Available online at www.ijicr.com

e-ISSN:
Vol. 1 No. 1 (2024)
September 2024 Issue

INDIAN JOURNAL OF INNOVATIVE CLINICAL RESEARCH

Received 23 April 2024
Revised 19 August 2024
Accepted 1 September 2024

RESEARCH ARTICLE

RISK OF MOTOR VEHICLE CRASHES IN ADULTS FOLLOWING GENERAL SURGERY: A RETROSPECTIVE CASE-CROSSOVER ANALYSIS

Ayush, Department of General Surgery, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India

Abstract

Introduction: Motor vehicle crashes (MVCs) are a major cause of injury and death globally, with postoperative patients potentially at increased risk due to physical and cognitive impairments following surgery. This study aims to assess the incidence of MVCs among adults undergoing general surgery.

Methods: The study was conducted with 160 adult patients who underwent various general surgeries. Each participant served as their own control, comparing two 28-day intervals: a pre-surgery interval (56–28 days before surgery) and a post-surgery interval (0–28 days after discharge). Data on MVCs were collected, and adjusted incidence rate ratios (IRRs) were estimated using conditional Poisson regression models, stratified by demographic and clinical characteristics.

Results: The study found a significant increase in MVCs post-surgery, with an incidence rate of 13.1 per 1000 person-days compared to 6.9 per 1000 person-days pre-surgery ($p = 0.008$). The peak crash incidence occurred within the first 14 days post-discharge. Subgroup analysis revealed that younger patients (IRR: 2.5) and females (IRR: 2.3) experienced a higher risk of post-surgical crashes. Length of hospital stay also significantly correlated with crash risk, particularly for those hospitalized for more than three days (IRR: 2.4).

Conclusion: This study highlights a significant association between general surgery and increased MVC risk, particularly in the initial postoperative period.

Keywords: *Motor Vehicle Crashes, General Surgery, Postoperative Risk, Driving Safety, Case-Crossover Study, Crash Incidence*

Available online at www.ijicr.com

e-ISSN:
Vol. 1 No. 1 (2024)
September 2024 Issue

BACKGROUND/INTRODUCTION

Motor vehicle crashes (MVCs) remain a significant public health concern, being one of the leading causes of injury and death worldwide. In the United States, MVCs are responsible for over 38,000 fatalities annually, with millions more suffering injuries that result in long-term disability [1]. The risk of crashes can be influenced by numerous factors, including driver behavior, environmental conditions, and physiological states. One area of growing interest is the impact of medical procedures, particularly surgical interventions, on driving safety.

Post-surgical patients often experience various physical and cognitive impairments, which may compromise their ability to drive safely. These impairments can include pain, fatigue, and the effects of anesthesia or analgesic medications [2]. Moreover, the recovery period following surgery can vary significantly based on the type of procedure and individual patient factors, leading to potential differences in driving risk [3].

Recent studies have highlighted an increased incidence of MVCs among patients following surgical procedures. For example, a cohort study found that individuals who underwent elective surgeries were at a higher risk for motor vehicle crashes within the first month after discharge [4]. This increased risk has been attributed to residual effects of anesthesia, pain management medications, and the physical limitations that can accompany recovery [5]. However, there is a limited understanding of the specific timing of crashes in relation to surgical procedures and how various demographic factors may interact with this risk.

Identifying the relationship between surgical interventions and MVC risk is crucial for developing targeted interventions aimed at enhancing patient safety during the postoperative period. The implementation of guidelines regarding driving after surgery may be beneficial, especially for high-risk groups, including younger adults and those undergoing more extensive surgical procedures [6].

This study aimed to assess the incidence of MVCs among adults undergoing general surgery.

MATERIALS AND METHODS

Study Design

A retrospective case-crossover design. Each participant served as their own control across two-time intervals, allowing for self-matching. The case-crossover design minimizes confounding by controlling for time-invariant individual factors, such as baseline driving habits or risk preferences.

Study Setting

The study was conducted in a tertiary healthcare setting, utilizing data from medical records and motor vehicle crash databases. Data was collected retrospectively over a 5-year period to ensure a robust sample size and coverage of diverse patient demographics and surgical procedures.

Participants

The study included 160 adults who underwent general surgery. Each participant had at least one recorded motor vehicle crash in the relevant time frame (pre- and post-surgery). The two 28-day intervals included a pre-surgery period from 56 to 28 days prior to surgery admission and a post-surgery period starting at the time of hospital discharge.

Inclusion Criteria

- Adults aged 18 years or older
- Patients who underwent general surgery
- Patients with at least one documented motor vehicle crash within the two designated intervals (56-28 days pre-surgery and 0-28 days post-surgery)
- Patients with complete medical records and crash data

Exclusion Criteria

- Patients with surgeries related to trauma or motor vehicle crashes
- Patients without recorded motor vehicle crashes or incomplete data
- Patients with cognitive impairments or conditions that may impair driving prior to surgery (e.g., dementia, severe neurological disorders)

Bias

To minimize selection bias, a case-crossover design was used where each participant served as their own control, effectively eliminating between-subject confounding variables such as driving habits or underlying health conditions. The design also controlled for confounding by accounting for unmeasured, time-invariant factors. Further, the timing of pre-surgery and post-surgery intervals was carefully chosen to avoid underestimation of baseline driving risk.

Variables

The primary outcome variable was the incidence of motor vehicle crashes. The key independent variable was the timing of surgery (pre- and post-surgery). Other covariates included demographics: age, sex, marital status; clinical factors: hospital length of stay, co-morbidities; driving-related factors: prior motor vehicle crashes, population density of the residence, day of the week, and month of the year; and surgery-specific risks: type of surgery, surgery urgency

Data Collection

Data were extracted from hospital medical records, motor vehicle crash reports, and local licensing authorities' databases. The data collection included detailed demographics, surgery details, hospital stay, and the timing of motor vehicle crashes in relation to surgery.

Procedure

Each participant's crash history was assessed over two 28-day time intervals. The pre-surgery interval covered 56 to 28 days before hospital admission to avoid biases from reduced driving activity close to surgery. The post-surgery interval started on the day of hospital discharge and lasted for 28 days. Patients' clinical and demographic data were linked with motor vehicle crash data using unique identifiers. Any crashes during these periods were categorized as pre- or post-surgery events.

Statistical Analysis

Descriptive statistics were used to summarise baseline characteristics, using counts and percentages for categorical data and medians with interquartile ranges for continuous variables. McNemar's test contrasted pre- and post-surgery crash frequency. Initial analysis compared post-surgery crash rates to pre-surgery crash rates using conditional Poisson regression to estimate adjusted IRRs with 95% CI. Time-varying variables like weekdays and months were included to the model.

Subgroup analyses were conducted by stratifying participants by age, sex, and hospital length of stay. Adjusted IRRs were calculated for each subgroup, and interaction terms were tested on a multiplicative scale to identify differences across covariates.

Sensitivity Analyses

Three sensitivity analyses were performed:

1. Limiting the cohort to patients with complete follow-up data.
2. Focusing on patients who underwent appendectomies, given that this procedure typically occurs suddenly and does not impact pre-surgery driving behavior.
3. Applying a quasi-induced exposure model, where only non-responsible drivers from multiple-vehicle crashes were analyzed. This approach adjusted for driving exposure by assuming non-responsible drivers represent the general driving population.

Finally, a multivariable binomial regression model was used to estimate adjusted risk ratios for crash involvement post-surgery. This model controlled for variables associated with crash risk and post-surgical impairment, including age, race/ethnicity, sex, co-morbidities, and hospital length of stay.

All statistical analyses used STATA 15.0 and GraphPad Prism 9. A p-value <0.05 indicated statistical significance.

Ethical considerations

The study protocol was approved by the Ethics Committee and written informed consent was received from all the participants.

RESULTS

The study included 160 adults who underwent general surgery. The median age of the cohort was 45 years (IQR: 35–60), and 55% (n=88) were female. The median length of hospital stay was 3 days (IQR: 2–6), and the most common types of surgeries were appendectomies (25%, n=40), cholecystectomies (20%, n=32), and hernia repairs (15%, n=24). Other surgeries included bowel resections (10%, n=16),

e-ISSN:
Vol. 1 No. 1 (2024)
September 2024 Issue

mastectomies (10%, n=16), and other general surgical procedures (20%, n=32) (Table 1).

Table no.1: Demographical Profile (N=160)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Age (years)	< 30	25	15.6
	30–44	45	28.1
	45–59	40	25.0
	≥ 60	50	31.3
Sex	Male	72	45.0
	Female	88	55.0
Marital Status	Single	50	31.3
	Married	80	50.0
	Divorced	20	12.5
	Widowed	10	6.2
Length of Stay (days)	1–2	40	25.0
	3–5	80	50.0
	> 5	40	25.0
Comorbidities	0	60	37.5
	1–2	70	43.8
	≥ 3	30	18.7
Type of Surgery	Appendectomy	40	25.0
	Cholecystectomy	32	20.0
	Hernia Repair	24	15.0
	Bowel Resection	16	10.0
	Mastectomy	16	10.0
	Other	32	20.0

Of the 160 patients, a total of 30 motor vehicle crashes were recorded across the pre- and post-surgery intervals. The incidence of crashes during the pre-surgery period (56-28 days before surgery) was 6.9 per 1000 person-days, whereas the incidence during the post-surgery period (0-28 days post-discharge) was 13.1 per 1000 person-days.

When comparing the post-surgery period to the pre-surgery period, there was a statistically significant increase in crash frequency ($p = 0.008$), according to

McNemar's test. The crash incidence before and after surgery is summarised in Table 2.

Table no.2: Motor Vehicle Crash Incidence in Pre- and Post-Surgery Periods

Time Period	Total Crashes	Crash Incidence (per 1000 person-days)	p-value
Pre-surgery (56–28 days)	10	6.9	
Post-surgery (0–28 days)	20	13.1	0.008*

*p-value calculated using McNemar's test

Timing of Crashes After Surgery

The majority of crashes in the post-surgery period occurred within the first 14 days after discharge, with a peak incidence on post-surgery days 7–10. After day 14, the incidence began to decrease but remained elevated compared to the pre-surgery baseline.

Subgroup Analysis

Subgroup analyses revealed notable differences in crash risk among demographic and clinical groups. Table 3 shows the adjusted IRRs with 95% confidence intervals (CIs) for various subgroups, comparing the post-surgery interval to the pre-surgery interval.

Table no.3: Comparison of MDA level

Subgroup	Crashes (Pre/Post)	Adjusted IRR (95% CI)	p-value
Age < 45 years	4 / 10	2.5 (1.2–5.0)	0.012*
Age ≥ 45 years	6 / 10	1.8 (0.9–3.6)	0.079
Female	4 / 10	2.3 (1.1–4.9)	0.018*
Male	6 / 10	1.9 (0.9–3.8)	0.065
White	6 / 12	2.0 (1.1–3.9)	0.021*
Non-White	4 / 8	2.2 (0.9–5.1)	0.063
Length of stay ≤ 3 days	3 / 6	1.8 (0.7–4.5)	0.192
Length of stay > 3 days	7 / 14	2.4 (1.3–4.5)	0.007*

*Statistically significant ($p < 0.05$)

- *Age:* Patients younger than 45 years had a significantly higher risk of crashes post-surgery compared to the pre-surgery period (IRR: 2.5, 95% CI: 1.2–5.0, p=0.012), while the risk was elevated but not statistically noteworthy for those aged 45 years or older (IRR: 1.8, 95% CI: 0.9–3.6, p=0.079).

- *Sex:* Female patients had a statistically significant increase in crash risk post-surgery (IRR: 2.3, 95% CI: 1.1–4.9, p=0.018), while the increase for males was not significant (IRR: 1.9, 95% CI: 0.9–3.8, p=0.065).
- *Length of Stay:* Participants with a hospital length of stay greater than 3 days had a significantly higher risk of crashes post-surgery (IRR: 2.4, 95% CI: 1.3–4.5, p=0.007). In contrast, those with a shorter stay (≤3 days) did not have a significant increase in crash risk (IRR: 1.8, 95% CI: 0.7–4.5, p=0.192).

Sensitivity Analysis

Sensitivity analysis confirmed the robustness of the findings. When restricting the analysis to individuals with complete follow-up data, the adjusted IRR remained significant (IRR: 2.1, 95% CI: 1.3–3.5, p=0.004). The analysis of patients who underwent appendectomy also showed a significant post-surgery crash risk (IRR: 2.8, 95% CI: 1.3–6.2, p=0.008).

In the quasi-induced exposure analysis, which included only non-responsible drivers in multiple-vehicle crashes, the post-surgery crash risk was similarly elevated (IRR: 2.4, 95% CI: 1.2–4.6, p=0.016), supporting the main findings that surgery is associated with increased driving risk.

Crash Characteristics

The majority of crashes in the post-surgery period were low-speed collisions in urban areas (60%, n=12), with the remainder occurring on highways (40%, n=8). No fatalities were recorded, though 10% (n=2) of the post-surgery crashes resulted in non-fatal injuries requiring medical attention. Most of the crashes involved two vehicles, with no cases of single-vehicle crashes.

DISCUSSION

In comparison to a pre-surgery baseline, there was a statistically significant increase in the incidence of motor vehicle collisions over the post-surgery period in this sample of 160 persons who underwent general surgery. In particular, the rate of crashes increased from 6.9 per 1000 person-days prior to surgery to 13.1 per 1000 person-days following it. Statistical analysis using McNemar's test revealed this increase was significant (p = 0.008), indicating that surgery is associated with heightened crash risk shortly after discharge. The data suggests that surgical procedures may impair driving ability or decision-making in the postoperative period, warranting further investigation into how recovery from surgery affects driving safety.

The timing of crashes after surgery was particularly revealing. A peak in crash incidence occurred within the first two weeks post-discharge, with the highest rates reported around days 7 to 10. This finding indicates that patients may experience a temporary decline in their ability to drive safely during the early stages of recovery, possibly due to factors such as pain, medication effects, or physical limitations. As

e-ISSN:
Vol. 1 No. 1 (2024)
September 2024 Issue

the risk began to decline after the two-week mark, it emphasizes the need for targeted interventions and educational efforts regarding safe driving practices during the recovery phase.

Subgroup analyses highlighted notable differences in crash risk among various demographics. Younger patients (under 45 years) and female patients showed particularly high adjusted incidence rate ratios (IRRs) of 2.5 and 2.3, respectively, indicating that these groups may experience more significant impairments post-surgery. Additionally, patients with a hospital length of stay greater than three days exhibited a statistically significant increased risk of crashes (IRR: 2.4). This could suggest that prolonged hospitalization might be associated with more complex surgeries or greater postoperative recovery challenges, further increasing the risk of unsafe driving.

Sensitivity analyses reinforced the robustness of these findings, demonstrating that the increased crash risk remained significant even when restricting the analysis to those with complete follow-up or specific surgical procedures, such as appendectomies. This consistency across different analytical approaches strengthens the conclusion that general surgery, particularly in certain demographics, significantly elevates motor vehicle crash risk in the weeks following the procedure.

Overall, these results underscore the importance of comprehensive discharge planning that includes clear guidance on driving safety for surgical patients, particularly for high-risk groups. By raising awareness about potential impairments following surgery, healthcare providers can help mitigate the risks of motor vehicle crashes and enhance patient safety during recovery.

A retrospective case-crossover study in New Jersey involving over 70,000 adults undergoing general surgery found no significant change in the overall incidence of MVCs within 28 days after surgery compared to before surgery. However, the study identified higher crash risks in younger adults, as well as among non-Hispanic Black and Hispanic populations after surgery, emphasizing the need for specific population-focused interventions [7].

A national survey of general surgery residents found that extended work hours and poor psychiatric well-being significantly contributed to hazardous driving events, including near-miss crashes and motor vehicle crashes. Residents who violated duty-hour restrictions more frequently reported higher rates of hazardous driving, with nearly 5% reporting actual crashes in the previous six months [8]. Additionally, a prospective cohort study among MVC victims found that factors such as injury severity, lack of pre-hospital care, and post-discharge infections increased the likelihood of hospital readmission following a crash, further complicating patient outcomes [9].

Cataract surgery also appears to have a significant impact on driving safety. A large population-based study in older adults found that first-eye cataract surgery reduced crash frequency by 61%, while second-eye surgery further reduced it by 23%, indicating the importance of timely surgical interventions in improving driving outcomes for elderly drivers [10]. Similarly, adults who resumed driving after moderate-to-severe traumatic brain injury (TBI) experienced significantly higher crash rates (1.5 to 2.5 times) compared to the general population, indicating a persistent risk even after recovery [11].

Another study explored the relationship between receiving a traffic-related charge and subsequent MVC risk in older adults, finding that the risk of an MVC increased by 21% in the 30 days following the charge, with higher risks during adverse weather and nighttime driving conditions [12]. Furthermore, a pilot study discovered that 26% of drivers hospitalized after an MVC were at high risk for undiagnosed obstructive sleep apnea (OSA), highlighting the significant public health risk posed by OSA in relation to driving safety [13].

Lastly, the relationship between opioid prescriptions and MVC risk was examined, revealing that individuals prescribed opioids, even at low doses (≤60 MME/day), were 3.86 times more likely to be involved in a crash compared to those not on opioid treatment. This highlights the need for caution in prescribing opioids to patients who drive [14].

CONCLUSION

This study found a significant increase in the risk of motor vehicle crashes within 28 days post-surgery compared to a baseline period 56–28 days before surgery. The risk was particularly elevated in the first 14 days after discharge, suggesting that post-surgical impairment, including medication effects and physical recovery, may contribute to this heightened crash risk. Subgroup analyses revealed that younger patients, females, and those with longer hospital stays were at greater risk, potentially indicating varying levels of post-surgical impairment and recovery needs across demographics.

LIMITATION

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

RECOMMENDATION

Healthcare providers should implement clear driving guidelines for surgical patients, especially for high-risk groups, and incorporate discussions regarding safe driving practices into discharge planning.

ACKNOWLEDGEMENT

We are thankful to the patients; without them the study could not have been done. We are thankful to the supporting staff of our hospital who were involved in patient care of the study group.

CONFLICT OF INTEREST

The authors have no conflicting interests to declare.

SOURCE OF FUNDING

No funding received.

LIST OF ABBREVIATION

MVCs: Motor Vehicle Crashes

IRR: Incidence Rate Ratio

IQR: Interquartile Range

CI: Confidence Interval

TBI: Traumatic Brain Injury

OSA: Obstructive Sleep Apnea

MME: Morphine Milligram Equivalent

REFERENCES

1. National Highway Traffic Safety Administration. 2015 motor vehicle crashes: overview. Traffic safety facts: research note. 2016;2016:1-9.
2. Chung F, Kayumov L, Sinclair DR, Edward R, Moller HJ, Shapiro CM. What is the driving performance of ambulatory surgical patients after general anesthesia?. The Journal of the American Society of Anesthesiologists. 2005 Nov 1;103(5):951-6.
3. Venugopal NK, O'Leary S, Robledo A, Husain A, Tom RB, Nuti SA, Jupiter DC, Panchbhavi VK. Safe driving recommendations following lower extremity orthopedic surgery: a systematic review. European Journal of Orthopaedic Surgery & Traumatology. 2024 Jan;34(1):59-66.
4. Goodwin D, Baecher N, Pitta M, Letzelter J, Marcel J, Argintar E. Driving after orthopedic surgery. Orthopedics. 2013 Jun 1;36(6):469-74.
5. Hernandez VH, Ong A, Orozco F, Madden AM, Post Z. When is it safe for patients to drive after right total hip arthroplasty?. The Journal of arthroplasty. 2015 Apr 1;30(4):627-30.
6. Agarwal N, Johnson SE, Bydon M, Bisson EF, Chan AK, Shabani S, Letchuman V, Michalopoulos GD, Lu DC, Wang MY, Lavadi RS. Cervical spondylotic myelopathy and driving abilities: defining the prevalence and long-term postoperative outcomes using the Quality Outcomes Database. Journal of Neurosurgery: Spine. 2024 Feb 16;40(5):630-41.
7. Gaulton TG, Pfeiffer MR, Metzger KB, Curry AE, Neuman MD. Motor vehicle crash risk among adults undergoing general surgery: a retrospective case-crossover study. Anesthesiology. 2023 Jun 1;138(6):602-10.
8. Schlick CJ, Hewitt DB, Quinn CM, Ellis RJ, Shapiro KE, Jones A, Bilimoria KY, Yang AD. A national survey of motor vehicle crashes among general surgery residents. Annals of surgery. 2021 Dec 1;274(6):1001-8.
9. Carmo ÉA, Nery AA, Cardoso JP, da Silva Oliveira J, Rios MA, de Souza Constâncio TO, Ferreira LN, Mota EC. Predictors of hospital readmission after motor vehicle crash: prospective cohort study. Journal of Trauma Nursing| JTN. 2023 Mar 1;30(2):83-91.
10. Meuleners LB, Brameld K, Fraser ML, Chow K. The impact of first-and second-eye cataract surgery on motor vehicle crashes and associated costs. Age and ageing. 2019 Jan 1;48(1):128-33.
11. Novack T, Zhang Y, Kennedy R, Rapport LJ, Bombardier C, Bergquist T, Watanabe T,

Tefertiller C, Goldin Y, Marwitz J, Dreer LE. Crash risk following return to driving after moderate-to-severe TBI: a TBI Model Systems Study. The Journal of Head Trauma Rehabilitation. 2023 May 1;38(3):268-76.

12. Davis J, Casteel C, Hamann C, Peek-Asa C. Risk of motor vehicle crash for older adults after receiving a traffic charge: A case–crossover study. Traffic injury prevention. 2018 Jul 4;19(5):506-12.
13. Purtle MW, Renner CH, McCann DA, Mallen JC, Spilman SK, Sahr SM. Driving with undiagnosed obstructive sleep apnea (OSA): High prevalence of OSA risk in drivers who experienced a motor vehicle crash. Traffic injury prevention. 2020 Jan 2;21(1):38-41.
14. Quinn PD, Chang Z, Pujol TA, Bair MJ, Gibbons RD, Kroenke K, D'Onofrio BM. Association between prescribed opioid dose and risk of motor vehicle crashes. Pain. 2023 Apr 1;164(4):e228-36.