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Case Series

Use of Autologous Platelet Gel in Bariatric Surgery

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Abstract: Gastric bypass surgery is a common corrective procedure for obesity that is associated with many risks. Recent studies describing the use of autologous platelet gel (APG) have shown promise in preventing certain operative complications and improved healing processes. These improvements have been credited to the concentrated platelets and growth factors present in APG, as well as the native concentrations of fibrinogen. There are numerous applications for the use of APG in surgery, and the list continues to expand. However, little research exists to support the efficacy of APG in bariatric surgery. This case series describes using APG with patients undergoing laparoscopic Roux-en-Y gastric bypass surgery. **Keywords:** autologous platelet gel, bariatric surgery, Roux-en-Y gastric bypass, hemostasis, anastomotic leak. *JECT. 2006;38:161–164*

According to the American Obesity Association, obesity is a disease that affects nearly one in three adult Americans (~60 million obese and 9 million severely obese). At least 300,000 deaths each year in the United States are caused by obesity, and the health care cost of American adults with obesity is approximately $100 billion.

Several treatment options for obesity are available and include the following: dietary therapy, physical activity, behavior therapy, drug therapy, combined therapy, and surgery. Bariatric surgery involves reducing the size of the gastric reservoir, resulting in satiation and reduced caloric intake. This treatment is offered to those who are morbidly obese, which the National Institute of Health defines as a body mass index (BMI) of 40 kg/m^2 or with being 100 pounds over recommended body weight for men and 80 pounds for women. A BMI of 35 kg/m^2 or more along with comorbidities (heart disease, sleep apnea, type 2 diabetes, and hypertension) may also be considered for surgery. For long-term success, these patients must be well informed, motivated, and able to participate in follow-up consultations.

Bariatric surgery alters the digestive process through either restriction or malabsorption and includes adjustable gastric banding, vertical banded gastroplasty, biliopancreatic diversion, or gastric bypass (1,2). Gastric bypass is the most common of these surgical procedures. A popular technique of gastric bypass is the Roux-en-Y gastric bypass (RYGB), which involves creating a stomach pouch out of a small portion of the stomach and attaching it directly to the small intestine, therefore bypassing a large part of the stomach and duodenum. RYGB surgery is a very effective weight loss treatment plan that has proven to resolve or improve obesity-related comorbidities (3,4). The risks associated with RYGB include wound infection, dehiscence, leaks from staple breakdown, stomal stenosis, marginal ulcers, various pulmonary problems, and deep thrombophlebitis (4–9).

A component of autologous blood therapy is autologous platelet gel (APG), which may reduce or even prevent some of these risks. Blood not only transports oxygen and nutrients, it is composed of cells that provide hemostasis, fight infection, and repair damaged tissue (10). In APG, the platelet-rich plasma (PRP) is sequestered, activated, and applied to soft tissue and bone to accelerate the healing process (11–13).

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The healing process involves the interaction of numerous cellular components and is separated into three phases: inflammation, cellular proliferation, and remodeling. Once tissue is injured, platelets begin to aggregate and release polypeptide growth factors (platelet derived growth factor, transforming growth factor α and β, epithelial growth factor, and others). Activated platelets, macrophages, fibroblasts, and endothelial cells release these growth factors. Cytokines and hemostatic plasma proteins are also released during the inflammatory phase. Neutrophils and macrophages migrate to the wound site, adding an immunologic component. During cellular proliferation, the cytokines and growth factors released into the wound act on various cells, stimulating the synthesis of cellular products, such as angiogenesis and epithelialization. Finally, the tissue is subject to the ongoing production and breakdown of collagen that forms a mature scar; this is known as remodeling (12,14).

Studies have shown that commercially prepared fibrin glues have reduced or eliminated the risk of leaks around the anastomosis sites in gastric bypass surgery (15,16). Fibrin glue preparation involves cryoprecipitation of fibrinogen from single donor or pooled homologous blood. The risk of infectious disease transmission exists in using homologous blood products. These products also lack valuable growth factors present in APG.

Currently APG is used in a variety of surgical procedures in orthopedics, neurosurgery, cardio-thoracic, vascular, plastics, general, wound healing, oral/maxillofacial, urology, and ear, nose, and throat. However, little research exists to support the efficacy of APG in bariatric surgery. This case series describes the use of APG in patients undergoing laparoscopic Roux-en-Y gastric bypass (L-RYGB).

DESCRIPTION

This study used 10 morbidly obese patients with a BMI of 44.5 kg/m^2. Attempts to lose weight in the past were unsuccessful for each patient. All but one patient were women, and the average age was 43 years. The patients' demographics are detailed in Table 1.

The patient's phlebotimization consisted of 166 mL of whole blood and was drawn preoperatively from the median cubital vein with an 18-gauge needle. Three 60-mL syringes with 8 mL of anticoagulant citrate dextrose (ACD) solution formula A (Baxter, Deerfield, IL) in each syringe were used to collect the blood. The blood was drawn at a slow, steady pace, mixing the anticoagulant with the blood at frequent intervals to prevent the formation of clots. Also at this time, 10 mL of blood was drawn in a separate syringe and dispensed into laboratory vacutainer tubes for a baseline platelet count (PLT Ct), platelet function test (PFT), white blood cell count (WBC Ct), and fibrinogen (FIB) analysis.

Table 1. Patient data.

Patient	Age (years)	Sex	(kg/m^2)	OR Time (minutes)	Hospital LOS (hours)
1	47	F	42	85	55.5
2	30	F	43	85	83.2
3	33	F	41	105	60.1
4	50	F	45	80	58.8
5	52	F	41	80	57.6
6	41	F	43	90	57.4
7	50	M	41	95	79.1
8	51	F	47	100	80.8
9	47	F	44	100	61.2
10	30	F	58	105	54.7
Mean	43.1 ± 8.9		44.5 ± 5.1	92.5 ± 9.8	64.8 ± 11.4

M, male; F, female; BMI, body mass index; OR, operating room; LOS, length of stay.

The blood was processed with the Medtronic Magellan Autologous Platelet Separator (Medtronic Inc., Minneapolis, MN) following the manufacturer's specifications. The instrument operates by separating anticoagulated whole blood into components by centrifugation. A total of 30 mL of PRP was collected in three 10-mL syringes. The PRP was mixed thoroughly by introducing a small volume of air into the syringe and gently inverting 10–15 times to obtain a homogeneous mixture immediately before sampling for PRP cell counts. A 1-mL sample was sent to the laboratory for a PLT Ct, WBC Ct, and FIB from each of the three 10-mL PRP syringes. The remaining 27 mL of PRP was transfered to the sterile field along with the activator. The activator consisted of 10,000 units of bovine thrombin reconstituted with 500 mg (5 mL) calcium chloride 10%. Various concentrations of thrombin and calcium chloride were previously trialed, and the formula described is the surgeon's preference.

After the surgeon oversewed the anastomosis sites and tested for air leaks, a 26-cm applicator tip dual cannula (Micromedics Inc., St Paul, MN) was inserted into a trocar site. The APG was applied to three anastomosis sites: gastro-jejunostomy, side-by-side jejuno-jejunostomy, and stomach's staple line. Each 10 mL of PRP was mixed with 1 mL of activator at a concentration of 2000 units of thrombin/100 mg calcium chloride and applied to each anastomosis site. The surgeon noted good hemostasis within the abdominal cavity. After the three applications of APG, a Blake (Ethicon Inc., Somerville, NJ) drain with Jackson-Pratt (Cardinal Health, McGaw Park, IL) reservoir was placed posterior to the gastro-jejunostomy, the trocars were removed, and the wound sites were oversewn.

Tables 2 and 3 show the baseline and PRP laboratory values. The patient's baseline blood was sampled at the same time of collecting the blood for PRP processing and not directly from the blood to be processed. Thus, to compare homogeneous blood samples, a simple dilutional calculation was performed to obtain the baseline values. The

Table 2. Baseline laboratory values.

	PLT Ct ($\times 10^3/\mu L$)	PFT (Epi) (seconds)	PFT (ADP) (seconds)	WBC Ct ($\times 10^3/\mu L$)	FIB (mg/dL)
Patient 1	321.0	97.0	64.0	7.45	394.0
Patient 2	285.0	73.0	94.0	9.79	295.8
Patient 3	319.0	161.0	150.0	8.19	272.0
Patient 4	293.0	110.0	65.0	9.97	500.0
Patient 5	272.0	118.0	76.0	9.19	375.0
Patient 6	288.0	103.0	87.0	9.64	403.0
Patient 7	264.0	95.0	70.0	9.93	308.0
Patient 8	196.0	116.0	78.0	5.15	349.0
Patient 9	234.0	89.0	60.0	7.03	308.0
Patient 10	240.0	99.0	71.0	6.73	396.0
Mean	271.2 ± 39.1	106.1 ± 23.4	81.5 ± 26.3	8.3 ± 1.7	360.1 ± 67.9

PLT Ct, platelet count; PFT, platelet function test; WBC Ct, white blood cell count; FIB, fibrinogen concentration.

Table 3. PRP laboratory values.

	PLT Ct ($\times 10^3/\mu L$)	WBC Ct ($\times 10^3/\mu L$)	FIB (mg/dL)	PLT Yield	WBC Yield
Patient 1 ($n = 3$)	724.7 ± 328.3	12.8 ± 1.7	378.0 ± 5.2	2.6 ± 1.2	2.0 ± 0.3
Patient 2 ($n = 3$)	908.3 ± 43.0	7.6 ± 1.1	267.9 ± 33.5	3.7 ± 0.2	0.9 ± 0.1
Patient 3 ($n = 3$)	1161.7 ± 171.0	11.5 ± 2.6	296.7 ± 7.1	4.2 ± 0.6	1.6 ± 0.4
Patient 4 ($n = 3$)	1081.0 ± 91.0	22.5 ± 0.6	471.6 ± 36.7	4.3 ± 0.4	2.6 ± 0.1
Patient 5 ($n = 3$)	1228.0 ± 247.9	18.9 ± 1.3	363.3 ± 4.0	5.2 ± 1.1	2.4 ± 0.2
Patient 6 ($n = 3$)	1133.3 ± 51.4	10.3 ± 1.7	390.7 ± 5.8	4.5 ± 0.2	1.2 ± 0.2
Patient 7 ($n = 3$)	830.7 ± 27.7	11.0 ± 0.2	308.0 ± 10.0	3.6 ± 0.1	1.3 ± 0.0
Patient 8 ($n = 3$)	746.7 ± 65.8	9.6 ± 0.6	335.0 ± 3.5	4.4 ± 0.4	2.1 ± 0.1
Patient 9 ($n = 3$)	763.3 ± 18.5	14.0 ± 1.3	224.7 ± 5.5	3.8 ± 0.1	2.3 ± 0.2
Patient 10 ($n = 3$)	889.0 ± 64.0	11.5 ± 1.5	385.0 ± 0.0	4.3 ± 0.3	2.0 ± 0.3
Mean ($n = 30$)	946.7 ± 188.4	13.0 ± 4.5	342.1 ± 70.9	4.1 ± 0.7	1.8 ± 0.6

See Table 2 for abbreviations.

baseline laboratory values were all within this institution's normal ranges. The PLT Ct, WBC Ct, FIB, PLT yield, and WBC yield were averaged from each of the three PRP 10-mL samples and indicated in Table 3. The Medtronic Magellan instrument produced PRPs that averaged a PLT Ct of $946.7 \pm 188.4 \times 10^3/\mu L$ from all 30 samples, resulting in a yield of 4.1 ± 0.7 increase over baseline. The WBC Ct averaged $13.0 \pm 4.5 \times 10^3/\mu L$, resulting in a yield 1.8 ± 0.6 increase over baseline.

On postoperative day (POD) 1, upper gastrointestinal contrast studies showed no leaks at the anastomosis sites for all 10 patients. The drainage output averaged 180.2 mL on POD 1, 159.2 mL on POD 2, and 98.3 mL on POD 3. The output volume included serosanguineous fluid. After the patients were discharged from the hospital, their follow-up visit in the physician's office was 7 days. The drains were removed, and the accumulated drainage amount since POD 3 averaged 432.5 mL.

None of the following complications were noted: stomal stenosis, reoperations for hemorrhaging, blood transfusions, anastomotic leaks, infections (intra-abdominal, necrotizing fasciitis, peritonitis, and septicemia). A patient was readmitted 1 day after the initial discharge and diagnosed with a small bowel obstruction secondary to an incarcerated trocar site hernia. The patient subsequently underwent an exploratory laparotomy to repair the trocar site hernia. The patient was discharged without further complications.

COMMENTS

Since 2003, APG has been routinely used at our institution for RYGB surgery. The objective was to use a product that would promote hemostasis and healing when directly applied to the wound site. APG is composed of biologically active proteins that contribute to a stable clot formation and accelerate the overall healing process. APG is readily available in the operating room with minimal effort or cost. Sequestering the PRP is completed in the immediate preoperative or perioperative period and used before the completion of surgery. Because it is an autologous preparation, patients are free from infectious disease transmission or clerical errors.

One of the major complications after gastric bypass surgery is an anastomotic leak. The morbidity associated with a leak is significant and can be fatal. Podnos et al. (9) reviewed 3464 L-RYGB cases and 2771 open RYGB cases. An anastomotic leak was documented in 71 of the L-RYGB patients and 42 of 2497 open RYGB patients. The mortality rate from these anastomotic leaks in L-

RYGB and open RYGB was 37.5% and 12.5%, respectively. It was noted that once a surgeon had passed his learning curve with the laparoscopic technique, the frequency of leaks decreased to that of an open procedure.

Fernandez et al. (6) reviewed the database at Virginia Commonwealth University hospitals for open and laparoscopic gastric bypass procedures. Of 3200 procedures, 102 (3.2%) were complicated by intestinal leaks. The patients who developed a leak tended to be older, heavier men with multiple comorbidities. Treating patients with APG may prevent these leaks and promote healing at the anastomotic site.

A study by Schwartz et al. (17) researched various challenges with L-RYGB including preoperative determinants of prolonged operative times, conversion to open gastric bypasses, and postoperative complications. Leaks from the gastrointestinal tract and hemorrhage were some of the postoperative complications directly related to the surgical procedure. Five patients developed leaks, and 12 exhibited hemorrhage from 600 patients reviewed. The authors from these three studies have shown the percentage of anastomotic leaks and/or hemorrhaging range from 2% to 3.2%. These percentages may seem low, but the morbidity and cost of caring for these patients can be immense.

Recently, some studies showed that commercially prepared fibrin sealants are useful in preventing internal leaks. Liu et al. (15) showed that, of 120 patients undergoing a standard RYGB, those who received a fibrin sealant at the gastrojejunal anastomosis sites experienced no leaks. However, of the 360 patients who did not receive the fibrin sealant, eight leaks were documented. A second study by Sapala et al. (16) used a fibrin sealant at the gastro-jejenostomy (GJS) site on 738 patients undergoing gastric bypass. There were no anastomotic leaks at the fibrin-sealed GJS anastomosis. The authors suggested that fibrin glue may contribute to "leak prophylaxis" in patients undergoing RYGB surgery.

Patients may benefit from APG. The high concentration of biologically active growth factors in PRP is responsible for the growth and proliferation of targeted cells. Some of the benefits expected from APG include enhanced hemostatic response, angiogenesis, accelerated tissue regeneration, enhanced collagen synthesis, increased leukocyte concentration (adds an antimicrobial effect), and native fibrinogen concentration imparts a gelatinous adhesive. The decisions that led to APG in RYGB included using a product that may prevent leaks that result in significant morbidity and mortality events. Other more expensive fibrin glues were previously used but were replaced with APG when it became available at our institution.

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