The Use of Platelet Rich Plasma in Total Knee Arthroplasty: A Controlled Clinical Evaluation

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Statement of Purpose: Platelets are integral to healing through their participation in hemostasis and release of growth factors and cytokines that influence cell migration, proliferation, and differentiation. Technologies exist to produce platelet rich plasma (PRP) from ~60ml of autologous blood drawn prior to surgery. (1,2) PRP applied to the surgical site has the potential to accelerate wound healing and decrease morbidity. (1,2) Platelet poor plasma (PPP), a byproduct of PRP production, has hemostatic properties. (3) While several clinical studies are suggestive of a benefit of PRP, few have included controls to substantiate the effect. (1,2) Our purpose was to compare outcomes between two groups of patients following total knee arthroplasty (TKA), namely, those that received PRP and PPP during wound closure (treatment) and those that did not (controls).

Methods: The hospital institutional review board approved use of the platelet system. Following unilateral or bilateral TKA, patients were treated with (71 patients, 81 knees) or without (66 patients, 72 knees) PRP and PPP during wound closure. Data was gathered retrospectively on consecutive patients – control then treatment. Briefly, 55ml of blood was drawn and mixed with 5ml of ACD-A, then centrifuged using the Gravitational Platelet System (GPS) (Cell Factor Technologies, Inc., Warsaw, IN), producing approximately 6ml of PRP and 30ml of PPP. PRP and PPP were each drawn into 10cc syringes (treatment). Two 1cc syringes were filled with solution consisting of 1000 units of topical bovine thrombin per ml of 10% $CaCl_2$ solution (activation). Treatment and activation syringes were connected, in tandem, to a dual spray apparatus, with treatment and activation sprays mixed during application. During closure, activated PRP was sprayed onto the cut bone surfaces, synovia, tendons, and the lining of the wound. The activated PPP was then applied to the subcuticular surface prior to closing the incision with staples. Post-operative drains were used in both groups, with collected volumes recorded. Patients were followed for six weeks, documenting a variety of outcome measures. Treatment and control means were statistically compared using a two-tailed t-test. Nominal data were compared using the Chi-square or two-tail Fisher exact test. Significance was taken as $p<0.05$.

Results / Discussion: There were no significant differences between the two groups of patients in terms of age (p=0.62), body mass index (p=0.583), preoperative range of motion (ROM) (p=0.421), or comorbidities (diabetes, rheumatoid arthritis, kidney failure, or cardiovascular disease, p=0.120 to 1.00), however, the treatment group contained significantly more males (25/71) than did the control group (12/66) (p=0.040). In general, expected trends were evident and, in some instances, were statistically significant – see Table 1.

Table 1. Summary of outcomes

Variable		Control	Treatment	p
In-patient (days)		3.97±1.14	3.53±0.907	0.015
ROM (°)	Preop	112.7±14.6	110.9±12.2	0.421
	Day 1	43.0±16.4	51.4±14.4	<0.001
	Day 2	66.1±13.5	72.9±13.4	0.002
	Day 3	75.4±11.7	79.2±11.8	0.066
	Wk 6	105±12.1	110.2±9.77	0.009
Collected Drainage (ml)	DOS	311±223	478±244	<0.001
	Day 1	92.0±82.0	81.5±86.3	0.447
	Day 2	2.08±11.0	0.125±1.12	0.137
Transfusion u/pt		0.70±0.94	0.39±0.57	0.035
Hb baseline (g%)		12.1±1.29	12.1±1.33	0.997
ΔHb (g%)	Day 1	-1.1±0.88	-0.68±0.79	0.006
	Day 2	-1.8±0.92	-1.37±1.08	0.007
	Day 3	-2.00±1.1	-1.77±1.01	0.294
Pain Day 1 (0-10)		4.68±1.82	4.14±1.95	0.098
Cellulitis by 6 wks		5/66	6/71	1.000

PRP/PPP treatment reduced the need for blood transfusion and resulted in shorter in-patient hospital stay. Such treatment was also associated with greater ROM through 6 weeks, although the difference was not significant on the third postoperative day. Post-operatively, the treatment group had significantly less hemoglobin decrement with respect to baseline at Days 1 and 2. The mean post-operative pain score on Day 1 (0-10 scale), as well as analgesic use (data not shown), for the treatment group were lower than that for controls, however, these differences were not significant (p=0.098 and 0.207, respectively). Rates of cellulitis were comparable between the two groups with no deep infections present. Paradoxically, there was lack of apparent benefit of PRP/PPP application on collected tube drainage. In fact, significantly more drainage from the treatment group was measured on post-operative Day 1. This may be due to measurement error as other studies have demonstrated a positive effect of such treatment on hemostasis. (3) Utilization of technologies that concentrate the plasma proteins in the PPP fraction might have merit in reducing drainage. Limitations of this study include non-randomization of patients, retrospective data, and only short-term follow-up.

Conclusions: Application of PRP and PPP during closure following TKA significantly shortened hospital stay, reduced early hemoglobin decrement, reduced transfusion requirements, and improved functional outcome (ROM) for at least six weeks. Pain, cellulitis, and analgesic use were unaffected by treatment. Longer term, randomized studies will help to more fully elucidate the role of PRP and PPP in TKA.

References:

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