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Postoperative Surgical Chest and Leg Incision Sites Using Platelet Gel: A Retrospective Study

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Abstract: The purpose of this study was to determine whether the application of platelet gel (PG) on cardiac surgery wound incisions would promote wound healing and reduce the subsequent incidence of postoperative infections, thereby decreasing the length of hospital stay and hospital costs. Previous work has shown increased incisional healing effect among coronary artery bypass graft patients who received platelet gel. A 1-year retrospective review of 128 cardiac surgery patient charts was performed to determine the clinical impact on those patients whom received platelet gel applications (treatment group) and those whom did not receive platelet gel applications (control group). The outcomes measured were (i) total length of stay, (ii) the incidence of incision wound infection, and (iii) postoperative blood loss. The treatment group had significantly shorter intensive care unit and total length of stays and experienced less postoperative blood loss compared with the control group. In addition, the treatment group had no reported incisional wound infections; however, four patients (3.16%) in the control group experienced incision wound infections. This study was a descriptive chart review and not a controlled study. Our findings support previous research that platelet gel seems to positively influence incisional wound healing among those who undergo cardiac surgery. **Keywords:** platelet gel, platelet rich plasma, platelet poor plasma. *JECT. 2008;40:225–228*

The untoward effects of surgical site infections in coronary artery bypass graft (CABG) surgery are significant in terms of mortality, morbidity, and costs (1). The mortality rate for deep sternal site infection is 22%, as opposed to 0.6% for non-infected CABG patients (1). Numerous host risk factors (HRFs) that contribute to the development of chest surgical site infections (obesity, diabetes mellitus, advanced age, male gender, chronic obstructive pulmonary disease (COPD), smoking, prolonged mechanical ventilation or number of hours on ventilator, steroid use in surgery only, and preoperative hospital stay >5 days) have been described extensively in the literature (2). The National Nosocomial Infections Surveillance (NNIS) systems study concluded that these risk factors increase the chances of developing a surgical site infection (2). Specifically, host intrinsic and surgical risk factors that result in poor healing include poor functional cardiac status, low cardiac output state, *Staphylococcus aureus* nasal carriage, and indiscriminate use of electrocautery (2).

After cardiac surgery, sternal wound infections (SWIs) and donor site infections (DSIs) or saphenous vein retrieval site infections were diagnosed in 4.5% and 1.5%, respectively, of patients during hospitalization (3). Total length of stay was three times longer for patients that develop a sternal infection (3). Ridderstolpe et al. (4) showed that one third of patients were diagnosed with surgical site infection before leaving the hospital. In addition, numerous surgical risk factors (SRFs) that contribute to the development of chest surgical site infections include use of internal mammary artery grafts (especially when bilateral), duration of cardiopulmonary bypass time and aortic cross-clamp time, use of intra-aortic balloon pump, postoperative bleeding, reoperation, sternal rewiring, type of sternal saw, and use of bone wax (2).

Fortunately, patients can be preoperatively identified as "high risk" for developing a sternal site infection based on their comorbidities (1). Success of treatment depends on

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early detection (4). HRF variables, and to a lesser extent, SRF variables are difficult to minimize. The mechanism of action of platelet gel (PG) has been well described in the literature (5). Therefore, the beneficial effects of PG in wound healing, which has previously been well described in the literature, may help to reduce the incidence of surgical site infection (SSI) (6,7).

MATERIALS AND METHODS

Institutional Review Board approval was obtained, and a 1-year retrospective review of patient charts for those who underwent cardiopulmonary bypass with a sternal and leg incision was conducted. Exclusionary criteria for this study included patients <18 years of age. Inclusionary criteria included subjects 18–90 years of age whom underwent coronary bypass surgery using a sternal incision and leg incision.

The date of admission, date of surgery, and length of hospital stay were cross-referenced from the hospital's Adult Cardiac Surgery Database to determine the preoperative hospital stay. The "prolonged perfusion time" and "duration of surgery" were broken down and quantified into the "aortic cross-clamp time" and "cardiopulmonary bypass time" that denote precise times. Length of surgery was measured from the skin incision start time to skin incision stop time in minutes. The time of administration of antibiotics was compared with the surgery time, measured as follows: 0; 2 hours before surgery (–2); 2 hours after surgery (+2) (Figure 1).

The HRF, SRF, and deep chest SSIs (DCSSIs) were included in the data collection. Additionally, if PG was used and applied to chest and leg incisions, height, length of stay (LOS) in the surgical intensive care unit (SICU) and LOS in the hospital, chest or leg incision infection, and average of highest perioperative glucose variables were collected (Table 1). The chest and leg incision infections were examined using criteria for defining an SSI (8).

The Medtronic Magellan Autologous Platelet Separator

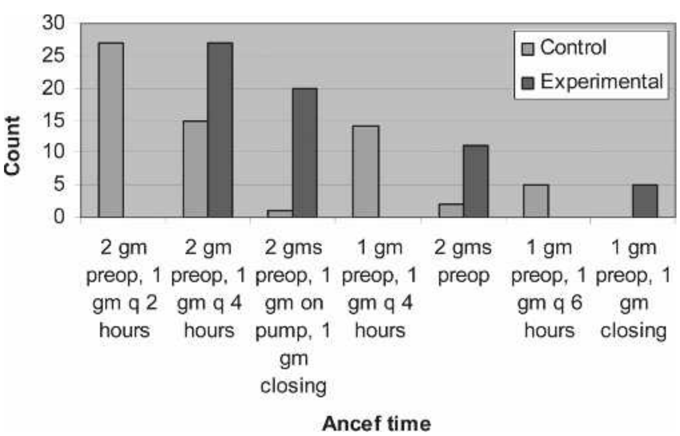

Figure 1. Ancef doses and times.

Table 1. Risk factors for CABG SSI at the sternal site.

Host Intrinsic Risk Factors	Surgical Risk Factors	Deep Chest Surgical Site Infections Consequences
Obesity	Use of IMA in CABG	Re-admission
Diabetes mellitus	Cardiopulmonary bypass time	Prolonged treatment with antibiotics
Increasing age	Aortic cross clamp time	Sternal debridement
Male gender	Use of Intraaortic balloon pump	Flap closure of the chest
COPD	Postoperative bleeding	Death
Cigarette smoking	Reoperation	
Prolonged ventilation status	Sternal rewiring	
Steroid therapy	Use of bone wax	
Preoperative length of stay >5 days	Sternal saw	

System and the Medtronic Magellan Autologous Platelet Separator Disposables Kit (Medtronic, Minneapolis, MN) were used, and their instructions for use were followed for processing of the autologous platelets. Platelet-poor plasma (PPP) was sprayed on the subcuticular tissue before closure of the chest incision and the leg incisions after the sapheneous vein leg harvest. Approximately 20 mL of PPP was applied to the subcuticular tissue using the Magellan Spray Tip, MST 700 and the Magellan Ratio Dispenser Kit, MRD500. Approximately 16 mL of PRP was applied to the sternum after sternal incision and before sternal wiring using the Magellan cannula tip, MCT600, to make a "caulking bead" to the sternum after the sternal wires were tightened.

Statistical *t* tests were used to examine whether there were any group differences among the variables. We found significance on three *t* tests and chose to conduct analysis of variance (ANOVA) tests to generate effect sizes (9). Because ANOVA is an extension of the *t* test, we focused our attention on the effect sizes that denote the magnitude of the differences between groups. All three ANOVAs generated moderately large to large η^2. Green and Salkind (9) stated that η^2 values of 0.1, 0.6, and 1.4 denoted small, medium, and large effect sizes, respectively. Three separate ANOVAs were conducted to generate an effect size (η^2) on the mean differences of the number of hours spent in the ICU, blood loss, and LOS.

RESULTS

From chart reviews of 128 patients, the treatment group (n = 64) differed from the control group (n = 64) among certain host risk factors (Table 2). The treatment group had less incidence of diabetes mellitus (n = 17, 26.6%) and COPD (n = 6, 9.4%), less smoking history (n = 39, 60.9%), decreased hospital LOS < 5 days (n = 57, 89.1%), and less use of the Hall sternal saw (n = 33 cases, 51.6%). In addition, the treatment group was of lower weight (mean = 81.82 kg, SD = 12.62 kg), spent less time on

Table 2. Comparison of variables within the control and treatment groups.

Variable	Control Group [*n* (%)]	Treatment Group [*n* (%)]
Hall sternal saw	64 (100%)	33 (51.6%)
Males	46 (71.9%)	51 (79.7%)
Preoperative stay <5 days	50 (78.1%)	57 (89.1%)
Positive smoking history	44 (68.8%)	39 (60.9%)
Current smokers	20 (31.3%)	20 (31.3%)
History of diabetes mellitus	25 (39.1%)	17 (26.6%)
History of chronic lung disease	9 (14.1%)	6 (9.4%)
IABP placed	9 (14.1%)	9 (14.1%)
Used IMA graft	41 (64.1%)	52 (81.3%)
Bonewax used	0	11 (17.2%)
Re-operation for bleeding/ tamponade	3 (4.7%)	2 (3.1%)
Re-operation for graft occlusion	6 (9.4%)	1 (1.6%)

bypass (mean = 61.64 minutes, SD = 64.04 minutes), experienced less blood loss (mean = 48.72 mL, SD = 51.84 mL), and spent less time in the ICU (mean = 57.21 hours, SD = 38.15 hours).

Among the patients in the control group, there was a decreased use of the internal mammary artery (IMA) graft ($n = 41$, 64.1%), no use of bone wax, and also a decreased perioperative glucose level (mean = 196.72 mg/dL, SD = 49.09 mg/dL). Both groups were equally represented by men ($n = 51$, 79% and $n = 46$, 71.9%, respectively), were fairly equal in age (mean = 64.28 years, SD = 10.59 years and mean = 63.58 years, SD = 11.99 years, respectively), and were equal on the current number of smokers ($n = 20$, 31.3% in each group).

Four patients (Table 3) in the control group developed sternal or leg infections. Three of the four patients were women; three of four patients were diabetic, two developed sternal infections, and two developed leg infections. In general, this group of four patients was slightly older (mean = 68.25 years, SD = 12 years) than the overall mean age (mean = 63.93 years, SD = 11.26 years), the treatment group mean age (mean = 64.28 years, SD = 10.59 years), and the control group age (mean = 63.58 years, SD = 12 years), and they spent more time in the ICU (mean = 189.38 hours, SD = 111.56 hours). In addition, they weighed more (mean = 102.29 kg, SD = 54.45 kg), were slightly shorter (mean = 168.28 cm, SD = 16.61 cm), spent a longer time on bypass (mean = 153.75 minutes, SD = 56.93 minutes), lost more blood (mean = 127.25 mL, SD = 39.74 mL), and stayed longer in the hospital (mean = 31.75 days, SD = 21.55 days). Among the four patients who had an infection, two subjects received Ancef 2 g preoperatively and then 1 g every 2 hours; one received Ancef 2 g preoperatively, 1 g on pump, and 1 g on closing; and one subject received 1 g preoperatively and 1 g every 4 hours (Figure 1).

All three ANOVA tests were significant and produced moderate to large effect sizes. Because rather large effect sizes were generated, we concluded that patients who had PG spent less time in the ICU, suffered less blood loss, and LOS was reduced.

DISCUSSION

The costs of a sternal site infection are high. Estimates vary widely; however, one of the more rigorous studies found this cost to be approximately $20,000 (1). Because hospitals in the United States are typically reimbursed on a per procedure basis for CABG surgeries (with only a small amount extra for additional hospital days), most of this extra cost falls directly to a hospital's bottom line. In addition, hospitals need to be concerned not only with direct costs, but the financial impact from reputational effects such as from having physicians available to treat patients rather than busy in the necessary review processes that occur when a case takes an unfortunate turn (1).

Direct costs of site infections are difficult to calculate in most hospital accounting systems because there are many confounding variables that effect infection; therefore, LOS was examined (3). The treatment group had a significantly shorter ICU and total LOS and experienced less postoperative blood loss compared with the control group. In addition, the treatment group had no reported infections; however, the four who were in the control group constituted only a small percentage of the entire sample (3.16%). Therefore, we could not subject this sample to statistical analyses because of the small number of patients.

One source of error in this study is related to the fact that capturing late or postrelease sternal infections was difficult once the patient was released from the hospital;

Table 3. Comparison table for the control and treatment groups.

Variable ($n = 128$)	Control Group ($n = 64$) [Mean (SD); Range]	Treatment Group ($n = 64$) [Mean (SD); Range]
Age (years)	63.58 (11.99); 41–86	64.28 (10.59); 41–85
ICU (hours)	110.07 (85.44); 20.5–337	57.21 (38.15); 14.5–219
Weight (kg)	87.78 (20.10); 32–162	81.82 (12.62); 59–127.10
Height (cm)	173.16 (9.24); 149.9–193	172.60 (8.68); 149.90–188
Highest perioperative glucose	196.72 (49.09); 89–357	204.72 (44.41); 100–349
Minutes on bypass	113.05 (70.52); 0–283	61.64 (64.04); 0–207
Blood loss (mL/min)	92.28 (59.17); 0–283	48.72 (51.84); 0–166
Length of stay (days)	11.96 (9.01); 1–59	8 (2.56); 4–16

therefore, this study had a bias with respect to late sternal infections.

Work by Furnary et al. (10) showed, in a non-randomized, prospective interventional study of 4684 patients undergoing open heart surgical procedures, that perioperative hyperglycemia is associated with increased rates of deep sternal wound infections and LOS. Furthermore, the authors stated that a target glucose range of <150 mg/dL is favorable (10). Average glucose levels were at least 25% higher in both the control and treatment groups; however, no infections were observed in the treatment group.

Although our study was a descriptive chart review and not a controlled study, our findings provide support for our previous research that PG positively influences patient healing among those who undergo CABG surgery. The results of our two previous studies provide additional evidence that supports other surgical literature that use of PG is advantageous in promoting wound healing.

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