Cost-effectiveness of spinal cord stimulation in patients with intractable angina

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Abstract

Aim. To review the cost of healthcare utilisation by patients suffering from intractable angina, unsuitable for coronary revascularisation, before and after treatment with spinal cord stimulation.

Methods. Data were collected for eight patients treated for intractable angina with spinal cord stimulation at Green Lane Hospital before April 1999. Information on consumption of specified medical resources for the twelve months preceding implantation, the implantation period, and the twelve months following implantation was collected. Where available, data were also collected for the eighteen months preceding and following treatment.

Results. In six patients successful permanent stimulation was established; in two it proved technically impossible to implant a stimulator. The six patients with successful stimulation spent fewer days in hospital (p=0.028) and consumed fewer resources (p=0.046) following implantation than in the period before implantation. The two patients for whom spinal cord stimulation was unsuccessful spent more days in hospital and consumed more resources in the twelve months following, than in the twelve months preceding attempted implantation. Extrapolation of data for all eight patients suggests that, on average, the cost of implanting a spinal cord stimulator will be recovered in approximately fifteen months.

Conclusion. Spinal cord stimulation is a cost-effective treatment for intractable angina pectoris.

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Angina pectoris is disabling with serious implications for quality of life and ability to carry out every-day activities. For an identifiable group of patients, surgery carries high risk or is technically impossible, and medication may fail to control symptoms. In 1994, the number of patients with such intractable angina was estimated as almost 30 000 in the US alone.[1] A treatment which could safely relieve suffering and improve the quality of life of these patients, would be of benefit. Spinal cord stimulation (SCS) may be such a treatment.

SCS was first used for angina in 1985, after success with pain relief in peripheral vascular disease indicated its utility for pain of ischaemic origin.[2] Since the first trial in the literature in 1987,[3,4] there has been growing interest in this treatment. By 1994, 500 patients with angina in Europe had been treated with SCS.[1]

Although the mechanisms of action of SCS remain incompletely understood, many investigations have concluded that the reduction of angina is secondary to an anti-ischaemic effect.[2,5-10] Published results on the efficacy of SCS in angina are promising, indicating reduced ischaemic burden,[2,10] reduction in angina episodes,[6,11,12] increased working capacity and exercise tolerance,[2,8,9] improved myocardial lactate metabolism,[9,10] reduction in intake of nitrates,[11,13] and improved quality of life.[13,14] Studies have reported SCS to be effective in about 80% of patients with intractable angina.[8,15]

Since July 1997, fourteen patients with intractable angina who were unsuitable for coronary surgery were referred by their cardiologists for consideration of treatment with spinal cord stimulation (SCS) at Green Lane Hospital. They were asked to undergo a screening procedure, in which a trial SCS lead was inserted, but externalised. If technically satisfactory stimulation was achieved, with relief of angina, the patients had implantation of a permanent stimulator.[15] Results were encouraging, but SCS is a costly procedure (NZ$13 300 for the implanted components alone), and in New Zealand its use has been restricted on economic grounds. In fact, there are limited data on the economic consequences of SCS.[16,17] It is clear that such patients will continue to utilise expensive healthcare resources if untreated, so it is possible that such economic restriction is misguided. Therefore the present study reviewed the cost of healthcare utilisation by patients suffering from intractable angina unsuitable for coronary revascularisation, before and after treatment with SCS at Green Lane Hospital.

Methods

Data were collected in April 2000 on patients (eight) for whom at least twelve months' follow-up information was available. Using patient notes, data related to the consumption of medical resources were collected for the twelve months preceding implantation, the implantation period itself, and the twelve months following implantation. When available, the same information was collected for the eighteen months preceding and following implantation. The implantation period was defined as beginning on the day of the first procedure related to SCS, and ending on the day of discharge, either after implantation of a permanent stimulator or failure of the screening procedure. Information was collected on the following designated components of healthcare utilisation: number of days of cardiac-related hospitalisation in a ward or in a coronary care unit (CCU), outpatient clinic visits, echocardiograms, ultrasound investigations, exercise tolerance testing, admission into the intensive care unit (ICU), and operative sessions (angiography, percutaneous transluminal coronary angioplasty (PTCA) with or without stents, coronary artery bypass grafting (CABG) and SCS related procedures). Each component was allocated a value in dollars, obtained (on a confidential basis) from current hospital pricing, and the mean times and costs were calculated for each period.

Results

Eight patients had a trial SCS lead implanted before April 1999 (Table 1). Of these, six proceeded to successful implantation of a permanent stimulator, while in two it was impossible to obtain technically satisfactory stimulation. In six of the eight patients, (coincidentally, the six in whom stimulation was successful) data were available for eighteen months before and after implantation. The average age of the eight patients was 65 years, and all were Canadian Cardivascular Society (CCS) angina class four. All had undergone at least one bypass grafting procedure and seven had undergone one or more PTCA procedures. Their average ejection fraction was 60%. Full medical treatment for angina, including perhexiline, had been tried in all patients and five had received anticoagulation at some stage.

The six patients in whom SCS was successful underwent two operative sessions during the implantation period: initial trial screening and permanent implantation (Table 2). The mean total cost for this period was NZ$24 523 (range NZ$22 590 - 27 793). Patients in whom implantation of a stimulator was unsuccessful had a screening procedure only. The mean cost

Table 1. Demographic and other patient-related information.

	Patients receiving SCS before April 1999							
Sex	M	M	M	M	M	M	F	M
Age (years)	55	71	65	69	69	63	58	71
Ejection fraction (%)	51	70	44	57	68	50	76	61
CABG (no. operations)	2	1	1	2	2	1	2	2
PTCA (no. procedures)	3	4	4	3	0	2	1	3
Perhexiline (daily dose, mg)	200	200	100	200	200	100	200	100
Anticoagulation therapy (heparin/warfarin)	H	-	W	-	-	H	H	H
Angina class (CCS)	4	4	4	4	4	4	4	4
Successful SCS implant	Y	Y	Y	Y	Y	Y	N	N
Follow up (months)	25	22	21	27	28	21	12	12

CABG = coronary artery bypass graft; PTCA = percutaneous transluminal coronary angioplasty; CCS = Canadian Cardiovascular Society; SCS = spinal cord stimulation.

for the implantation period for these two patients was NZ$6782.

Patients in whom SCS was successful required fewer days in hospital (p=0.028, Wilcoxon signed-rank test) and consumed fewer resources in the twelve months post-implantation than in the twelve months before implantation (Table 2; p=0.046, Wilcoxon signed-rank test). Compared with the twelve months preceding implantation, the post-implantation period was associated with at least a four-fold reduction in CCU admissions, operative sessions and total cost. Cardiology ward admissions dropped from an average of 18.3 to 6.2 days per year.

The two patients in whom the trial of SCS was unsuccessful showed an increase, post-procedure, in all measured outcomes except CCU admissions and operative sessions (Table 2). Total cost was similar for pre- and post-implantation periods for these two patients.

The decrease in resource consumption and hospitalisation seen in the initial twelve month post-implant period were maintained until eighteen months in the six patients with sufficient follow-up data (Table 3). The mean cost for the eighteen months post SCS implantation was NZ$26 935 less than that for the eighteen months prior to treatment, a net saving of NZ$2412 after subtracting the mean cost of SCS implant treatment (NZ$24 523).

For all eight patients, the average cost of SCS insertion (successful or unsuccessful) was NZ$20 088. Combining the

Table 2. Hospital admissions and resource consumption costs for twelve months before and after SCS implantation.

		Pre-implant	Implant period	Post-implant
Successful implant (n=6)	Days in CCU Mean (range)	9.1 (2-17)	0	1.7 (0-5)
	Days in ward Mean (range)	18.3 (5-32)	11 (7-18)	6.2 (0-24)
	Operative sessions Mean (range)	2.17 (1-4)	2 (2)	0.5 (0-3)
	Cost per patient NZ$ Mean (range)	28 072 (13 413-56 845)	24 523 (22 590-27 793)	6044 (0-21 676)
	Total cost NZ$	168 436	147 142	36 261
Unsuccessful implant (n=2)	Days in CCU Mean (range)	5 (0-10)	1 (0-2)	4.5 (0-9)
	Days in ward Mean (range)	1.5 (0-3)	1.5 (0-3)	10.5 (7-14)
	Operative sessions Mean (range)	1.5 (1-2)	1 (1)	1 (1)
	Cost per patient NZ$ Mean (range)	10 915 (9887-11 943)	6782 (6519-7044)	13 131 (5611-20 650)
	Total cost NZ$	21 830	13 563	26 261
Total (n=8)	Days in CCU Mean (range)	8.13 (0-17)	0.25 (0-2)	2.4 (0-9)
	Days in ward Mean (range)	14.13 (0-32)	8.6 (0-18)	7.25 (0-24)
	Operative sessions Mean (range)	2.25 (1-4)	1 (1-2)	0.6 (0-3)
	Cost per patient NZ$ Mean (range)	23 783 (9887-56 845)	20 088 (6519-27 793)	7815 (0-21 676)
	Cost per patient per month NZ$	1982	-	651
	Total cost NZ$	190 266	160 705	62 522
	Total cost per month NZ$	15 856	-	5210

data for successful and unsuccessful SCS, the average total cost including SCS implantation for the eight patients after twelve months was NZ$27 903. The cost per month in the post-implantation period was NZ$10 646 less than during the pre-implantation period, for all eight patients (ie an average saving of NZ$1330 per patient per month). Assuming that this benefit was maintained, a net saving would occur after approximately fifteen months (Figure 1).

Table 3. Hospital admissions and resource consumption costs for eighteen months before and after SCS implantation (for patients with successful implantation).

	Pre-implant (n=6)	Implant period (n=6)	Post-implant (n=6)
Days in CCU Mean (range)	10.5 (2-25)	0	2.3 (0-6)
Days in ward Mean (range)	19.8 (5-32)	11 (7-18)	6.2 (0-24)
Operative sessions Mean (range)	3.17 (1-7)	2 (2)	1 (0-4)
Cost per patient NZ$ Mean (range)	35 222 (13 443-88 318)	24 523 (22 590-27 793)	8287 (30-25 302)
Total cost NZ$	211 335	147 142	49 727

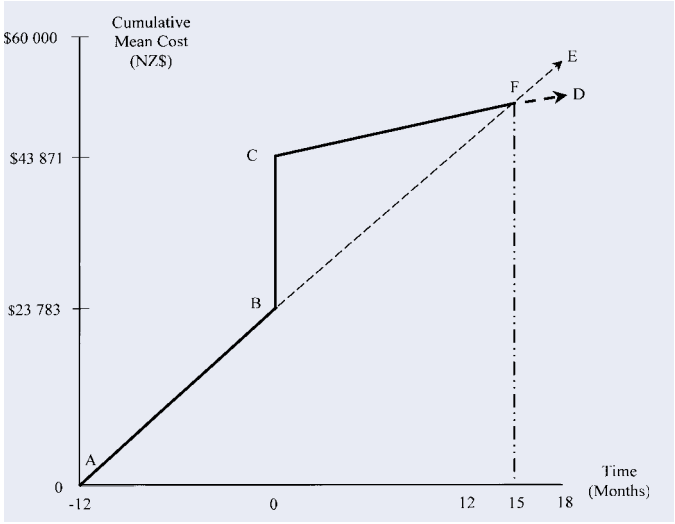

Figure 1. Rates of resource utilisation (mean cost per patient in NZ$) before and after SCS insertion. AB=Pre-implantation cost by time, BC=Cost of implantation, CD=Post-implantation cost by time, BE=Extrapolated pre-implantation cost by time, F=Break even point for SCS insertion. *After twelve months data are extrapolated.

Discussion

Our data suggest that the costs to the healthcare system of implanting spinal cord stimulators are likely to be recovered after fifteen months on average. The clinical benefits of SCS have been extensively documented.[2,6-14,18] Therefore, SCS is justifiable on both economic and clinical grounds.

Post-implantation costs in the two unsuccessful patients were not reduced, suggesting that the savings seen in the others were attributable to SCS, and not simply coincidental. Our conclusion takes account of the costs related to patients in whom stimulation was unsuccessful, as well as those in whom it was successful, which clearly it should. A higher failure rate would reduce the savings made overall. However, the literature suggests a success rate of 80% with SCS for angina,[8,15] so our proportion of good results (six out of eight) is likely to be achievable on an ongoing basis.

One barrier to offering this treatment in the current public health system in New Zealand is the lack of an appropriate Diagnostic Related Group (DRG) code for SCS implantation for angina. At present these procedures are coded as a treatment for back pain, unrelated to the principal diagnosis of angina, and are allocated too low a value to cover the costs of providing the treatment. Under the current code (DRG 950) the hospital is left with a net loss in respect to implantation of the stimulator of approximately NZ$15 000. In the light of our results, this situation is irrational and should be addressed urgently.

The main limitation of our study relates to the comprehensiveness of the cost estimates. The cost information was obtained from current Green Lane Hospital pricing data, and applied in the same way to pre- and post-operative periods. Any omitted costs are likely to follow the same trends as those we have included. Even if the exact dollar amounts were disputed, the central conclusion seems secure. SCS does lead to a reduction in the level of resources used by patients with angina, and eventually to saved money.

The exact place of SCS in the management of angina is uncertain. In addition to the patients described in this paper, for whom surgery was not an option, there is a group of patients in whom coronary artery grafting is feasible but associated with very high risk. It may well be that these patients would be better treated with SCS. Only one study has subjected SCS for angina to the rigours of a prospective randomised comparison with surgery. In this study, the effects of the two treatments were similar, but mortality was lower in the SCS group in an intention-to-treat analysis.[19] We have begun a randomised prospective comparison of SCS with surgery in patients for whom the latter is possible but poses a higher than usual risk. The results of this study will help to refine our understanding of the indications for SCS. In the meantime there is a steady demand for SCS in patients for whom surgery is not an option. Our data justify continuing to meet this demand if possible.

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