Is Bone Cement Waste in Total Knee Arthroplasty Economically or Environmentally Significant?

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INTRODUCTION:

Cemented total knee arthroplasty (TKA) remains the gold standard of treatment for knee arthritis, and surgical volumes are forecast to increase. A common practice is to use two 40 gram packages of methacrylate bone cement per TKA, regardless of patient or implant size. To our knowledge, the impact of excess bone cement discarded after surgery has never been studied. The goals of this study were:

1) To determine the expected yield of 2 X 40g packages of plain and gentamicin-impregnated medium-viscosity cement.
2) Use price and yield data to determine the cost per gram of prepared plain and gentamicin cement.
3) Measure the wasted cement to determine mass and cost per case
4) Scale these results to larger volumes of TKA.

METHODS:

Commercial packages of plain and gentamicin-impregnated cement (DePuy SmartSet Medium Viscosity) were mixed to determine the yield (cured) of 2 X 40 gram packets. Using price and yield data, the prices (US $/gram) of plain and gentamicin cement were calculated.

After IRB approval, a prospective study was performed by two fellowship-trained arthroplasty surgeons using the same medium viscosity cement/techniques/implants with two packages of 40 gram cement/ case. Patient demographic and implant size data were collected. All unused cement was collected and, after curing, was weighed, and its volume determined though water displacement. The amount and cost of wasted cement was calculated, as well as the percent waste of initial product. The results were then scaled to determine the mass and cost of wasted cement per 500 TKA.

RESULTS:

2 X 40 g packages of plain medium viscosity plus 18.88 g liquid monomer produced 106.7 grams cured cement (SD 1.2 g). 2 X 40 gram packages of gentamicin-cement plus 18.88 g liquid monomer produced 109.6 grams cured cement (SD 1.4 g). Price for plain cement was calculated as $0.94/gram and gentamicin cement was $2.68/gram.

38 TKA have been studied to date. Mean cement waste per case was 59.2 grams (SD 15.0 g, range: 38.7-80.6 g), equal to 54.5% mean waste per case (SD 14.2%, range: 30.9-75.5%). Mean volume of wasted cement was 57 cc (SD 17.3 cc), and calculated mean density of wasted cement was 1.04 gram/cc.

Mean cost of wasted cement per case was $68.72 (SD $11.39, range $34.87-$90.80) for plain cement and $145.20 (SD $31.76, range: $91.92-$201.54) for gentamicin-impregnated cement. The calculated total cost of wasted cement in this series was $4698.

If these results are scaled to volume, this represents 29.6 kg /28.5 liters of cement and $34,000 (plain)- $73,000 (gentamicin-impregnated) wasted per 500 cases.

DISCUSSION AND CONCLUSION:

The routine use of 2 X 40 gram packages of cement for TKA resulted, on average, in more than 50% waste, costing approximately $125 per case. Approximately 65 pounds of bone cement, occupying approximately 1 cubic foot, would be wasted per 500 cases. Discarded cement goes to landfills and is not biodegradable. Thus, scaled to hospital/health system/national volume levels, particularly given forecasted increases, the waste of bone cement after TKA potentially has potentially significant environmental and cost implications.

Efforts to reduce this waste are warranted, particularly for regular users of antibiotic cement. Correlation between cement use and implant size is currently being investigated as a means of "demand matching" for cement preparation. Improved cement "stewardship" will reduce waste, effecting cost savings and environmental benefit.