

Use of the Tego[®] needlefree connector is associated with reduced incidence of catheter-related bloodstream infections in hemodialysis patients

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Overview

This retrospective analysis compared outcomes among patients of a large dialysis organization receiving in-center hemodialysis using a central venous catheter with either the Tego connector or standard catheter caps. Incidence rates for intravenous antibiotic starts, receipt of an IV antibiotic course, positive blood cultures, mortality, missed dialysis treatments, utilization of erythropoiesis-stimulating agents (ESAs), and thrombolytics were calculated and compared.

The analysis comprised 10,652 Tego patients and 6,493 non-Tego patients (controls).

Results:

- > Tego use was independently associated with decreased risk of CRBSI, defined by initiation of IV antibiotics (adjusted IRR 0.92, 95% confidence interval [CI] 0.87–0.97) or initiation of IV antibiotic course (adjusted IRR 0.89, 95% CI 0.84–0.95).
- > Tego use was independently associated with decreased rate of missed dialysis treatments (adjusted IRR 0.98, 95% CI 0.97–1.00).
- > No significant difference between Tego and control cohorts was observed with respect to mortality.
- > Tego use was associated with decreased likelihood of thrombolytic use (adjusted per-month probability of 5.6% versus 6.2% for controls)
- > Tego use was associated with lower utilization of ESAs in study months 7–9.

Conclusion

Use of the Tego connector may reduce the risk of CRBSI and result in lower utilization of thrombolytics, antibiotics, and ESAs, as well as fewer missed dialysis treatments.

BACKGROUND

For end-stage renal disease (ESRD) patients undergoing long-term use of central venous catheters (CVC), common complications include catheter-related bloodstream infections (CRBSI) and catheter occlusions due to thrombosis. Data from the United States Renal Data System suggest that CRBSIs among patients receiving hemodialysis remain high—roughly 300 admissions with bacteremia/sepsis per 1000 patient-years in 2011.¹ In addition to negatively impacting patient well-being, CRBSI contributes to systemic inflammation, which may necessitate the increased dose requirement for erythropoiesis-stimulating agents (ESA).^{2,3}

Additionally, patient care may be further complicated by catheter occlusion because of thrombosis, which can result in lower blood flow and dialysis inadequacy.⁴ To prevent thrombotic occlusions, CVCs are locked with heparin after completion of a treatment.^{5,6} However, heparin use is associated with increased risk to patient safety including systemic anticoagulation, heparin-induced thrombocytopenia, and the proliferation of *Staphylococcus aureus* biofilm formation.^{7,8} Together, infection and occlusion can impact clinical outcomes and add significant cost to the care of ESRD patients.

The Tego Needlefree Hemodialysis Connector was developed with the intent of reducing CRBSI and thrombotic occlusions associated with CVCs used in the treatment of patients receiving hemodialysis. The silicone seal of Tego remains closed when not activated, creating a mechanically and microbiologically closed system when attached to the hub of a catheter, minimizing the risk of catheter contamination. Unlike conventional catheter caps, the Tego connector can be effectively flushed and locked with saline, reducing the need for heparin or other antithrombotic locking solutions.^{9,10} As a neutral displacement connector, Tego limits reflux of blood into the catheter lumen during tubing or syringe removal, thus reducing the need for heparin as an anticoagulant.

DaVita[®], a leading provider of kidney care in the United States serving more than 160,000 Americans, designed and performed a rigorous retrospective, observational analysis of the comparative effectiveness of Tego versus standard catheter caps with respect to rates of CRBSI, missed treatments, mortality, and the utilization of ESA and thrombolytics.

STUDY DESIGN

Between November 2010 and July 2011, DaVita implemented the use of Tego in nearly 70% of its CVC patients. Implementation was not universal to all DaVita facilities. However, within individual facilities, Tego connectors were universally used or universally not used. The study compared rates of six clinical endpoints among 17,145 patients receiving treatment at DaVita.

Patient data was collected from October 1, 2012, through June 30, 2013, for patients who had CVC placement and received dialysis for at least 21 days. Patients were excluded from the study if data about the type of catheter used was not available, if they switched cap types within the first 21 days, if they were under 18, or if there was incomplete demographic data to support the analysis. Patients were defined as at-risk until censoring for change in dialysis access type, transfer of care, change in modality, transplant, withdrawal from dialysis, or end of study (June 30, 2013).

DaVita used three metrics to identify CRBSI: the receipt of any IV antibiotic, administration of two or more doses of antibiotics within a 21-day period, and the occurrence of a positive blood culture. Additionally, the researchers compared patient mortality, missed dialysis sessions, and the utilization of ESA and thrombolytics. Incidence rates were calculated by dividing the count of each of the events divided by the time at risk. Incidence rate ratios (IRR) were estimated using Poisson regression models. All models were performed to three different specifications: model 1 – unadjusted for any covariates, model 2 – adjusted only for confounding variables that were found to be different between the Tego and standard connector caps, and model 3 – fully adjusted for all potential confounding variables. All data were analyzed using Stata 10.0 MP (StataCorp, College Station, TX).

RESULTS

Of the 17,145 patients who met all inclusion criteria, 62% (10,652) were given the Tego connector, and 38% (6,493) were given standard caps (control group).

Antibiotic Starts

Antibiotic starts occurred within the Tego population at a rate of 118 events per 100 patient-years-at-risk. Without adjustment, this was 10% lower than the 131 events per 100 patient-years-at-risk among the group with standard connectors ($p < .001$). After adjusting for both the significant demographic differences (age, race, vintage, and etiology of ESRD) as well as all demographic measures, the Tego group showed a smaller but still significant reduction in CRBSI of 8% ($p = .02$).

Antibiotic Course

The results were similar when analyzing the incidence of patients administered two or more doses of antibiotics within a 21-day period. Unadjusted, the Tego population experienced CRBSI 13% less than the control ($p < .001$), and after both models of adjustment, the Tego population experienced an 11% reduction in infection ($p < .001$).

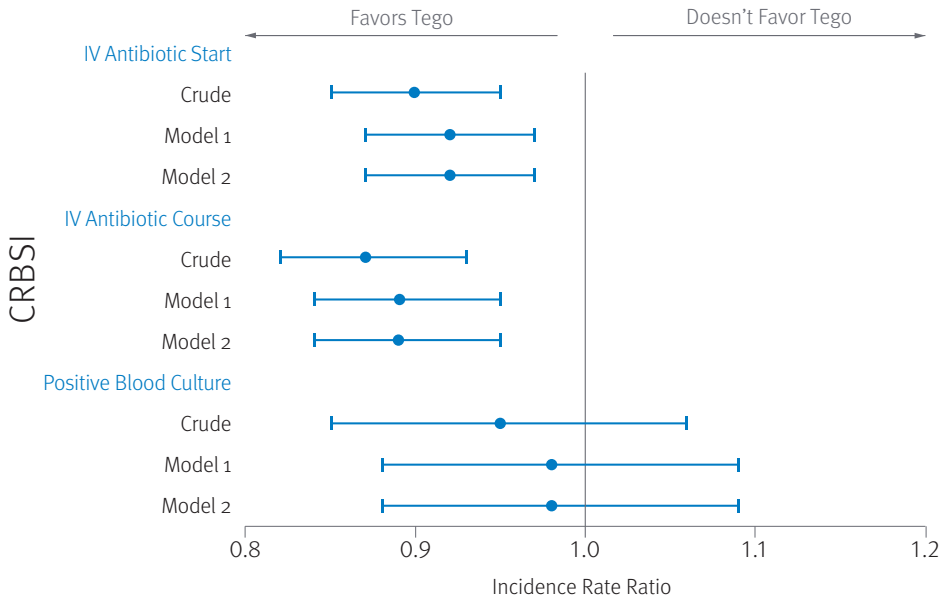
Positive Blood Culture

Tego was found to reduce the incidence of CRBSI as measured by positive blood culture by 5%, though the reduction was not statistically significant ($p = .34$). It was noted that this indicator may be undercounted because many patients receive blood cultures in the context of hospitalization or emergency care and such cultures were not captured in this data set.



The Tego connector can be effectively flushed and locked with saline, reducing the need for heparin or other antithrombotic locking solutions.^{9,10}

FIGURE 1. INCIDENCE-RATE RATIOS (IRRS) BETWEEN TEGO USE AND CRBSI.



Mortality

There was no statistically significant ($p=.64$) association between Tego use and mortality rate observed on either unadjusted or adjusted analysis.

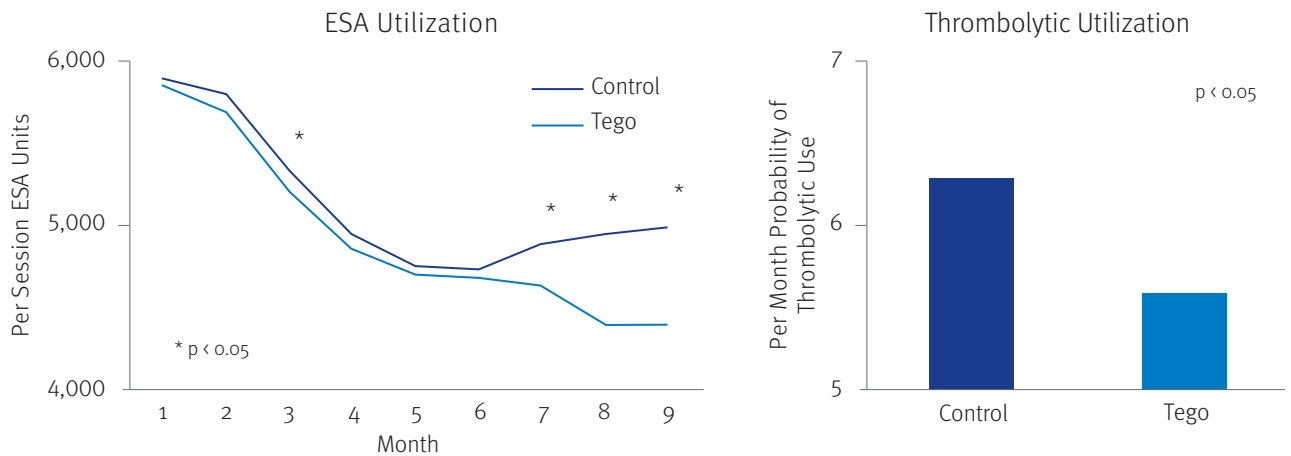
Missed Dialysis Sessions

Patients in the Tego group experienced a small but statistically significant reduction in the number of missed dialysis sessions, with only 17.2 sessions missed per 100 patient-years compared to 17.8 (3.3%, $p=.001$). This difference remained small but still statistically significant after adjusting for all confounding variables (2% reduction, $p=.04$), but was insignificant when only adjusting for the significant demographic differences ($p=.11$).

Medication Use

Both the probability of receiving ESA and the per session dose declined over the course of the study for both groups. The differences were generally insignificant with one notable exception when the dosages in months 7, 8, and 9 were significantly lower among the Tego group, before and after adjustment. Thrombolytics were used with 5.6% of the Tego population, which was significantly lower than among the control population (6.2%) before and after adjustment ($p=.007$ and $p=0.03$).

FIGURES 2 AND 3. MEDICATION UTILIZATION FOR TEGO AND CONTROL COHORTS.



DISCUSSION

In this retrospective analysis, Tego connector use was found to be independently associated with a 10-12% reduction in risk of CRBSI, as defined by initiation of IV antibiotics or initiation of an IV antibiotic course. A directionally similar, although not statistically significant, association was observed when CRBSI was defined by positive blood

Tego connector use was found to be independently associated with a 10-12% reduction in risk of CRBSI.

culture. However, the lack of statistical significance for this indicator of infection may be attributed to the likelihood that most patients receive blood cultures in the context of hospitalization or emergency care and therefore their laboratory results were not captured in the DaVita study data. The fact that similar reductions in the risk of CRBSI were identified using all three definitions suggests that the observed associations were unlikely due to chance or to choice of definition.

The Tego population also experienced significant improvements in resource utilization. Tego use was independently associated with approximately 0.6 fewer missed treatments per patient per year as well as a decreased likelihood of thrombolytic use. Since missed hemodialysis sessions are associated with higher rates of morbidity and mortality as compared to patients who adhere to their prescribed schedule, even small reductions can provide meaningful cost benefits.

Additionally, the Tego population experienced lower levels of ESA utilization and dosage, reducing pharmaceutical costs and challenging the idea that the saline lock possible with Tego could fail to control catheter occlusions as well as a heparin lock. In fact, the data consistently showed that thrombolytic use (a marker of thrombotic complications) was modestly decreased with Tego use. For patients who were taking ESAs, Tego use was independently associated per-administration dose differences of approximately 500 U at later time points in the study, which could have substantive financial impact for dialysis providers in the light of recent downward pressure on dialysis reimbursement rates.¹¹

As the first large-scale study on the impact of Tego connectors on CRBSI, this study improves on results from previous smaller studies in showing a reduced infection rate along with reduced utilization of erythropoiesis-stimulating agents. Further study with a randomized controlled trial would be needed to demonstrate causality. A longer time period could shed meaningful insights on comparing mortality rates between the two groups and additional economic analyses should be conducted to assess Tego's net budgetary impact.

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