

## Gluteal artery injuries including pseudoaneurysm associated with powered bone marrow biopsies

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### Abstract

The bone marrow procedure (BMP) is a frequently performed procedure, with over 700,000 recorded in the U.S. annually. It is a fundamental component in the evaluation and management of both malignant and benign hematologic conditions. Adult patients are generally assured that the BMP is a safe procedure with minimal risk, albeit briefly painful. Traditionally performed using a manual Jamshidi needle, the procedure is increasingly being performed using powered bone marrow kits, which have shown consistently good results. In the current review we describe three cases of gluteal artery injuries following the powered driver procedure, one of which resulted in the formation of a pseudoaneurysm requiring radiology-guided intervention. We highlight the need for both hematologists and patients to be aware of this potentially life threatening complication as well as how to recognize it clinically and institute timely diagnostic and therapeutic measures.

### Introduction

The bone marrow procedure (BMP) has long been an essential component in the evaluation and management of both malignant and benign hematological conditions. Local hemorrhage is the most frequent serious complication<sup>1,2</sup> and may result from vessel injury after inadvertent penetration of the inner iliac cortex in the course of a posterior superior iliac spine (PSIS) approach.<sup>3</sup> Less frequently, serious vessel

injuries superficial to the PSIS have been reported, including scattered case reports of superior gluteal artery hematoma, pseudoaneurysm (PSA) of the gluteal artery, gluteal compartment syndrome (with permanent foot drop) and A-V fistula.<sup>4-10</sup> Gluteal hematomas and PSAs usually present promptly with local pain and a palpable mass, but delay in diagnosis occurs frequently (Table 1).<sup>4-11</sup> Longer delays in diagnosis seem to predispose to compartment syndromes and neurologic sequelae.<sup>5,7</sup>

In recent years, BMP's are increasingly performed using powered bone marrow kits. A commercially available battery-powered drill system (OnControl, Teleflex, San Antonio, TX, USA) has been reported to be faster, less painful and to yield a better quality specimen than the traditional manual Jamshidi needle.<sup>12-15</sup> To our knowledge, there have been no reported cases of severe bleeding complications with the new device. We describe 3 cases of major gluteal artery injury following the powered driver procedure.

### Case Report #1

This 62-year-old man with atypical chronic lymphocytic leukemia (CLL) underwent a right posterior iliac BMP with a power driver. Before the needle penetrated the iliac bone, he complained of severe local pain and the procedure was then completed using a manual needle instead. There was prolonged local bleeding after the procedure, which resolved with local pressure for 30 minutes. On Day 9 after the BMP, the patient presented to the Emergency Department (ED) with severe pain in the right buttock at the site of the BMP. A pelvic CT with contrast revealed a 3.4×2.6 cm gluteal hematoma and a pseudoaneurysm of the right gluteal artery in the right piriformis muscle immediately adjacent to the right PSIS (Figure 1A). On Day 11 post BMP, worsening pain and paresthesias prompted a Doppler ultrasound revealing a 3 cm pulsatile vascular sac, adjacent to the gluteal artery, with alternating flow in the neck of the sac (Figure 1B). The surrounding hematoma had markedly enlarged in the 2-day interval.

Recombinant thrombin was injected into the PSA under ultrasound guidance with immediate cessation of pulsatile flow and prompt improvement in the buttock pain and lower extremity paresthesias. Follow up imaging studies showed complete resolution of the PSA (Figure 1C).

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Key words: Bone marrow biopsy, Gluteal artery injuries, Pseudoaneurysm.

Conflict of interest: Dr. Reed reports having previously received grant support and complementary OnControl Bone Marrow Biopsy kits from the VidaCare Corporation, San Antonio, Texas. Otherwise, the authors report no conflicts of interest.

Contributions: APS, drafting of manuscript, revision and submission of manuscript; GP, SS, AS, critical revision of the manuscript for important intellectual content; TP, administrative, technical, and material support; LJR, critical revision of the manuscript for important intellectual content, final approval of manuscript

Received for publication: 12 March 2017.

Revision received: 21 June 2017.

Accepted for publication: 22 June 2017

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Hematology Reports 2017; 9:7131  
doi:10.4081/hr.2017.7131

### Case Report #2

This 65-year-old female with suspected myeloma underwent a powered BMP. Although the procedure was completed without any complications and standard local pressure for 10 minutes was applied following the procedure, local pain persisted with progressive swelling of the buttock and right lower extremity over the next several days. On Day 10, patient was hospitalized with a large buttock hematoma that extended down the right thigh with edema and ecchymosis to the foot with a hemoglobin (Hgb) drop from 8.8 to 6.9 gm/dL.

A pelvic CT with contrast revealed a 9×12×7.3 cm hematoma in the right gluteus medius muscle with hemorrhage tracking the intermuscular planes distal to the lower leg. A blush of contrast adjacent to the gluteus minimus muscle suggested continued bleeding although a pelvic arteriogram (Figure 1D) showed no evidence of active bleeding into the hematoma. The patient recovered completely from the iatrogenic

hematoma and began chemotherapy for myeloma.

### Case Report #3

This 40-year-old man with recently diagnosed follicular lymphoma underwent a staging manual BMP. A powered driver was employed on the left PSIS. However, when the stylette was removed, pulsatile arterial bleeding was seen, and the procedure was immediately terminated. Prolonged active local pressure was instituted for over 30 minutes. Eventually, a stable 3 cm local swelling at the biopsy site permitted discharge to home.

On Day 4, the patient presented to ED with progressive pain and swelling in the left buttock and thigh with a Hgb drop from 13.1 to 11.2 gm%. CT of the abdomen and pelvis with contrast revealed a large hematoma (4 cm in AP diameter) in the left gluteus medius muscle extending to the left thigh. The patient was treated with opiate analgesia and gradually improved with stable Hgb.

### Discussion and Conclusions

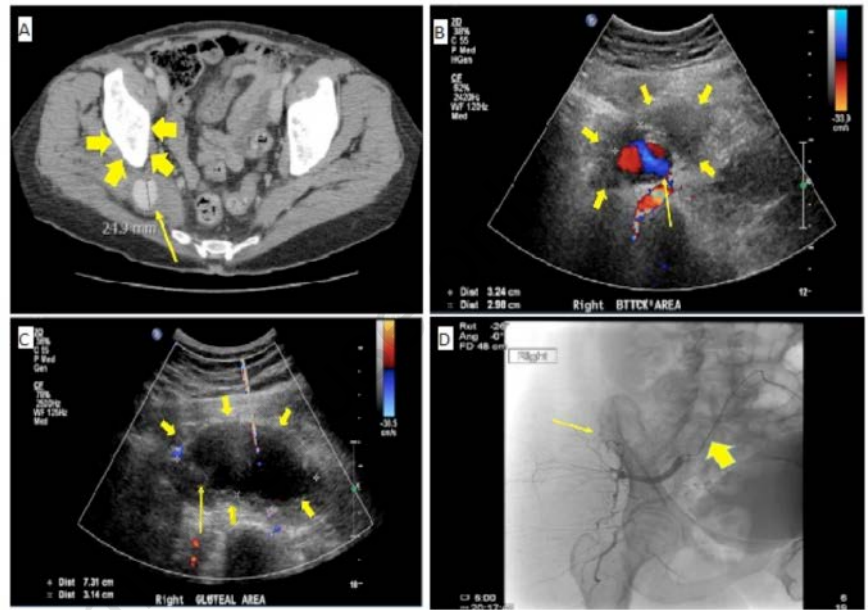
BMP's are generally considered quite safe with low risk of complications. Bain surveyed British hematologists and collected retrospective voluntary reports indicating that the risk of serious complications was very low, 0.05-0.07%.<sup>1,2</sup>

Considering the relatively superficial location of the gluteal artery, a palpable mass or swelling might be expected in all cases of gluteal hematomas and PSAs and yet this physical finding was lacking in 4 of the 9 cases (including Case 1). Hence, any patient complaining of prolonged local pain after a BMP should have an appropriate imaging study, even if no local swelling is

evident. The diagnosis can be quickly ascertained using duplex ultrasonography, CT imaging, magnetic resonance imaging or formal arteriography. The latter may also be therapeutic for thrombin injection or embolization of an actively bleeding vessel (Case 2).

Case 1 had not only a gluteal artery hematoma, but also a PSA, which is a rare complication of the posterior iliac BMP. Only 8 cases of pseudoaneurysm after BMP (Table 1) have been reported, to our knowl-

edge.<sup>4-15</sup> The increasing frequency in PSAs in recent years may be due to improvements in radiologic diagnostic techniques or possibly due also to changes in BMP techniques, including the use of the powered driver. BMP-related PSA is a grave complication that may result in long-term neurologic deficits (foot drop, lower extremity weakness and gait impairment). In all 3 cases of our present series, the coagulation parameters were normal. Although some of the 8 cases of BMP-related PSA reportedly had



**Figure 1.** A). Case 1. Pelvic CT with IV contrast on Day 9 after bone marrow procedure (BMP) on the right posterior superior iliac spine (PSIS). Probable pseudoaneurysm (PSA) of the right gluteal artery (arrow) was demonstrated immediately adjacent to the PSIS (arrowheads) measuring 2.5 × 2.4 × 2.4 cm. (B) Case 1. Color Doppler ultrasound of the right gluteal area on Day 11 after BMP on the right PSIS. A 3 cm pulsatile vascular sac with alternating flow was demonstrated in the neck of the sac (arrow). Inferior to this PSA, an actively bleeding vessel was seen. Surrounding the PSA, an irregular hematoma, measuring 10.2 × 5.3 cm was noted (arrowheads). (C) Case 1. Color Doppler ultrasound of the right gluteal area on Day 43 after BMP (29 days after thrombin injection). The PSA has completely resolved (arrow). The hematoma and/or organizing thrombus persist, but are smaller, measuring 7.3 × 3.1 cm (arrowheads). (D) Pelvic arteriogram on Day 10 after BMP of Case 2. The catheter is seen in the right internal iliac artery (arrowheads). Catheter advancement revealed no active bleeding and a small PSA is seen (arrow).

**Table 1. Reported gluteal artery pseudoaneurysm after bone marrow procedure.**

No	Reference (year)	Age/Sex	Indication	Days to diagnosis	Palpable mass	Neurologic symptoms	Treatment	Follow-up
1	Mahallati <i>et al.</i> <sup>4</sup> (1999)	33/M	Pancytopenia	17	No	Yes	Coil embolization	Recovered
2	Lowenthal <i>et al.</i> <sup>5</sup> (2006)	61/F	CLL/CML	42	Yes	Yes	Coil embolization	Foot drop
3	Chamisa <i>et al.</i> <sup>6</sup> (2007)	29/M	Thrombo-cytopenia	1	No	No	Coil embolization	Died
4	Ge <i>et al.</i> <sup>7</sup> (2010)	51/M	Leukopenia	28	Yes	Yes	Coil embolization, then open surgery	Foot drop
5	Sullivan <i>et al.</i> <sup>8</sup> (2013)	55/M	Thrombo-cytopenia	1	No	No	Coil embolization	Impaired gait
6	Caldwell <i>et al.</i> <sup>9</sup> (2016)	62/M	CML	1	Yes	Yes	Coil embolization	Unknown
7	Yap <i>et al.</i> <sup>10</sup> (2016)	52/F	AML	28	Yes	No	Thrombin	Hospice
8	Griselli <i>et al.</i> <sup>11</sup> (2016)	75/M	Lung cancer	30	Yes	No	Thrombin	Recovered
9	Present case 1 (2016)	62/M	CLL	9	No	Yes	Thrombin	Recovered

CLL: Chronic Lymphocytic Leukemia, CML: Chronic Myeloid Leukemia, AML: Acute Myeloid Leukemia.

thrombocytopenia of some degree, a very low platelet count was not incriminated in any case, and no patient was reported as having received a platelet transfusion. The 2 most recent PSA cases were successfully treated with thrombin injections.<sup>10</sup> 6 patients were treated with coil embolization with variable results (Table 1) and one patient ultimately required open drainage.<sup>7</sup> Thus, thrombin injection would appear to be the treatment of choice whenever feasible. The signs and symptoms of gluteal hematoma and PSA, although sometimes obvious, may be subtle and delayed for weeks (Table 1). The development of persistent sciatic pain or lower extremity paresthesias after a BMP should signal the need for immediate, appropriate imaging to rule out a PSA or a compartment syndrome. Hematologists should be alert to possible hemorrhagic complications, especially after a difficult or prolonged BMP and educate patients about warning signs and symptoms.

In the present case series, faulty needle localization was not a factor, since imaging studies confirmed the correct site. Secondly, although hematologists-in-training were involved in 2 of the 3 BMP's, an experienced operator performed or supervised all procedures.<sup>14</sup> All operators followed standard procedure in accordance with the power drill manufacturer's instruction manual. Standard practice of local pressure for 10 minutes was instituted in case 2 where there was no local swelling however, prolonged pressure for 30 minutes was used in cases 1 and 3 where prolonged bleeding was observed. All three patients had normal vitals and did not complain of any symptoms after the initial pain and bleeding after the procedure and were deemed stable to be discharged home. Bed rest or any other activity restriction was not advised at the time of discharge.

The third predisposing factor is the BMP device employed, the OnControl powered driver. Although the needle is initially inserted manually up to the iliac cortex and the drill is used to then penetrate the cortex, we hypothesize that the driver, being faster and more powerful, is more likely to directly impale a large superficial vessel, like the

gluteal artery, than a manual BMP needle, which rotates and advances more slowly, guided by direct palpation. Studies comparing the powered BMP to a manual BMP did not report any hematomas or PSA's, but the follow-ups were short.<sup>12,13,15</sup> Nevertheless, it seems remarkable that in a 3-year period (2014-2016) at a single center, 3 large gluteal hematomas should occur among powered BMP patients, and none among manual BMP patients. Although no formal follow-up was instituted for asymptomatic patients who underwent the powered BMP, no complications were reported during scheduled follow-ups for their respective clinical conditions. We are currently performing a prospective study utilizing imaging for all patients undergoing BMPs including both manual and powered devices, to evaluate for appropriate needle position and any inadvertent complications including gluteal artery injuries. More prospective studies, both short and longer term, of complications of powered and manual BMP's would certainly be informative.

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