ELSEVIER

European Journal of Cardio-thoracic Surgery 40 (2011) 221–226

EUROPEAN JOURNAL OF CARDIO-THORACIC SURGERY

www.elsevier.com/locate/ejcts

Persistent sensitivity disorders at the radial artery and saphenous vein graft harvest sites: a neglected side effect of coronary artery bypass grafting procedures

Florian Dick, Ana Hristic, Eva Roost-Krähenbühl, Thierry Aymard, Alberto Weber, Hendrik T. Tevaearai *, Thierry P. Carrel

Clinic for Cardiovascular Surgery, Inselspital Berne, Berne University Hospital and University of Berne, Berne, Switzerland

Received 18 October 2010; received in revised form 28 October 2010; accepted 2 November 2010; Available online 22 December 2010

Abstract

Objective: The use of radial artery conduits in coronary artery bypass grafting (CABG) surgery is associated with improved long-term patency and patient survival rates as compared with saphenous vein conduits. Despite increasing popularity, relative incidence of local harvest-site complications and subjective perception of adverse long-term sequelae remain poorly described. **Methods:** To allow for direct comparison, we investigated a consecutive series of patients in whom both the radial artery and the saphenous vein had been harvested for isolated CABG during a 36-month period. Patients were identified from a prospective database that collects baseline clinical information. The patients' own perceptions were assessed by a standardized direct telephone survey regarding any persistent functional impairment from their arm and leg operation sites. **Results:** Out of 1756 CABG patients during the study period, 168 (10%) were eligible (78% men, median age: 60.1 ± 9.6 years, range: 29.6–82.4 years). Of these, 123 (73%) could be contacted and interviewed at a median follow-up time of 2.5 ± 0.9 years. Surgical wound complications at harvest sites (arms and legs) had occurred in 3% and 12%, respectively, and persistent symptoms (arms and legs) were self-reported as follows: chronic pain (5% and 8%), numbness (32% and 34%) and paresthesia/dysesthesia (14% and 7%). Overall, 39% of the patients reported persistent discomfort at the arm and 39% at the leg. Both sites were simultaneously affected in 21% (P = n.s., paired testing). Logistic regression modeling showed that patients with adverse long-term sequelae were younger ($P < 0.005$), had a higher body mass index ($P < 0.05$) and a lower EuroSCORE ($P < 0.001$) at the time of operation (EuroSCORE, European System for Cardiac Operative Risk Evaluation). Perioperative wound complications, however, did not predict persistence of symptoms. **Conclusions:** Persistent harvest-site discomfort occurs with astonishing frequency after CABG surgery and affects arms and legs equally. Although usually considered a minor complication, long-term limitation to quality of life may be substantial, particularly in younger and relatively healthy patients. Thus, harvest-site discomfort clearly belongs to the list of possible post-CABG complications of which patients need to be aware.

Keywords: Coronary artery bypass; Radial artery; Saphenous vein; Treatment outcome; Wound complication; Sensory dysfunction

1. Introduction

Coronary artery bypass grafting (CABG) continues to be the preferred treatment option for severe coronary artery disease despite the current era of percutaneous intervention [1]. Its main advantage comprises a high degree of reliability and durability, both of which have improved considerably with the use of autologous radial artery conduits. This conduit was proposed originally by Carpentier in 1973 [2], but the initial clinical results were disappointing and limited its popularity for a long time [3]. It was not before the 1990s that a new wave of publications demonstrated advantageous midterm results when compared with use of saphenous vein conduits [4,5]. Eventually, long-term results were also confirmed to be better for radial arterial conduits [6].

With radial harvesting, ischemic complications of the hand are certainly feared the most [7], but, fortunately, can be all but eliminated by previous evaluation of ulnar artery function. Less dramatic complications, however, are more common and include, as with any superficial surgery, local hematoma, cicatrization delay, or wound infection during early, and persistent pain or sensitivity disorders during long-term follow-up [5,8–11]. Generally, such complications are reported very rarely, probably because they are considered negligible in the context of CABG surgery. However, persistent sensory discomfort may be perceived as highly unpleasant by the patient, particularly if the hand is affected.

* Corresponding author. Address: Research & Development, Clinic for Cardiovascular Surgery, Inselspital, CH-3010 Berne, Switzerland.
Tel.: +41 31 632 2373; fax: +41 31 632 9766.
E-mail address: hendrik.tevaearai@insel.ch (H.T. Tevaearai).

1010-7940/$ – see front matter
doi:10.1016/j.ejcts.2010.11.020

The aim of this investigation was to establish the relative incidence of persistent wound complications after CABG surgery at both radial artery and great saphenous vein harvest sites, and to determine potential risk factors for their occurrence. As we tested the hypothesis that persistent discomfort might be more relevant at the hand, we tried to quantify the patient's subjective perception of the gravity of impairment.

2. Materials and methods

The local ethical committee approved the current analysis as part of regular quality control, and all involved patients provided informed consent upon inclusion into this *post hoc* analysis. The study sample was drawn from a consecutive series of patients undergoing CABG surgery during a 36-month period. The patients were identified from a prospective cardiac surgery patient registry. To allow for direct comparisons and assessment of relative incidences of complications, only patients in whom at least one segment of the great saphenous vein and one radial artery were concomitantly harvested for CABG surgery were considered for analysis. A single author (AH) attempted to contact all patients at least 5 times for a scripted interview on the telephone. Patients who were not reached or unable to individually and adequately answer the series of questions were excluded from the analysis. No other exclusion criteria applied.

2.1. Predictor variables and main outcome measures

Clinical data were imported from a prospectively maintained and comprehensive database, which collects a conventional range of preoperative, operative and postoperative information. The additive European System for Cardiac Operative Risk Evaluation (EuroSCORE) model was used to estimate the overall risk at time of surgery. All data were checked for plausibility and corrected, where necessary and possible, before being entered into the analysis as independent (predictor) variables. Main outcome information was collected from the scripted interviews: as mentioned, assessment focused on the patient's own perception of the local situation at both graft harvest sites. Information regarding perioperative wound complications (dehiscence, local hematoma, or infection) was categorized in a bimodal form ('yes' or 'no'). Persistent (at the time of interview) sensory discomfort was distinguished between numbness, dysesthesia and paresthesia and similarly categorized as 'yes' or 'no'. The intensity of persistent pain was scored by the patient using a scale ranging from 1 (no pain) to 10 (unbearable pain).

2.2. Operative procedures

In all patients, the functional reserve of the ulnar artery was assessed by the Allen test before operation and, if needed, supplemented by Doppler ultrasonography. Cardiac surgery was performed in a standardized manner, and included a traditional extracorporeal circulation (ECC) approach for all CABGs combined with another procedure, whereas a Mini-ECC (MECC) [12] was used for all isolated CABG procedures. All radial arteries were harvested by experienced surgeons via a single forearm cutaneous incision. The graft was taken invariably in a pedicled technique using low-current diathermy, clips and scissors. The saphenous vein was harvested in a similar technique using a series of prolonged cutaneous incisions. Wound closure was standardized and included cautious hemostasis, deep subcutaneous closure using running vicryl 4/0 sutures (Ethicon), subcutaneous running Vicryl 4/0 sutures and intradermal running monocryl sutures (Ethicon). Redon drainage was systematically used at all forearms and thighs.

2.3. Statistical analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) for Windows (version 15.0; SPSS Inc, Chicago, IL, USA). Continuous variables are expressed as mean $\pm$ standard deviation (SD) or, when skewed, as median and interquartile ranges. To avoid undue influence of skewed data, all comparisons were performed using a Mann–Whitney test except for paired analyses of radial and great saphenous vein harvest sites. Dichotomous variables are expressed in absolute numbers and percentages, and comparisons were made using a chi-square test except for paired analyses of radial and great saphenous vein harvest sites. For identification of independent risk factors for persistent sensory discomfort at the harvest site, logistic regression modeling was used, and all factors with a *P*-value < 0.1 in bivariable analysis were entered as potential confounders into the model. Metric variables including age, body mass index, and EuroSCORE were included in the regression model in continuous format; but, results were also presented above and below the median to demonstrate direction of any effect. In addition, other factors with an established effect on postoperative local complications (smoking, diabetes mellitus, gender, and arteriopathy) were included into the model. *P* values inferior to 0.05 were deemed to indicate statistical significance.

3. Results

During the study period, 1756 patients underwent isolated or combined CABG surgery. Of these, 168 had their saphenous vein and radial artery harvested concomitantly and were, thus, considered for the current analysis. The postoperative (30 days) mortality rate was 1.8% ($n = 3$) and five patients died later during the follow-up. Thirty-seven patients either could not be contacted or were unable to participate personally or adequately in the interview. Thus, a complete interview was performed in 123 patients, all of whom were included into the current analysis. Selection was probably not completely random as the analyzed patients included fewer women and fewer patients with positive family history, preoperative cardiovascular events or earlier cardiac surgery but a greater number of patients with arterial hypertension or emergent CABG procedures. However, none of these variables was significantly associated with the assessed outcome. Mean follow-up of the analyzed patients was 2.5 ± 0.9 years post surgery (range: 1.0–3.9 years).

Table 1. Baseline patient characteristics.

	n (%)/mean ± SD
Male gender	100 (73.6%)
Age, years	60.3 ± 9.2
BMI	28.9 ± 4.7
BMI > 30	36 (29.3%)
Diabetes mellitus	35 (28.4%)
Dyslipidemia	106 (86.2%)
Arterial hypertension	88 (71.5%)
Smoker	81 (65.8%)
Positive family history	66 (53.6%)
Preoperative TIA/stroke	10 (8.1%)
Renal insufficiency	10 (8.1%)
Arteriopathy	27 (30.0%)
Ejection Fraction (%)	57.8 ± 13.1
Additive EuroSCORE	3.2 ± 2.8
ASA score	3.1 ± 0.4

Demographic characteristics and comorbidities of 123 patients with concomitant radial artery and saphenous vein coronary bypass grafting.
SD: standard deviation; BMI: body mass index; TIA: transient ischemic attack; and ASA: American Society of Anesthesiologists.

The demographic characteristics of this group are displayed in Table 1. In total, a mean of 3.8 ± 0.8 bypasses were performed and the left or right mammarian artery was used in almost all cases (99%). A total of 107 patients had an isolated CABG procedure, while 16 (13%) had a CABG combined with another cardiac procedure. The operative characteristics are summarized in Table 2.

None of the patients suffered an ischemic complication of the hand. Early complications are detailed in Fig. 1. Perioperative wound complications occurred significantly less often at the antebrachial harvest site than at the saphenous vein harvest site (2.5% vs 12.3%; $P < 0.05$ by paired test). Persistent sensory discomfort at the time of the interview was reported by 70 patients (57%) and consisted mainly of numbness (Fig. 1). Forty-eight patients (39%) suffered from symptoms at the forearm and 48 (39%) suffered from symptoms at the leg. Concomitant symptoms at the arm and leg were reported by 26 patients (21%, P = n.s. by paired test; Table 3). Reported pain (defined as ≥5/10) was similar between both sites (5.0% and 7.7%, respectively, P = n.s., Fig. 1), but paresthesia and/or dysesthesia were

Table 2. Perioperative information.

	N (%)/mean ± SD
Urgent procedure	39 (31.7%)
Coronary 1-vessel disease	1 (0.8%)
Coronary 2-vessels disease	6 (4.9%)
Coronary 3-vessels disease	116 (94.3%)
Left main coronaropathy >50%	29 (23.6%)
Arterial anastomoses	2.5 ± 0.6
LIMA	122 (99.2%)
Venous anastomoses	1.4 ± 0.6
Anastomoses, in total	3.8 ± 0.8
Combined surgery	15 (12.2%)
MECC	58 (47.2%)
Operation time (min)	203.9 ± 44.7
ECC time (min)	88.6 ± 26.1
Cross-clamping time (min)	51.7 ± 20.1

Perioperative characteristics of 123 patients with concomitant radial artery and saphenous vein coronary bypass grafting.
SD: standard deviation; LIMA: left internal mammarian artery; and (M)ECC: (minimized) extracorporeal circulation.

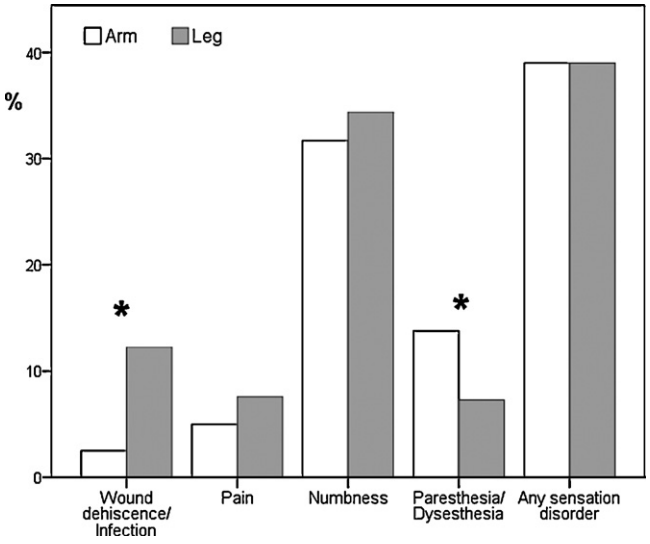

Fig. 1. Comparison of local postoperative complications at the radialis versus the saphenous harvest sites. *$P < 0.05$.

significantly more prevalent at the arm (13.8% vs 7.3%; $P < 0.05$, Fig. 1).

In bivariable analyses, none of the operative data appeared significantly correlated with late sensory discomfort at either of the harvest sites. However, age, EuroSCORE, body mass index, and the absence of an earlier transient ischemic attack (TIA) or stroke were clearly correlated with a sensitivity disorder at the saphenous vein or radialis harvest sites (Fig. 2 and Table 3).

Logistic regression modeling identified the following factors to be associated with risk of late sensory discomfort. The effect size is expressed as an odds ratio demonstrating the change in rate of complications per unit increase in that variable with 95% confidence intervals (CIs) and *P*-values: additive EuroSCORE (0.70; 95% CI 0.53–0.92; $P = 0.009$) and age (0.94; 95% CI 0.89–0.99; $P = 0.047$) were independent protective factors at the saphenous vein harvest site, and EuroSCORE (0.68; 95% CI 0.52–0.89; $P = 0.005$) and body mass index (1.13; 95% CI 1.01–1.27; $P = 0.027$) were independent protective and risk factors, respectively, at the antebrachial harvest site. Of note, diabetes mellitus and perioperative wound complications were not associated with the occurrence of persistent disturbances.

4. Discussion

This study demonstrates that certain types of harvest-site complications may persist for several years after CABG, and that those complications may lead to considerable discomfort in a high percentage of patients. Interestingly, occurrence of persistent sensory discomfort was independent from presence of diabetes mellitus, surgical technique, and perioperative wound complications at the time of operation, whereas it was correlated to obesity. However, perception of its severity seemed to decrease with age and complexity of treated disease, as measured by the additive EuroSCORE.

Conventionally, complications of CABG surgery refer to events occurring at the cardiac level. Consequentially,

Table 3. Results of unadjusted comparisons.

Characteristic	No sensitivity disorders	Sensitivity disorder arm	*P* Arm	Sensitivity disorder leg	*P* Leg	Sensitivity disorder arm and leg
N (% of all)	53 (43.1%)	48 (39.0%)		48 (39.0%)		26 (21.1%)
Demographic characteristics and comorbidities						
Male gender, *n* (%)	39 (73.6%)	41 (85.4%)	*ns*	41 (85.4%)	*ns*	21 (80.7%)
Age, years	63.5 ± 10.0	58.1 ± 8.4	*ns*	56.3 ± 8.1	*<0.01*	54.9 ± 8.8
BMI	27.7 ± 3.9	30.4 ± 5.7	*<0.05*	28.7 ± 4.7	*ns*	29.9 ± 6.0
BMI>30, *n* (%)	9 (17.3%)	20 (41.7%)	*<0.05*	17 (35.4%)	*ns*	10 (38.5%)
Diabetes mellitus, *n* (%)	15 (28.3%)	15 (31.3%)	*ns*	12 (25%)	*ns*	7 (26.9%)
Dyslipidemia, *n* (%)	45 (84.9%)	43 (89.6%)	*ns*	42 (87.5%)	*ns*	24 (92.3%)
Arterial hypertension, *n* (%)	39 (73.6%)	34 (70.8%)	*ns*	34 (70.8%)	*ns*	19 (73.1%)
Current smoker, *n* (%)	30 (56.6%)	33 (68.8%)	*ns*	37 (77.1%)	*ns*	19 (73.1%)
Positive family history, *n* (%)	25 (49%)	26 (54.2%)	*ns*	27 (56.3%)	*ns*	12 (46.2%)
Preoperative TIA/stroke, *n* (%)	10 (17.8%)	0 (0%)	*<0.05*	0 (0%)	*<0.05*	0 (0%)
Renal insufficiency, *n* (%)	6 (11.3%)	3 (6.4%)	*ns*	3 (6.3%)	*ns*	2 (7.7%)
Peripheral arteriopathy, *n* (%)	16 (30.2%)	6 (12.8%)	*ns*	9 (18.8%)	*ns*	4 (15.4%)
Ejection fraction, (%)	55.7 ± 15.7	60.1 ± 10.6	*ns*	58.3 ± 10.9	*ns*	59.3 ± 11.2
Additive EuroSCORE	4.7 ± 3.3	1.9 ± 1.4	*<0.001*	1.9 ± 1.6	*<0.001*	1.4 ± 1.2
ASA score	3.1 ± 0.5	3.1 ± 0.3	*ns*	3.1 ± 0.3	*ns*	3.1 ± 0.3
Procedural characteristics						
Urgent procedure, *n* (%)	21 (39.6%)	13 (27.1%)	*ns*	11 (22.9%)	*ns*	6 (23.1%)
Coronary 1-vessel disease, *n* (%)	1 (1.9%)	0 (0%)	*ns*	0 (0%)	*ns*	0 (0%)
Coronary 2-vessels disease, *n* (%)	1 (1.9%)	4 (8.3%)		5 (10.4%)		4 (15.4%)
Coronary 3-vessels disease, *n* (%)	51 (96.2%)	44 (91.7%)		43 (89.6%)		22 (84.6%)
Left main coronaropathy >50%, *n* (%)	10 (18.9%)	14 (29.2%)	*ns*	12 (25.0%)	*ns*	7 (26.9%)
Arterial anastomoses, *n*	2.5 ± 0.6	2.4 ± 0.6	*ns*	2.4 ± 0.6	*ns*	2.4 ± 0.6
Venous anastomoses, *n*	1.4 ± 0.7	1.3 ± 0.5	*ns*	1.4 ± 0.6	*ns*	1.3 ± 0.5
Anastomoses, in total, *n*	3.9 ± 1.0	3.7 ± 0.8	*ns*	3.9 ± 0.7	*ns*	3.7 ± 0.7
Combined surgery, *n* (%)	8 (15.1%)	4 (8.3%)	*ns*	4 (8.3%)	*ns*	1 (3.8%)
MECC, *n* (%)	24 (45.3%)	27 (56.3%)	*ns*	20 (41.7%)	*ns*	13 (50%)
Operation time (min)	211.6 ± 50.4	196.1 ± 39.2	*ns*	202.3 ± 36.7	*ns*	202.3 ± 33.5
ECC time (min)	92.7 ± 29.9	83.8 ± 20.5	*ns*	87.1 ± 23.0	*ns*	85.5 ± 19.1
Cross-clamping time (min)	53.6 ± 22.3	48.6 ± 15.1	*ns*	51.2 ± 19.6	*ns*	49.1 ± 15.0

Bivariable comparisons of demographic characteristics, comorbidities and procedural characteristics between patients having and not having persistent postoperative sensitivity disorders at their arm and/or leg harvest sites, respectively. A total of 123 patients were included into analysis. Continuous variables are given as mean ± standard deviation.

BMI: body mass index; TIA: transient ischemic attack; ASA: American Society of Anesthesiologists; and (M)ECC: (minimized) extracorporeal circulation.

complications at graft harvest sites have been analyzed less thoroughly. Postoperative hematoma, wound dehiscence, and infection are considered typical complications after saphenous vein harvesting, and have been reported to occur in up to 20–40% of patients [13]. By contrast, according complications seem less frequent at the radialis harvest site and were observed in 2–8% of patients [8,11,14]. Accordingly, we observed a similar difference between legs and arms, which proved to be statistically significant in paired testing. Such aspects of CABG performance are certainly likely to gain increased interest with the ever-new techniques and instruments being developed for minimally invasive harvesting.

Sensitivity disorders around surgical scars are believed to regress spontaneously within a few weeks or months after surgery [9,15]. However, as demonstrated in this and other evaluations, these alterations may persist and, according to the scarce literature, may concern up to 24% of the patients [10] (Table 4). In our analysis, for instance, we found that after a mean of 2.5 years, only 43% of the patients did not report any remaining sensitivity disorders at either the saphenous vein or the radialis artery harvest sites. Conversely, numbness, paresthesia and/or dysesthesia were still mentioned by an equal percentage (39%) of the interrogated patients at these respective locations with a high degree of overlap. Therefore, even though this disorder may be considered as minor from a surgical point of view, its high frequency cannot be ignored, especially as it is persistently reported by the patients several months or years after surgery has been accomplished.

Apart from obvious iatrogenic neural damages, mechanisms of injuries may imply the use of cautery and the invasiveness of the prolonged cutaneous incisions and the consequent large exposure. The use of less-traumatic instruments and exchange of traditional cautery for ultrasonic scalpels was suggested to reduce the occurrence of postoperative neurologic complications [9]. Indeed, the high incidence of persistent sensory discomfort in the current analysis may be seen as an important argument to propagate the use of minimally invasive harvesting techniques further against the persisting reluctance of many surgeons. However, although a minimally invasive approach for saphenous vein harvesting reduced the immediate postoperative local complication rate [16], long-term benefits of such measures remain unclear. In any case, potential benefits in terms of persistent sensitivity disorder are, if at all, not well characterized, and available results are even controversial, at least for radial artery harvesting [17,18].

Overall, the exact reasons for persistent sensitivity disorders remain unclear. Our bivariable analysis suggested a moderate association with the patient's EuroSCORE, body mass index, age, and history of preoperative TIA or stroke.

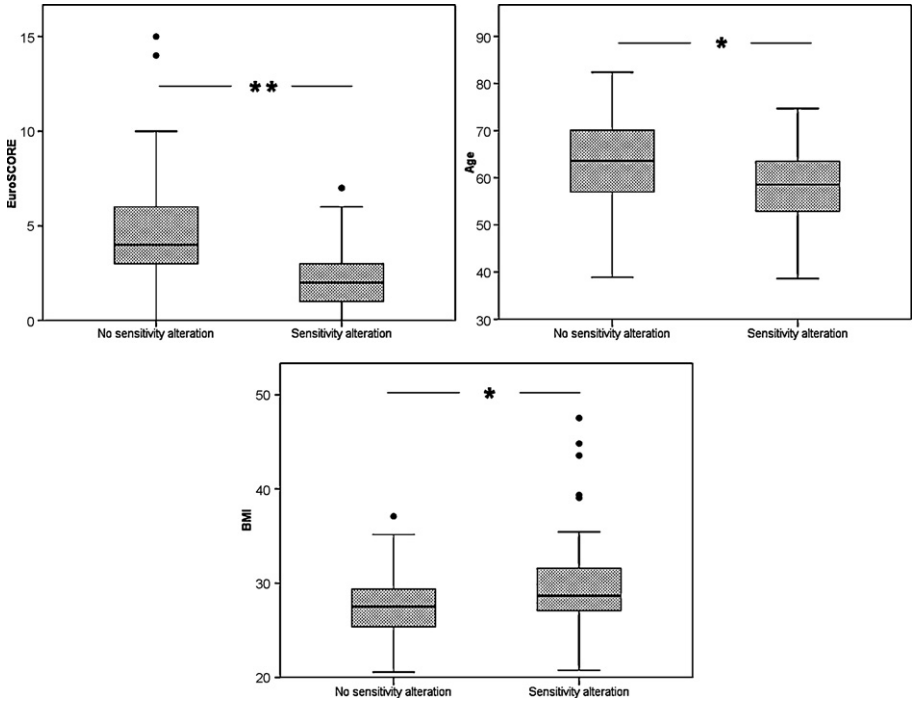

Fig. 2. Differences in distribution of additive EuroSCORE (A), age (B) and body mass index (BMI) (C) between patients with and without persisting sensitivity alterations after radialis and/or saphenous vein harvesting. Boxplots indicate medians and interquartile ranges. Conversely, sensitivity alterations occurred in the following frequencies below and above the median of variable: 77% (below median EuroSCORE of 3) versus 36% (above, $P < 0.001$); 68% (below median age of 60 years) versus 45% (above, $P < 0.01$); and 50% (below median body mass index of 28 kg/m^2) versus 65% (above, $P < 0.1$). *$P < 0.05$; **$P < 0.001$.

Interestingly, no investigated aspect of surgical technique showed any association suggesting that the potential risk factors are largely patient dependent. Indeed, logistic regression modeling confirmed the role of EuroSCORE, age, and body mass index to predict the persistence of sensory discomfort either at the arm or the leg.

Both EuroSCORE and age showed a protective effect, meaning that the higher the EuroSCORE and the higher the age the less likely was the occurrence of the adverse effect. Although no robust explanation can be proposed to explain this finding, one could hypothesize that those patients with a higher EuroSCORE or higher age may consider the evolution at the harvest sites subjectively as less critical than the evolution of their cardiac disease. In other words, patients with a less critical cardiac disease at the time of surgery as well as younger patients both seem to be more sensitive or pay more attention to the evolution of their arm and leg scars. A difference between age groups regarding a possible difference of perception of a sensitivity disorder at the radialis harvest site has already been suggested earlier [14]; however, and interestingly, this was never further studied. In our series, 60% of the patients who reported persistent sensory discomfort were younger than 60 years, whereas 65% of those who did not complain of sensitivity problems were older than 60 years.

Due to associated peripheral neuropathy, diabetes mellitus was previously described to be a risk factor for postoperative wound sensitivity disorders, also and specifically at the radialis harvest site [11,19]. In our current analysis, however, diabetes was not found to correlate with this adverse outcome at either the upper limb or lower limb harvest sites.

As any observational analysis, the current study has some limitations. Self-reported outcomes do not probably

Table 4. Synoptic review of the literature.

	Year	*n*	Follow-up (months)	Any sensory abnormality (%)	Numbness (%)	Paresthesia/ dysesthesia (%)
Manasse et al. [21]	1996	105	18 ± 9			2.9
Possati et al. [5]	1998	66	12			27.3
Royse et al. [20]	1999	328	12		15.5	
Denton et al. [22]	2001	560	14.5 ± 9	18.1		
Saeed et al. [10]	2001	127	8 (4.6–10.8)	24.0		
Galajda et al. [23]	2002	197	12		16.5	
Ben Gal et al. [24]	2003	209	49 (46–57)		2.3	4.6
Budillon et al. [19]	2003	271	6			3.7
Shah et al. [25]	2007	629	48.3 (2–86)		2.4	
Rudez et al. [18]	2007	25	37 ± 7			46.0
Dick et al.		123	30 ± 11	39.0	31.7	13.8

Summary of previously published reports on sensory impairment after radial artery harvesting for coronary artery bypass grafting.

correlate exactly with results as provided by an objective assessment. For instance, at the radialis harvest site, a previous study demonstrated an objective sensation loss in 2.1% of in the lateral cutaneous nerve area, whereas 15.5% of patients reported sensation alteration [20]. However, objective assessments of sensitivity alterations conversely do not take into account less measurable parameters or factors that are less clearly related to these sensitivity disorders. Thus, most of the previous studies on post-operative sensitivity alterations at the radialis artery and the saphenous vein harvest sites also relied solely on the results of a scripted interview. To correct, however, for potential (and unknown) risk factors that might have specific influences on outcomes at the arm or leg location, we included in our series only patients with concomitant harvesting of the saphenous vein and the radialis artery. As a result, not only were the patient-related factors normalized regarding these two outcomes, but also the surgery-related factors.

To conclude, the problem of persistent long-term sensory discomfort after harvesting for CABG operations is much more frequent than expected and affects, contrary to perioperative wound complications, leg and forearm equally. It is poorly discussed in the literature; however, it seems from the current analysis that older patients and those with more complex disease may attach less importance to this phenomenon. It seems, thus, particularly important to discuss this potential complication with younger patients and those with a low EuroSCORE to modulate its perception, whenever possible.

Acknowledgments

The authors are deeply thankful to our biostatistician, Ms Brigitta Gahl, for her help in the statistical analysis, and to Miss Laura Graham for her assistance in the writing of the article.

References

[1] Serruys PW, Morice MC, Kappetein AP, Colombo A, Holmes DR, Mack MJ, Stahle E, Feldman TE, van den Brand M, Bass EJ, Van Dyck N, Leadley K, Dawkins KD, Mohr FW, Investigators S. Percutaneous coronary intervention versus coronary-artery bypass grafting for severe coronary artery disease. N Engl J Med 2009;360(10):961—72.

[2] Carpentier A, Guermonprez JL, Deloche A, Frechette C, DuBost C. The aorta-to-coronary radial artery bypass graft. A technique avoiding pathological changes in grafts. Ann Thorac Surg 1973;16(2):111—21.

[3] Fisk RL, Brooks CH, Callaghan JC, Dvorkin J. Experience with the radial artery graft for coronary artery bypass. Ann Thorac Surg 1976;21(6):513—8.

[4] Acar C, Ramsheyi A, Pagny JY, Jebara V, Barrier P, Fabiani JN, Deloche A, Guermonprez JL, Carpentier A. The radial artery for coronary artery bypass grafting: clinical and angiographic results at five years. J Thorac Cardiovasc Surg 1998;116(6):981—9.

[5] Possati G, Gaudino M, Alessandrini F, Luciani N, Glieca F, Trani C, Cellini C, Canosa C, Di Sciascio G. Midterm clinical and angiographic results of radial artery grafts used for myocardial revascularization. J Thorac Cardiovasc Surg 1998;116(6):1015—21.

[6] Zacharias A, Habib RH, Schwann TA, Riordan CJ, Durham SJ, Shah A. Improved survival with radial artery versus vein conduits in coronary bypass surgery with left internal thoracic artery to left anterior descending artery grafting. Circulation 2004;109(12):1489—96.

[7] Fox AD, Whiteley MS, Phillips-Hughes J, Roake J. Acute upper limb ischemia: a complication of coronary artery bypass grafting. Ann Thorac Surg 1999;67(2):535—6. discussion 536—7.

[8] Hata M, Shiono M, Sezai A, Iida M, Saitoh A, Hattori T, Wakui S, Soeda M, Negishi N, Sezai Y. Comparative study of harvest-site complications following coronary artery bypass grafting between the radial artery and the saphenous vein in identical patients. Surg Today 2005;35(9):711—3.

[9] Moon MR, Barner HB, Bailey MS, Lawton JS, Moazami N, Pasque MK, Damiano Jr RJ. Long-term neurologic hand complications after radial artery harvesting using conventional cold and harmonic scalpel techniques. Ann Thorac Surg 2004;78(2):535—8. discussion 535—8.

[10] Saeed I, Anyanwu AC, Yacoub MH, Amrani M. Subjective patient outcomes following coronary artery bypass using the radial artery: results of a cross-sectional survey of harvest site complications and quality of life. Eur J Cardiothorac Surg 2001;20(6):1142—6.

[11] Trick WE, Scheckler WE, Tokars JI, Jones KC, Smith EM, Reppen ML, Jarvis WR. Risk factors for radial artery harvest site infection following coronary artery bypass graft surgery. Clin Infect Dis 2000;30(2):270—5.

[12] Immer FF, Pirovino C, Gygax E, Englberger L, Tevaearai H, Carrel TP. Minimal versus conventional cardiopulmonary bypass: assessment of intraoperative myocardial damage in coronary bypass surgery. Eur J Cardiothorac Surg 2005;28(5):701—4.

[13] Wipke-Tevis DD, Stotts NA, Skov P, Carrieri-Kohlman V. Frequency, manifestations, and correlates of impaired healing of saphenous vein harvest incisions. Heart Lung 1996;25(2):108—16.

[14] Greene MA, Malias MA. Arm complications after radial artery procurement for coronary bypass operation. Ann Thorac Surg 2001;72(1):126—8.

[15] Shapira OM, Alkon JD, Aldea GS, Madera F, Lazar HL, Shemin RJ. Clinical outcomes in patients undergoing coronary artery bypass grafting with preferred use of the radial artery. J Card Surg 1997;12(6):381—8.

[16] Tevaearai HT, Mueller XM, von Segesser LK. Minimally invasive harvest of the saphenous vein for coronary artery bypass grafting. Ann Thorac Surg 1997;63(6 Suppl.):S119—21.

[17] Connolly MW, Torrillo LD, Stauder MJ, Patel NU, McCabe JC, Loulmet DF, Subramanian VA. Endoscopic radial artery harvesting: results of first 300 patients. Ann Thorac Surg 2002;74(2):502—5. discussion 506.

[18] Rudez I, Unic D, Sutlic Z, Biocina B, Baric D, Ivkovic M, Pavlovic M. Endoscopic radial artery harvesting reduces postoperative pain and neurologic complications. Heart Surg Forum 2007;10(5):E363—5.

[19] Budillon AM, Nicolini F, Agostinelli A, Beghi C, Pavesi G, Fragnito C, Busi M, Gherli T. Complications after radial artery harvesting for coronary artery bypass grafting: our experience. Surgery 2003;133(3):283—7.

[20] Royse AG, Royse CF, Shah P, Williams A, Kaushik S, Tatoulis J. Radial artery harvest technique, use and functional outcome. Eur J Cardiothorac Surg 1999;15(2):186—93.

[21] Manasse E, Sperti G, Suma H, Canosa C, Kol A, Martinelli L, Schiavello R, Crea F, Maseri A, Possati GF. Use of the radial artery for myocardial revascularization. Ann Thorac Surg 1996;62(4):1076—82. discussion 1082-1083.

[22] Denton TA, Trento L, Cohen M, Kass RM, Blanche C, Raissi S, Cheng W, Fontana GP, Trento A. Radial artery harvesting for coronary bypass operations: neurologic complications and their potential mechanisms. J Thorac Cardiovasc Surg 2001;121(5):951—6.

[23] Galajda Z, Jagamos E, Maros T, Peterffy A. Radial artery grafts: surgical anatomy and harvesting techniques(1). Cardiovasc Surg 2002;10(5):476—80.

[24] Ben Gal Y, Sternik L, Shinfeld A, Locker C, Pevni D, Nesher N, Kassif Y, Smolinsky AK, Lavee J. Long-term arm morbidity after radial artery harvesting for coronary bypass operation. Heart Surg Forum 2004;7(3):E211—3.

[25] Shah SA, Chark D, Williams J, Hessheimer A, Huh J, Wu YC, Chang PA, Scholl FG, Drinkwater DC. Retrospective analysis of local sensorimotor deficits after radial artery harvesting for coronary artery bypass grafting. J Surg Res 2007;139(2):203—8.