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Clinical Research

Primary Prevention of Sudden Cardiac Death With Device Therapy in Urban and Rural Populations

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ABSTRACT

Background: Implantable cardioverter defibrillators (ICDs) have shown benefit in reducing mortality in patients with heart failure, after myocardial infarction, and those with reduced ejection fraction. We sought to explore the use of this therapy in specialized heart function clinics, in rural and urban locations.

Methods: This was a retrospective cohort study performed in 3 specialized heart function clinics in Nova Scotia, 2 of which were in rural locations. All patients with an initial left ventricular ejection fraction $\leq 35\%$ were included from 2006 to 2011. Rates of referral, ICD implantation, and mortality were compared between urban and rural groups.

Results: There were 922 patients included in the study; 636 patients in the urban clinic, 286 in the rural locations. Referral rates were higher in the urban clinic compared with the rural locations (80.4% vs

RÉSUMÉ

Introduction : Les défibrillateurs cardioverters implantables (DCI) ont démontré des avantages dans la réduction de la mortalité chez les patients souffrant d'insuffisance cardiaque, après un infarctus du myocarde et chez ceux dont la fraction d'éjection est réduite. Nous avons cherché à étudier l'utilisation de cette thérapie dans des cliniques spécialisées en fonction cardiaque, en milieu rural et en milieu urbain.

Méthodes : Il s'agissait d'une étude rétrospective de cohorte réalisée dans 3 cliniques spécialisées en fonction cardiaque de la Nouvelle-Écosse, dont 2 en milieu rural. De 2006 à 2011, tous les patients dont la fraction d'éjection ventriculaire gauche initiale était $\leq 35\%$ étaient inclus. Les taux d'aiguillage, l'implantation de DCI et la mortalité étaient comparés entre les groupes en milieu urbain et les groupes en milieu rural.

There is broad consensus on the basis of randomized clinical trials evidence that implantable cardioverter defibrillator (ICD) therapy can provide significant benefit for patients who are at identifiably high risk of sudden cardiac death. These devices provide early detection and therapy when life-threatening ventricular arrhythmias occur, and thus can reduce mortality risk for patients with reduced ejection fraction (EF) and heart failure.^{1,2} In addition, cardiac resynchronization therapy has also been reported to improve mortality

in patients with a prolonged QRS duration, mild to moderate heart failure, and systolic dysfunction.^{3,4}

Despite this, there have been several studies that suggest that there is significant underutilization of this life-saving therapy.^{5–10} The rate of referral for ICD therapy in the heart failure population is unclear. We sought to study whether differences in referral rates exist between urban and rural environments.

Methods

Institutional approval was obtained from the research ethics board to conduct this study. This was a retrospective, observational study conducted at 3 established heart function clinics in Nova Scotia; 1 urban site was the regional tertiary care centre with on-site cardiac electrophysiology specialists, the other 2 sites were rural (111 km and 219 km from the

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See page 6 for disclosure information.

68.3%; $P = 0.024$). Refusal rates for referral were higher in the rural locations (13.7% vs 2.1%; $P < 0.0001$). Higher referral rates were associated with urban location (odds ratio [OR], 1.81; 95% confidence interval [CI], 1.01-3.26; $P = 0.047$), and younger age (OR, 0.96; 95% CI, 0.93-0.99; $P = 0.003$); lower referral rates for women was observed (OR, 2.29; 95% CI, 1.13-4.63; $P = 0.021$). Mortality was significantly associated with older age, lack of referral, presence of comorbidities (renal failure, diabetes, peripheral vascular disease) and a rural location.

Conclusions: Specialized heart function clinics have a high rate of appropriate referral for primary prevention ICDs, but referral rates for this life-saving therapy remain lower in rural jurisdictions. This disparity in access to care is associated with increased mortality and might require particular attention to prevent unnecessary deaths.

urban centre), situated in secondary care institutions, without on-site cardiac electrophysiology services but with cardiology care (rural). All heart function clinics were nurse-run, physician supervised clinics dedicated to the care of heart failure.^{11,12}

Patient selection

Patients admitted to the care of the heart function clinics from January 1, 2006 until December 31, 2011 with an initial left ventricular (LV) EF of $\leq 35\%$ were included. Patients with known terminal illness, metastatic malignancy, or dementia were excluded from further analyses. Data collection was performed by nurses trained in chart abstraction, and specialized in the care of heart failure. Data on demographic variables, comorbidities, change in EF, and documentation regarding any discussion regarding ICD therapy were collected. Patients were classified into 1 of the following groups: ICD already implanted at initial visit, eligible for ICD at last visit and referred, eligible for ICD at last visit and not referred, or not eligible for ICD at last follow-up. ICD eligibility was on the basis of current guidelines: (1) EF $\leq 35\%$ with or without heart failure for patients with an ischemic cardiomyopathy, receiving optimal medical therapy, and more than 1 month after myocardial infarction or 3 months after revascularization; or (2) EF $\leq 35\%$ with New York Heart Association classification of II, III, or ambulatory IV, heart failure of a nonischemic etiology, with at least 9 months of heart failure therapy, and receiving optimal medical therapy.^{13,14} Patients were considered ineligible for primary prophylactic ICD if they were older than age 80 years, had a physician-estimated life expectancy of < 1 year or significant comorbidity (eg, advanced dementia) or did not meet the inclusion criteria for eligibility. Reasons for nonreferral if ICD-eligible, and reasons for noneligibility were collected. Referral for ICD, subsequent implantation, and ICD therapies were obtained through linkage with the QEII ICD registry. This is a comprehensive prospective ICD registry at the QEII Health Sciences Center, the region's only ICD implant

Résultats : L'étude comptait 922 patients, dont 636 de la clinique en milieu urbain, et 286 des cliniques en milieu rural. Les taux d'aiguillage étaient plus élevés dans la clinique en milieu urbain que dans les cliniques en milieu rural (80,4 % vs 68,3 %; $P = 0,024$). Les taux de refus d'aiguillage étaient plus élevés en milieu rural (13,7 % vs 2,1 %; $P < 0,0001$). Les taux d'aiguillage plus élevés étaient associés au milieu urbain (ratio d'incidence approché [RIA], 1,81; intervalle de confiance [IC] à 95 %, 1,01-3,26; $P = 0,047$), et à un plus jeune âge (RIA, 0,96; IC à 95 %, 0,93-0,99; $P = 0,003$); les taux d'aiguillage plus faibles étaient observés chez les femmes (RIA, 2,29; IC à 95 %, 1,13-4,63; $P = 0,021$). La mortalité était significativement associée à un âge plus avancé, à l'absence d'aiguillage, à la présence de comorbidités (insuffisance rénale, diabète, maladie vasculaire périphérique) et au milieu rural.

Conclusions : Les cliniques spécialisées en fonction cardiaque ont un taux élevé d'aiguillage convenable pour les DCI en prévention primaire, mais les taux d'aiguillage pour les traitements de sauvetage restent plus faibles dans les milieux ruraux. Cette disparité dans l'accès aux soins est associée à une mortalité accrue et nécessiterait une attention particulière pour prévenir les décès inutiles.

centre.⁶ This registry was established in 2006 and has been prospectively collecting data on all patients referred or implanted with an implantable defibrillator in the province of Nova Scotia. All patients who were implanted with an ICD before 2006 were entered into a separate retrospective registry, where follow-up was continued prospectively. Follow-up was available for the entire population of patients with ICDs in the province of Nova Scotia.

Mortality data were obtained through chart abstraction and linkage with the provincial vital statistics registry. This linkage is highly reliable because each patient in Nova Scotia must have a death certificate filed with the provincial vital statistics registry; linkage was accomplished through health card number, which is provided to each Nova Scotia resident at no charge and is a requirement to obtain any medical care.

Definitions

Ischemic heart disease was defined as presence of coronary disease on coronary angiogram, with at least 70% stenosis in 1

Table 1. Baseline characteristics

Variable	All (N = 922)	Urban (n = 636)	Rural (n = 286)	P
Mean age	66.5 \pm 13.4	65.1 \pm 13.8	69.6 \pm 11.9	< 0.0001
Women, %	204 (22.1)	139 (21.9)	65 (22.7)	0.77
Mean LVEF	24.1 \pm 7.2	23.6 \pm 7.3	25.2 \pm 7.0	0.002
Coronary artery disease, %	468 (50.8)	310 (48.7)	158 (55.2)	0.07
Previous PCI/CABG	330 (35.8)	241 (37.9)	89 (27.0)	0.05
Diabetes	313 (35.2)	227 (37.7)	86 (30.1)	0.03
Previous stroke/TIA	128 (14.7)	78 (13.4)	50 (17.5)	0.11
COPD/asthma	178 (20.5)	114 (19.5)	64 (22.4)	0.33
Current smoking	141 (16.0)	102 (17.1)	39 (13.6)	0.19
Peripheral vascular disease	118 (13.6)	97 (16.6)	21 (7.3)	0.0002
History of renal failure	247 (28.5)	168 (28.9)	79 (27.6)	0.69

CABG, coronary artery bypass graft; COPD, chronic obstructive pulmonary disease; LVEF, left ventricular ejection fraction; PCI, percutaneous coronary intervention; TIA, transient ischemic attack.

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