

## Review

# Is It Time to Bring Back Knee Washout?

Robert W. Ike<sup>1</sup>  and Kenneth C. Kalunian<sup>2</sup> 

**ABSTRACT.** Washout of knee joint contents, whether by arthrotomy, arthroscopy, or percutaneous methods, can remove phlogistic material contributing to the problem at hand. Observations dating from the turn of the last century coupled with multiple trials suggest such that an intervention can be useful in the management of osteoarthritis, inflammatory arthropathies, crystal arthritis, and septic arthritis. We suggest that this intervention—applicable at the bedside with minimal cost, preparation, or expertise—be reconsidered as an adjunct in management of these disorders.

**Key Indexing Terms:** arthroscopy, arthritis, crystal arthropathies, knee, osteoarthritis, therapeutic irrigation

Around the dawn of the last century, the first American orthopedic surgeons observed that many of their patients with knee arthritis felt relief following arthroscopy, ascribing it to the washout delivered to provide a clear view for arthroscopic inspection.<sup>1,2</sup> While arthroscopy never became popular in the pre–World War II era, arthrotomy with joint washout became an option for knee osteoarthritis (OA) in the pre–joint replacement era.<sup>3</sup> Well before the advent of arthroscopic surgery, Masaki Watanabe, the father of modern arthroscopy, devised a technique he called *articular pumping*,<sup>4</sup> which sought to duplicate the improvements in arthritis symptoms he had been seeing in patients whose knees he had arthroscoped. He set aside the scope and simply penetrated the knee with a large bore needle, filled it with saline then removed the saline, repeating the process until 1 liter to 2 liters had passed through. Improvements were similar to those felt after arthroscopy. The technique of this simple joint washout—removing intraarticular debris and stretching the capsule—has been repeated (under different names like “tidal irrigation” and “joint lavage”) in the many decades since, although it never became widely accepted. Whether delivered at arthroscopy or with less invasive methods, washout has been cited as an effective intervention for OA, inflammatory arthropathies, crystal associated arthritis, and septic arthritis.<sup>5,6</sup> While trials conducted in the ’90s greatly dimmed enthusiasm for washout in OA, subsequent data have suggested that washout might indeed be effective in that disorder.<sup>7</sup> Other applications of washout have received less scrutiny, although washout of phlogistic material,

whether through arthroscopy or closed needle methods, has been described to have a salutary effect in arthropathies of inflammatory, crystalline, and infectious origin. We submit that this simple inexpensive bedside procedure deserves another look as an intervention for various forms of knee arthritis, particularly in scenarios where use of arthroscopy might be considered prohibitive.

## METHODS

To update our existing files, PubMed, Scopus, and Web of Science were searched from January 1, 2000 to December 31, 2021, using the terms “washout OR irrigation OR lavage” AND “arthritis” OR “gout OR chondrocalcinosis OR pseudogout OR calcinosis.”

## Osteoarthritis

Washout incidental to the pressure irrigation necessary to provide a clear view at arthroscopy has been cited as one of the main reasons patients with OA often report feeling better after that procedure, whether or not any surgery is done.<sup>8</sup> However, the bulk of evidence from many clinical trials suggests the intervention, like all the surgical components of arthroscopy, is no better than placebo, at least for OA.<sup>8</sup> These and other data essentially shut down all rheumatologic arthroscopy for OA, but they have not yet completely permeated orthopedic practice where arthroscopy is still occasionally performed for knee OA.<sup>8</sup> Nevertheless, the use of arthroscopy in OA is steadily diminishing.<sup>9,10</sup>

Still, whether the substantially simpler and cheaper intervention of closed joint washout should also be abandoned remains debatable. For rheumatologists, among whom some were quite excited about the technique in the ’80s and ’90s, which largely has been abandoned. Although a large body of evidence suggests the washout effect in OA is real, with many physiologic mechanisms for its effect,<sup>11</sup> the positive results from the first prospective trials<sup>12,13</sup> could not be confirmed by Bradley et al, who included a sham control as comparator<sup>14</sup>; however, the “sham” treatment was injection of 20 mL 0.25% bupivacaine following

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arthrocentesis, an intervention that has been shown to provide relief that persists well beyond that expected due to the half-life of bupivacaine.<sup>15</sup> Yet, washout continues to draw attention. Of the many features of the OA knee that washout may alter, removal of the ubiquitous “wear particles” arising from degenerating articular cartilage (Figure 1) seems to be the most likely mechanism to effect change. Joint washout is aimed at cleaning out microscopic wear particles (sometimes macroscopic) that maintain reactive OA synovitis with chronic knee effusion. These particles have been shown to induce tumor necrosis factor production by chondrocytes,<sup>16</sup> interact with fibroblast-like synoviocytes to increase extracellular matrix and production of both nitric oxide and prostaglandin E2<sup>17</sup>; they also effect cellular proliferation, with release of nitric oxide, interleukins-6 and -8 and matrix metalloproteases-9,-10, and -13 from osteoarthritic synoviocytes, with similar trends in nonosteoarthritic cells.<sup>18</sup> Cartilaginous wear particle attachment in vitro significantly increased friction coefficient against native cartilage and synovium.<sup>19</sup>

Ravaud et al found the same additive effect of injection of glucocorticoids (GCs) following joint lavage for the first 4 weeks, with no synergistic effect on washout effect at week 24.<sup>20</sup> Kalunian and colleagues demonstrated that patients with OA undergoing arthroscopic washout did enjoy better outcomes after a larger volume than smaller one, and those with macroscopic calcinosis did best,<sup>21</sup> a finding supported by several subsequent studies cited in a previous review.<sup>22</sup> Ike and colleagues found that of patients with knee OA undergoing arthroscopic washout, 39% had macroscopic features of calcinosis.<sup>23</sup> N. Wei, MD, arthroscopied 57 patients with OA but no radiographic chondrocalcinosis and found visible calcific deposits in 38 (67%), identifying calcium pyrophosphate deposition disease (CPPD) in the synovial fluid of 24 (42%; unpublished data, 2017). This still-underappreciated component of OA suggests another facet of the disease upon which washout might act, with crystals not only contributing to synovitis but also directly wearing the cartilage surface.<sup>24</sup> Acute pseudogout has been described as a rare complication of arthroscopic washout, occurring even in patients without chondrocalcinosis or prior demonstration of synovial fluid CPPD.<sup>25</sup>

In 4 large prospective trials, washout alone led to as much pain relief as washout plus GCs, or as steroids alone,<sup>26-29</sup> with significantly longer relief after washout, although Parmigiani et al found that washout conferred benefit beyond that of GCs only in Kellgren-Lawrence (KL) grade 3 knees.<sup>27</sup> Injection of GCs following arthroscopic washout compared to washout alone influenced outcome for only 2 weeks to 4 weeks, with no effect on longer-term benefit.<sup>29</sup> Washout plus GCs was more effective than aspiration followed by GCs.<sup>30</sup> Patients receiving either a series of hyaluronate injections or an arthroscopic washout had similar results.<sup>31</sup> Among patients receiving hyaluronate, significantly more had a successful outcome—defined as at least 50% reduction in visual analog scale pain plus good-to-excellent overall satisfaction—had they first been washed out.<sup>32</sup> Washout was as effective as radiation synovectomy in patients with knee OA and chronic effusion.<sup>33</sup> Of 100 washed out (arthroscopic)

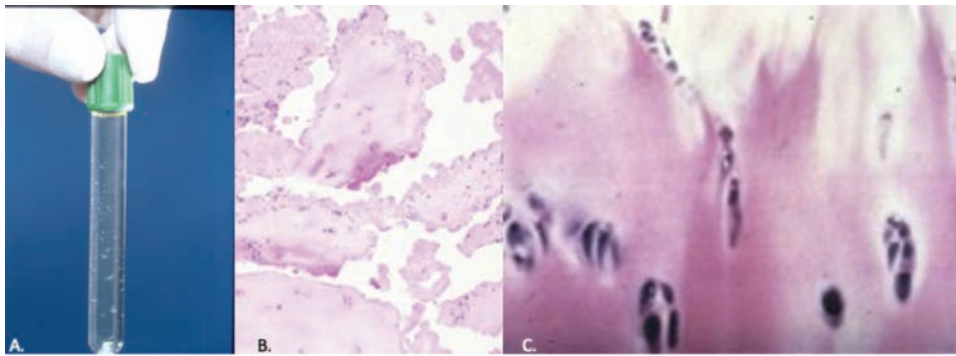
patients with OA followed for 5 years, only 18% underwent knee arthroplasty.<sup>34</sup> There was no comparison group. Patients aged > 60 years were less likely to need further surgery than younger patients.<sup>34</sup> In 2010, an extensive Cochrane analysis, which did not include all the previous studies, concluded that washout had no place in the management of knee OA.<sup>35</sup> Their conclusions were matched by an independent group.<sup>36</sup> As these committees were wrapping up their work, another paper emerged describing a retrospective analysis of a large group of patients undergoing washout (arthroscopic) and reported good results at 6 months and 12 months.<sup>37</sup> In a lapine model of OA, animals receiving washout after OA induction surgery showed less inflammation and cartilage breakdown than controls when sacrificed 2 weeks to 3 weeks later.<sup>38</sup> Saline itself may contribute to nociceptive pain relief.<sup>39</sup>

Management of knee OA involves more than injections; noninvasive modalities such as nonsteroidal antiinflammatory drugs (NSAIDs), analgesics, topicals, exercise, weight loss, physical therapy, and bracing are all recommended, with injections (and washout) considered for those patients whose response is inadequate.<sup>40</sup> The things we commonly inject for knee OA may not be quite so benign. A 2-year study of 140 patients with symptomatic knee OA (KL grades 2 or 3) sought to determine the effects of intraarticular (IA) 40-mg triamcinolone acetonide vs saline placebo, injected every 3 months, on progression of cartilage loss and knee pain. IA triamcinolone resulted in significantly greater cartilage volume loss vs saline (mean change in index compartment cartilage thickness of  $-0.21$  mm vs  $-0.10$  mm) and no significant difference in pain.<sup>41</sup> Use of IA hyaluronates is generally accepted,<sup>42</sup> but concerns remain about cost, true efficacy, and occasional reactions.<sup>43</sup> The jury is still out on the far more expensive injections of platelet-rich plasma and of mesenchymal stem cells.<sup>44</sup>

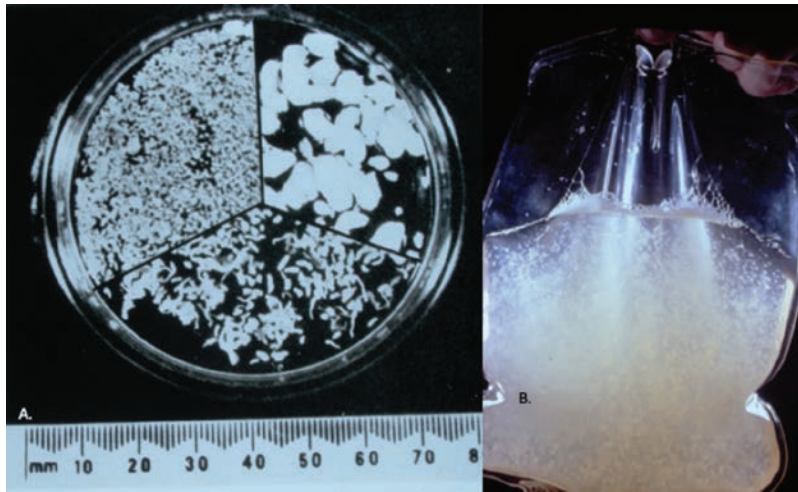
Washout is still popular in France, with 290 knee lavages done in 2019 at Hôpital Cochin, Paris, in patients with OA with chronic knee effusion resistant to GC injections (X. Ayral, MD, email communication, April 1, 2020). Washout fluid may have value after leaving the joint. Royle et al studied washout fluid from 382 arthroscopies and concluded microscopic characteristics of the fluid could predict meniscal pathology, subchondral trauma, or even a normal knee.<sup>45</sup> A previous report describing isolation from arthroscopic washout fluid of mesenchymal stem cells that can be encapsulated in a cross-linked hydrogel to generate particles to induce new cartilage matrix in rats, suggests the therapeutic effect of joint lavage may someday extend beyond the immediate effect on the joint.<sup>46</sup> So, it seems that a search for an alternative nonoperative intervention for knee OA is valid, and bedside joint washout deserves reexamination, particularly as concerns about toxicity and expense emerge for other IA therapies.

### Inflammatory arthropathies

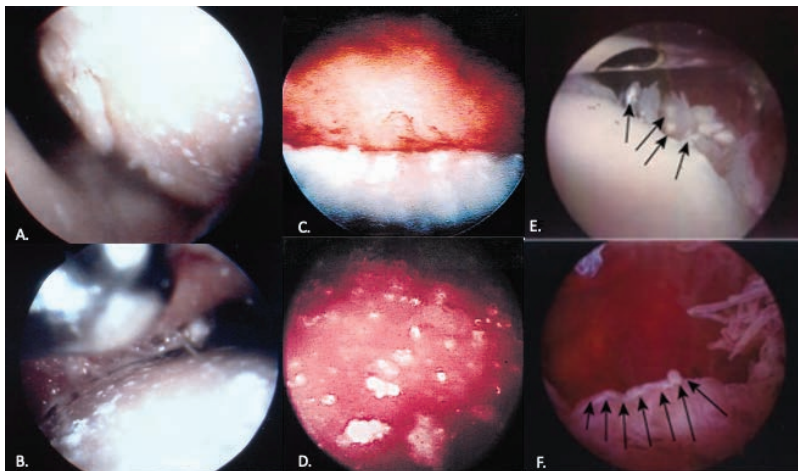
IA injection of GCs tends to be more effective in inflammatory arthropathies as compared to OA.<sup>47</sup> Use of such interventions has likely diminished with the explosion of more effective treatments for inflammatory arthropathies in the 3 decades since



*Figure 1.* Cartilaginous debris from washout of knees with osteoarthritis. (A) Synovial fluid with visible floating particles. (B) H&E of particles. (C) Higher magnification demonstrating chondrocyte brood clusters (panels B,C reprinted with permission from Ike et al).<sup>7</sup>



*Figure 2.* Rice bodies in RA. (A) Rice bodies of different sizes from joints of patients with RA. Reproduced from Popert et al with permission from BMJ Publishing Group Ltd.<sup>49</sup> (B) Effluent from washout of knee of RA patient with "refractory" synovitis. RA: rheumatoid arthritis.



*Figure 3.* Intraarticular appearances of crystal deposition disease. (A) Urate deposits on meniscus and hyaline cartilage, and (B) synovium of a patient with gout. (C) Calcium pyrophosphate deposition on cartilage, and (D) synovium of a patient with calcium pyrophosphate deposition disease arthropathy (reproduced from van den Bosch et al with permission from The Journal of Rheumatology).<sup>97</sup> (E) Visible calcinosis on cartilage, and (F) synovium of a patient with osteoarthritis. Arrows indicate deposits (reprinted with permission from Ike et al).<sup>23</sup>



*Figure 4.* Technique of joint washout. (A) 14-g Veress needle, 3 different brands. (B) Knee being washed out through Veress needle connected to irrigation tubing, during which 30-60 mL aliquots of saline are instilled into joint, then removed and repeated until at least 1 L passes through. (C) The 2-mm cannulae favored by French rheumatologists (reproduced with permission from X. Ayral, MD, Paris, email communication, 2017).



the heyday of joint washout.<sup>48</sup> Yet, relief following injection may be brief or absent. Reasons for suboptimal response range from inaccurate placement, uncontrolled systemic disease, IA damage consequent to prior inflammation, or residual IA material that both impedes effective needle drainage and irritates synovium. Washout of phlogistic material, such as inflammatory cells, cytokines, and products from the degradation of inflamed synovium, is hypothesized to potentiate the antiinflammatory effects of IA GCs in inflammatory arthropathies.<sup>49</sup> Particularly in rheumatoid arthritis (RA), coalescences of fibrin and inflammatory cells—so-called rice bodies—can persist in the joint, potentiate the inflammatory process, and impede successful needle drainage (Figure 2). Microscopic rice bodies in centrifuged sediment of RA synovial fluid were found in 13.7% of patients and were highly specific for RA.<sup>50</sup> More recently, submicron extracellular vesicles termed *microparticles* (MPs) have been identified in the synovial fluid from autoimmune arthritis.<sup>51</sup> Such MPs contain immune complexes and are highly proinflammatory, eliciting leukotriene production by neutrophils and suggesting these MPs are autoantigen-expressing elements capable of perpetuating formation of inflammatory ICs.<sup>51</sup> In 9 patients with RA who had not responded to IA GCs, arthroscopic washout followed by GC led to sustained relief in 8 of these patients.<sup>52</sup> Four prospective, controlled studies have tested this washout hypothesis, and another study examined the effects of washout alone. Fitzgerald and colleagues randomly allocated 20 patients to receive either washout with 60 mL to 120 mL of saline or arthrocentesis, followed by IA triamcinolone.<sup>53</sup> Both patient groups improved subjectively; however, patients who received washout had significantly decreased joint tenderness whereas joint effusions resolved in more patients who were given washout than in those who received only arthrocentesis. Srinivasan et al used a reduced volume of washout solution (40 mL), and undertook either washout alone, or GC treatment preceded by either washout or arthrocentesis in 60 knees.<sup>54</sup> All groups experienced similar improvements in pain, morning stiffness, walking distance, and range of motion. A further study by Lindsay et al, which tested the effect of washout alone, included 24 patients treated with either 500-mL washout solution or arthrocentesis coupled with sham washout<sup>55</sup>; outcomes were similar between the groups. Tanaka et al examined the effect of different volumes of washout solution on 166 knees affected with RA; patients were randomly allocated to receive 5 L, 3 L, 1 L, or arthrocentesis alone.<sup>56</sup> Effusions recurred significantly less after 5-L washout, with increased recurrence associated with each successively smaller volume of washout. An additive therapeutic effect from GC administration (randomly delivered to half of the patients in each group) occurred only in the washout group. Van Oosterhout et al observed that 1-L lavage plus GC injection had superior effects to those who received either lavage only or arthrocentesis plus GCs.<sup>57</sup> Only two-thirds of patients had knees affected with RA, where IA debris is most likely to form. Only synovial biopsy findings predicted outcome, where low scores for fibrosis identified patients whose synovitis did not recur within 9 months after washout plus GCs. In 17 children with juvenile idiopathic arthritis, bedside saline washout led to freedom from

effusion and pain in all 17 knees after 1 month, in 8 (47%) knees after 6 months, and in 7 (41%) knees after 12 months.<sup>58</sup>

Use of arthroscopy by American rheumatologists ceased early this century. However, European, Asian, and Australian rheumatologists continue to employ the technique, particularly at research centers<sup>59,60</sup> for the investigation of synovial disorders. Observation of improvement after diagnostic procedure conferred by this “therapeutic lavage” has been cited as a reason to prefer the arthroscope over the ever more popular ultrasound-guided technique<sup>61</sup> as a means to obtain synovial tissue for investigation.<sup>62</sup>

A unique synovial arthropathy with its origin in a response to repeated hemarthroses is that of hemophilia.<sup>63</sup> Washout followed by viscosupplementation has recently been described as an effective intervention,<sup>64,65</sup> but not without doubters.<sup>66</sup>

Thus, much indirect evidence suggests washout has an antiinflammatory effect and could be used to potentiate the effect of IA GCs in inflammatory arthropathies.

### Crystal arthropathies

A range of arthropathies can develop when monosodium urate, calcium pyrophosphate, and basic calcium phosphate deposit in the joint.<sup>67</sup> Except for urate-lowering therapies for gout, treatment is nonspecific, antiinflammatory, and mostly directed at acute flares, where colchicine abrogates the host response to the shed crystals, whereas GCs and NSAIDs aim to dampen that response.<sup>68</sup> Crystals accumulate in joints long before producing clinical symptoms or being detectable by imaging or synovial fluid studies. Crystal deposits are readily seen at arthroscopy (Figure 3), with urates seen in asymptomatic knees of patients with established knees<sup>69</sup> or in hyperuricemic patients before any expression of arthritis.<sup>70</sup> Only when these inert tissue-based deposits are disturbed are free crystals released into the joint to elicit inflammation.

A more specific adjunct to treatment—removing free crystals by washing out the joint—has been described by some of the first arthroscopic surgeons. In 1973, O'Connor found that 16 of 17 patients with calcinosis at arthroscopy had a “dramatic reduction in symptoms following joint perfusion.”<sup>71</sup> A decade later, a review of the use of arthroscopy in CPPD-related arthroscopy mentions in passing the therapeutic value of washout in such patients.<sup>72</sup> The effect has been recognized internationally.<sup>73</sup> Milwaukee shoulder, a destructive arthropathy associated with calcium apatite deposition<sup>74</sup> has been reported to improve following washout accomplished percutaneously.<sup>75</sup> The vigor of crystal liberation must be tempered, as indicated by pseudogout complicating arthroscopy<sup>25</sup> and the report of pseudogout flares following attempted chelation by washout with EDTA in all treated patients.<sup>76</sup> Washout alone may not be sufficient for very difficult gout, as salutary effects following mechanical resection of residual tophaceous deposits in such patients have been described.<sup>79</sup>

While application of closed needle washout to crystalline arthropathies has been limited, use as an adjunct antiinflammatory intervention directed at removing inciting crystals seems an application worth expanding.

## Infectious (septic) arthritis

Time-honored principles of the management of acute septic arthritis include the prompt and most thorough drainage of joint purulence possible.<sup>78,79</sup> Importance of washout was bolstered from the laboratory when reports of a lapine model of septic arthritis described far less cartilage loss in animals whose knees had been washed out once infected.<sup>80</sup> Early in the development of surgical arthroscopy, it became apparent that arthroscopy can accomplish this goal at least as well as the more invasive open arthrotomy,<sup>81</sup> with the more benign outcome following arthroscopy recently bolstered by a review of the American College of Surgeons database.<sup>82</sup> Taking the septic knee to the operating room for a quick arthroscopic washout is now standard of care.<sup>82</sup> How intently such an intervention must occur,<sup>83,84</sup> and whether it need occur at all,<sup>85,86</sup> remain issues under discussion. Use of minimal anesthesia and more frequent performance of arthroscopy in an office or procedure room setting have reduced barriers to arthroscopy compared to when it was strictly an operating room procedure. Nevertheless, in the United Kingdom during the 2020 COVID-19 (coronavirus disease 2019) pandemic, the British Orthopaedic Association (BOAST) guidelines stipulated medical treatment (needle aspiration plus antibiotics) for patients as first-line management, with operative treatment (arthroscopic washout plus synovectomy) reserved for patients showing signs of sepsis, the goal being to reduce exposure of COVID-infected patients to the operating room environment.<sup>87</sup> The quick trip to the operating room for arthroscopic washout is often not an option in communities and countries where resources are limited and/or arthroscopic expertise is not available.<sup>88</sup>

Some of the techniques to wash out the septic joint were described prior to the widespread use of arthroscopy. Washout of septic knees with carbolic acid, boric acid, or a magnesium sulfate solution was reported as effective during World War I, well before antibiotics, let alone arthroscopy.<sup>89</sup> Since then, numerous variations of joint washout have been described for large-joint septic arthritis.<sup>90</sup>

Robert Jackson published the first description of arthroscopy to treat septic knees, including practices no longer pursued, such as inclusion of a detergent and prolonged postoperative suction drainage.<sup>91</sup> Previous analyses of the use of arthroscopy in the septic knee mention only the arthroscopy and washout, with no other adjunctive interventions.<sup>82</sup> One small report in the '90s described the use of bedside washout in patients managed with the older model of repeated closed aspirations; patients who had reached the point of referral for surgical drainage owing to incomplete evacuation of the joint, failure to resolve synovial leukocytosis, extending of local infections, or sepsis underwent bedside washout and 4 of 11 patients avoided any further surgical therapy.<sup>92</sup>

Joint washout is desirable in septic arthritis regardless of how it is provided. Details of performance, such as type and volume of washout fluid, additives, and postlavage instillations, remain to be sorted out, and will obviously vary according to clinical scenario. Bedside washout could accomplish this without the barriers of access, cost, and expertise that govern use of

operating room–based procedures. Use of washout in developing countries, where such barriers are real and high,<sup>88</sup> holds high promise to improve the management of septic arthritis in those regions. Joint infections are several times more common in resource-poor areas than in the developed world<sup>93</sup> and treatment remains a venture with low expectations, taking avoidance of amputation as a victory.<sup>94</sup>

## Performing knee washout

Bedside knee washout can be accomplished by any physician proficient in arthrocentesis. Washout can be performed with 2 cannulae, as in France,<sup>5</sup> or by the single-entry method—once called “tidal irrigation”—we have always employed. We believe this provides a more thorough washout as inflow fluid cannot exit out a pressure gradient before filling the joint and the instillation distends capsule somewhat. Initial steps are the same as those for arthrocentesis: a comfortably supine patient, appropriate skin anesthesia (with some extra infiltrated in anticipation of a larger bore needle), joint penetration with removal of any fluid, followed by intraarticular instillation through the same needle of 10-mL bupivacaine. After this, things become more specialized. A needle of around 14 gauge (2 mm)—whether a Veress needle, sterilized cow teat cannula, or plain 14-gauge needle (Figure 4)—is used to penetrate the joint. The hub of the needle is connected to the male end of the tube of the assembly that will flush washout fluid into and out of the joint. The 30 mL to 60 mL of fluid is instilled into the joint, 3-way stopcocks are then adjusted to direct effluent to a tube connected to a collection bag or suction. The process is repeated until the infusion bag is empty, whether starting at 1 L or 3 L. The entire process takes approximately 30 minutes. GCs or hyaluronate can be instilled as desired. A wound closure strip is adequate for closure; the patient is immediately ambulatory and is given the usual instructions regarding postinjection activity.<sup>95</sup> A more detailed description has been published.<sup>96,97</sup>

## Conclusions

Removal of phlogistic joint contents by washout has been described as an intervention—delivered by arthrotomy, arthroscopy, or closed techniques—that can lead to improvement in clinical features of OA, inflammatory arthritis, crystal arthritis, and septic arthritis. For all these interventions, percutaneous methods applicable at the bedside have been described. Such interventions deserve reconsideration in the day-to-day management of these entities. It is time to bring back knee joint washout as a safe, simple, inexpensive adjunct to the management of several different common knee arthritides. Barriers to application are primarily logistical and administrative, ranging from the simple task of obtaining necessary supplies to the harder job of securing third-party coverage for the procedure. Successful application will depend on those rheumatologists both curious and bold enough to face these hurdles in the interest of providing better care to their patients.

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We thank our mentor, Bill Arnold, who not only taught us arthroscopy, but showed us how to wash out a knee when an arthroscope was not handy.

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