke (2019)	Adverse-Event Free Survival, Hospitalizations, and Mortality in Left Ventricular Assist Device Recipients	Data from 141 LVAD recipients were taken and patients were separated into rural and urban demographics. Patients were then analyzed for hospitalizations and adverse events.	Demographics • 52 rural patients • 89 urban patients Rural Adverse Events • 14 major bleeding • 14 infection • 7 device malfunction • 2 Neurological dysfunction Rural Hospitalizations • 50 hospitalizations Urban Adverse Events • 22 Major bleeding • 22 Infection • 7 Device malfunction • 6 Neurological dysfunction Urban Hospitalizations • 76 hospitalizations Adverse events and hospitalizations within 2 years of implantation* Survival within 2 years of LVAD transplantation • 28 deaths • 7 rural patients • 21 urban patients
Alonso, Kitko (2018)	Rural-Urban Comparison of VAD-Related Hospitalization Risk and Survival in the 6 Months Following Device Implantation	Data from the “Profiling Biobehavioral Responses to Mechanical Support in Advanced Heart Failure (5R01NR013492-04) trial” was analyzed to compare survival and hazards in rural and urban LVAD recipients.	100 total VAD recipients • 7 deaths during study • 60% of recipients required hospitalization • Rural VAD recipients have higher instances of hospitalization (not statistically significant)
Alonso, Faulkner (2020)	A Longitudinal Comparison of Health-Related Quality of Life in Rural and Urban Recipients of Left Ventricular Assist Devices	Data from the “Profiling Biobehavioral Responses to Mechanical Circulatory Support in Advanced Heart Failure” was analyzed using demographic information and subject characteristics	Demographics • 32 rural patients • 63 urban patients Rural Adverse Events • 13 major infection • 9 bleeding • 7 device thrombosis • 5 Neurologic dysfunction Urban Adverse Events • 44 major infection • 23 bleeding • 19 device thrombosis • 20 Neurologic dysfunction Hospitalizations • 107 total admissions among 58 patients • 18 of the 58 patients were rural • Rural subjects visited the ED a mean of 1.28 times during study • Urban subjects visited the ED a mean of .41 times during study Adverse events in the 6 month study period*
Cai (2022)	Relation of Sociodemographic Factors With Primary Cause of Hospitalization Among Patients With Left Ventricular Assist Devices (from the National Inpatient Sample 2012 to 2017)	LVAD patient Data from the Agency for Healthcare Research and Quality Healthcare Cost and Utilization Project National Inpatient Sample was collected and analyzed using patient demographics between 2012-2017	Hospitalizations and Adverse events • Higher instances of GI bleeding among rural patients than urban residences ($p < 0.01$) • Higher instances of ventricular arrhythmias in rural patients (4.8% rural vs 4.4% urban) • Higher instances of LVAD complication in rural patients (4.0% rural vs 3.1% Urban) • Higher instances of Stroke in rural patients (5.3% rural vs 4.3% urban)
Rajagopalan (2016)	Success of Left Ventricular Assist Device Therapy in Rural United States Residents	102 LVAD patients were evaluated between 2011-2014. Patients were then evaluated regarding whether they are rural or urban status. Outcomes and adverse events were measured.	Demographics 54 rural patients 48 urban patients Outcomes • Both urban and rural groups had same survival rate (82%), and readmission rate in patients who survived 1 year. • Infection rate was higher in rural patients

Results



Discussion

The sources collectively suggest that both rural and urban LVAD recipients face challenges post-implantation, with rural recipients potentially at higher risk for post-implantation hospitalization, while urban recipients may face a higher mortality rate. Specific adverse events, such as gastrointestinal bleeding, ventricular arrhythmias, LVAD complications, and stroke, are more prevalent in rural patients. Despite these challenges, survival rates and heart transplantation outcomes at 1 year are similar between rural and urban recipients. However, rural patients exhibit a higher driveline infection rate at 1 year. Overall, the data highlight the need for closer management and ongoing resource assessment for all LVAD recipients, regardless of their place of residence, and highlight the potential benefits of telehealth, mobile health, and remote monitoring in managing complications and avoiding hospitalizations.

Conclusion

The association between living in a rural area and the incidence of postoperative complications or hospital readmissions following LVAD implantation is not definitive, the sources suggest that rural recipients may face unique challenges. Further research is needed to fully understand the interplay between place of residence and LVAD outcomes. These findings however may emphasize the importance of tailored interventions and close monitoring for rural LVAD recipients to improve their overall outcomes and quality of life. Longer and larger studies following both cohorts will be essential to truly understand the relationship between adverse events/hospitalizations between rural and urban LVAD recipients.

References

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