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Elective hand surgery and concomitant corticosteroid injection: Confirming increased infection risk using A national dataset

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ABSTRACT

Background: Recent studies demonstrate a link between corticosteroid injection and surgical complications when procedures occur shortly after steroid administration. These publications focus on single procedures like carpal tunnel release. This study seeks to demonstrate how surgical site infection risk changes across thirteen common elective hand procedures when steroid injection is performed contemporaneously.
Methods: The Truven MarketScan® database identified patients who had undergone elective hand surgery between 2015 and 2016. Two cohorts were created based on the administration, or absence thereof, of contemporaneous corticosteroid injection. The primary outcome measure was infection within 30 days of surgery as measured by antibiotic prescription or repeat surgical intervention. Multivariate logistic regression was performed to assess the association between concomitant corticosteroid injections and post-operative infections while controlling for demographics and comorbidities.
Results: 149,689 patients underwent elective hand surgery. 6104 (4.1 %) received concomitant corticosteroid injection and 14,070 (9.4 %) received post-operative antibiotics or underwent secondary surgical intervention for infection. Treatment for post-operative infection was significantly higher in the corticosteroid group (10.2 % versus 9.3 %; $p = 0.02$) driven by difference in severe infection requiring surgical intervention (3.7 % versus 3.1 %; $p = 0.03$). This finding persisted when controlling for demographics and comorbidities with adjusted OR of 1.10 (CI 1.01–1.20) for all infections and 1.16 (CI 1.01–1.33) for severe infections.
Discussion: These results support prior findings that patients undergoing concurrent steroid injections and surgery have increased rates of infectious complications though the absolute risk remains small. Limitations of the database preclude further investigation into the details of each procedure (e.g. ipsilateral vs contralateral injection, peri-operative antibiotics) which may impact infection rates.
Conclusions: Concomitant steroid injection with elective hand surgery may increase the risk of postoperative infection, particularly severe infection. However, that relative increase lies between 1 and 33 percent and should be weighed against the benefit from intraoperative corticosteroid administration.

Introduction

Hand surgeons frequently utilize corticosteroid injections for treatment of upper extremity maladies including stenosing tenosynovitis of the fingers and wrist [1–4], carpal tunnel syndrome [5–7] and thumb carpometacarpal joint arthritis [8–10]. Efficacy of corticosteroid treatment varies by indication, but these interventions are not without risk. Several recent publications have sought to quantify that risk to better guide corticosteroid administration. These studies point out that patients who undergo surgical intervention in the period after corticosteroid injection have associated increases in post-operative complications [11–14]. These studies focus on the incidence of infection and need for additional surgery in addition to previously described complications of corticosteroid use including hyperglycemia, [15–17] hypopigmentation [18] and hypertension [19]. Fewer studies have sought to determine the correlation between concomitant corticosteroid injection and surgical intervention with post-operative complications [20]. As described by Lutsky et al. concomitant steroid injection may be indicated in patients with multiple ailments such as carpal tunnel syndrome and basilar thumb arthritis such that surgery may be performed

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for one and steroid injection for the other at the same time. This study found a rate of infection of 2.0 % for patients who underwent intra-operative injection vs 0.5 % for those patients who did not.

Most studies currently published on this topic are retrospective single center investigations and thus limited by small sample sizes. There are a few exceptions with Qin et. al. publishing an assessment of complications after thumb carpometacarpal joint surgery using a Humana database of 5046 patients and Lane et.al evaluated a large Hospital Episode Statistics database with 18,356 patients undergoing base of thumb corticosteroid injection [12,21]. Both studies found low, but elevated rates of complication/infection when steroid injections were performed within 90 days of surgery. However, they did not specifically evaluate patients who had steroid injections at the time of their surgical procedure. Smaller studies are underpowered to detect complications such as infection which are rare in elective hand surgery. Larger database studies have not focused in on the subset of patients receiving corticosteroid injections at the time of their elective hand procedure. As such, this study seeks to utilize the MarketScan commercial claims dataset which provides a larger patient sample sufficient for detection of rare complications while focusing on patients who are receiving corticosteroid injections at the same time, though not necessarily the same location, as their elective hand procedure. This dataset, compiled by IBM, provides de-identified patient-level health data (medical, drug and dental) through queries to hospitals, managed care organizations, employers, and electronic medical record providers. The commercial dataset does not include Medicare and Medicaid enrollees, so all patients evaluated are under sixty-five and working or are their dependents. We hypothesize that concomitant corticosteroid injections administered concurrently with elective hand surgery are associated with increased patient infection risk.

Materials and methods

The institutional review board approved query of the MarketScan commercial claims dataset from 2015 to 2016. This database provides comprehensive health data on a large and diverse cohort of patients, which includes medication data and was available to the study team for a specific and limited time frame. Hand surgeries were identified using thirteen current procedural terminology (CPT) codes for the most common hand procedures including carpal tunnel release, trigger finger release and mucous cyst excision. A full list of surgery types queried can be found in the supplemental material. Patients were included if they were 18 years of age or older, and they underwent an elective hand surgery. Administration of a concomitant corticosteroid injection at any site was determined by billing for an injection CPT code (20,526, 20,550, 20,551, 20,600, 20,605, 20,610) on the same day as the CPT for the index procedure. The main outcome variable assessed in this study was infection within 30 days of surgery. Infections were divided into two categories: superficial, requiring oral antibiotic prescription (see supplemental materials) and severe, requiring a return to the operating room as identified by CPT codes (see supplemental materials). Relevant patient comorbidities of smoking, obesity, and diabetes were determined by reviewing relevant ICD-9 and billing codes for the 6 months prior to surgery. These comorbidities were chosen due to their known association with increased infection risk.

Patients were grouped into concomitant steroid and no concomitant steroid cohorts and compared with respect to comorbidities, demographics, and post-operative infection rates via Chi-square analyses. A T-test was used to compare patient age. A multivariate logistic regression model assessed the association between steroid injections and post-operative infections, while controlling for patient age, sex, and the presence of comorbidities. Odds ratios (OR) and 95 % confidence intervals (CI) are reported. This analysis was performed using SAS software.

Results

Cohort: 149,689 patients underwent elective hand surgery from 2015 to 2016 and met the inclusion criteria. These patients were separated into cohorts based on receipt of concomitant corticosteroid injection during the index procedure with 143,585 patients in the no corticosteroid group and 6104 patients in the corticosteroid group (4.1 %). A significantly greater percentage of patients who received a concomitant steroid injection were female (72.3 % steroid vs 65.6 % no-steroid, $p < 0.001$) and these patients were also significantly older at 53 years old vs 50.9 years old ($p < 0.001$) though this was not a clinically relevant difference (Table 1). The proportion of patients who were obese (14.7 % steroid vs 15.0 % no-steroid, $p = 0.52$) and had diabetes (17.6 % steroid vs 16.7 % no-steroid, $p = 0.06$) was not significantly different. Fewer smokers received an injection at the time of surgery (6.7 % steroid vs 7.8 % no-steroid $p = 0.009$).

The most common surgical procedure performed was open carpal tunnel release in both groups at 47,990 (33 %) and 2064 (34 %) for the no steroid and steroid groups, respectively. The second most common procedure in both groups was trigger finger release. These two procedures account for 80,076 (53 %) of all elective hand interventions evaluated in this study. The remainder of procedures queried are detailed in Table 2.

Post-operative infections: A total of 9.4 % of all patients received post-operative antibiotics or underwent a second procedure suggestive of infection. This proportion was significantly greater in patients who received a steroid injection (10.2 % versus 9.3 %, $p = 0.02$, Relative risk: 1.10, $p = 0.02$). When analyzed by infection severity, there was no significant difference in patients who received antibiotics alone based on if they received a corticosteroid injection (6.6% vs. 6.2 %, $p > 0.05$). However, there was a significantly greater proportion of patients who experienced a severe infection in the corticosteroid group (3.7 % versus 3.1 %, $p = 0.03$, Relative risk: 1.19, $p = 0.01$). This finding persisted when controlling for patient age, sex, smoking status, obesity, and diabetes, with a 10 % increase in odds for all infections (OR: 1.10 95 % CI: 1.01–1.20) and a 16 % increase in odds for a severe infection (OR 1.16 95 % CI: 1.01–1.33) in patients receiving a concomitant steroid injection.

Discussion

This study set out to describe the association between steroid injections and infection rates after common hand surgical procedures. Our analysis supports the hypothesis that concomitant steroid injections administered at the same time as operative intervention are associated with an increased relative risk of perioperative infection. This is especially true for severe infections which require return to the operating room.

Prior studies have demonstrated an association between perioperative steroid injections and increased complication rates after orthopedic procedures including those procedures most commonly performed in

Table 1
Demographic variables.

	No Steroid Injection	Steroid Injection	% Concurrent Steroid Injection
Total	143,585	6104	4.1 %
Mean age (standard deviation)	50.9 (10.4)	53 (8.5)	
Female (%)	94,156 (65.6 %)	4413 (72.3 %)	4.5 %
Smoking (%)	11,261 (7.8 %)	408 (6.7 %)	3.5 %
Obesity (%)	21,502 (15.0 %)	896 (14.7 %)	4.0 %
Diabetes (%)	23,933 (16.7 %)	1073 (17.6 %)	4.3 %

Table 2
Procedures.

Surgery Type	No Steroid Injection	Steroid Injection	% Concurrent Steroid Injection
Open carpal tunnel release	47,990	2064	4.1 %
Trigger finger release	28,540	1482	4.9 %
Endoscopic carpal tunnel release	14,315	838	5.5 %
Mucous cyst excision	10,347	207	2.0 %
Cubital tunnel release	9784	293	2.9 %
Primary ganglion excision	9120	185	2.0 %
CMC arthroplasty	7650	433	5.4 %
De Quervain's release	7623	299	3.8 %
Epicondylar debridement with tendon re-attachment	3086	82	2.6 %
Epicondylar debridement	2066	66	3.1 %
Percutaneous elbow tenotomy	1485	129	8.0 %
Guyon canal decompression	868	19	2.1 %
Revision ganglion excision	711	7	1.0 %

this dataset [11–14,22]. There remains debate within the literature regarding timeframe during which steroid injections impart an increased risk of infection. The timing after steroid injection during which the greatest risk for complication exists varies by study and procedure. For instance, the greatest Odds ratio for infection after carpal tunnel release (1.37) and for return to the operating room (1.46) occurs when the procedure is performed within 30 days of injection [13]. Trigger finger procedures demonstrate slightly different risk profiles with the greatest Odds ratio (9.38) for development of deep infection after release occurring 31–60 days after injection though overall risk is elevated for all patients receiving injection within 3 months of surgical intervention [11,23].

Within these reports few studies have assessed the period within the first 30 days after surgery in more granular detail, particularly with identification of patients who undergo surgery at the same time as receiving a steroid injection. This is due in part to the relative infrequency of concomitant steroid injection which makes it difficult for studies with small sample sizes to capture adequate numbers of patients to detect differences in outcomes between patients undergoing surgery alone and those with concomitant steroid administration. Lutsky et. al. sought to reveal risk of concomitant steroid injection by retrospective review of 782 patients in a matched comparison and identified increased risk of infection in those patients with concomitant injection in the extremity ipsilateral to the surgical site (2.0 %) vs those without injection (0.5 %), however the two groups only differed by a total of four patients: six infections in the injection group and two in the matched controls. While this result achieves statistical significance, given the relative infrequency of infection a larger data set is needed to confirm this finding. Our study, using the MarketScan dataset supports the findings of Lutsky et. al. by supporting increased odds of infection for those patients receiving a concomitant steroid injection while undergoing surgery. From our data we can determine that a concurrent corticosteroid injection during elective hand surgery has a number needed to harm of 166. This means that, on average, 166 patients would have to receive a corticosteroid injection during surgery to cause one excess severe infection. Based on those numbers, the benefit of a concurrent injection must be weighed against the inherent risks. It is important to note that our study does find higher rates of infection after clean elective hand surgery than those previously reported in the literature both in the steroid and non-steroid groups which is likely a result of our surrogate markers for post-operative infection (antibiotic prescription and return to OR). However, such a finding should impact both groups equally, and thus the relationship between the groups should not be affected.

The limitations of this study hinge on its reliance upon the MarketScan database as it is limited to evaluation of commonly documented CPT codes in an employed, insured population less than 65 years old. As such, the database query may have overlooked injections or procedures which were miscoded or not documented at all. Additionally, there is limitation to the amount of data accessible through the database. For example, we are unable to identify whether the injections were performed in the contralateral or ipsilateral limb. Surgical technique and details were also not assessed in the MarketScan dataset, such as perioperative antibiotic administration or, for the steroid group, type, and dose of injection. This information would be helpful in guiding the decision to perform concomitant steroid injection. Patient charts cannot be evaluated to determine the reason for antibiotic prescription or surgical intervention in the post-operative period so there is no way to determine if the treatment was indeed for surgical site infection or something else altogether. Other risk factors such as immunosuppression, HIV status, autoimmune and inflammatory disease, which may elevate post operative infection rates were not assessed in this study. Furthermore, the data are limited to only one year of claims which prevents assessment of year-to-year trends in outcomes. Lastly, while this study supports the association between concomitant steroid injection and increased odds of surgical site infection, it does not establish causation. Plausible explanations exist for steroid induced complications including local immunosuppression and needle inoculation of contaminants, but these are not confirmed by this study design. The generalizability of this study is broadened relative to prior literature given its inclusion of the thirteen most common elective hand procedures, and its larger sample size, but it is limited to insured patients as those without insurance are not captured in the dataset.

Conclusions

The findings of this study support the association between concomitant steroid injection and surgical site complications after common elective hand procedures. Despite overall low incidence of severe infections after elective hand surgery, the increased incidence of infection should be discussed as part of thorough patient counseling. It may be beneficial to wait until after surgery to administer steroid injection to minimize complications and to improve patient outcomes.

Institutional review board

This study was approved as IRB exempt by the Icahn School of Medicine at Mount Sinai institutional review board.

Statement of informed consent

Informed consent does not apply to this study as no identifiable patient information was used in its production. Patients included in the MarketScan database are informed that their deidentified information may be used for research purposes.

Statement of human and animal rights

Researchers using the MarketScan database did not have access to identifiable patient information. All research activity followed the ethical standards of the Helsinki Declaration of 1975, as revised in 2008, and was conducted in accordance with established ethical principles of research.

Declaration of generative AI in scientific writing

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Benjamin J. Kirby: Writing – review & editing, Writing – original draft. **Jashvant Poeran:** Data curation, Formal analysis, Investigation, Methodology, Project administration, Software. **Nicole Zubizarreta:** Data curation, Formal analysis, Investigation, Methodology, Software. **Daniel A. London:** Conceptualization, Methodology, Project administration, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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