Outcomes after single-look trauma laparotomy: A large population-based study

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BACKGROUND: Outcomes following damage control laparotomy for trauma have been studied in detail. However, outcomes following a single operation, or "single-look trauma laparotomy" (SLTL), have not. We evaluated the association between SLTL and both short-term and long-term outcomes in a large population-based data set.

METHODS: The California Office of Statewide Health Planning and Development patient discharge database was evaluated for calendar years 2007 through 2014. Injured patients with SLTL during their index admission were identified using *International Classification of Diseases, Ninth Revision, Clinical Modification* procedure codes. Diagnosis and procedure codes were used to identify specific abdominal organ injuries, surgical interventions, and perioperative complications. Subsequent acute care admissions were examined for postoperative complications and related surgical interventions. Clinical characteristics, injuries, surgical interventions, and outcomes were analyzed by mechanism of injury.

RESULTS: There were 2113 patients with SLTL during their index admission; 712 (33.7%) had at least one readmission to an acute care facility. Median time to first readmission was 110 days. Penetrating mechanism was more common than blunt (60.6% vs. 39.4%). Compared to patients with penetrating injury, blunt-injured patients had a significantly higher median Injury Severity Score (9 vs. 18, $p < 0.0001$) and a significantly higher mortality rate during the index admission (4.1% vs. 27.0%, $p < 0.0001$). More than 30% of SLTL patients requiring readmission had a surgery-related complication. The most common primary reasons for readmission were bowel obstruction (17.7%), incisional hernia (11.8%), and infection (9.1%). There was no significant association between mechanism of injury and development of surgery-related complications requiring readmission.

CONCLUSIONS: Patients with SLTL had postinjury morbidity and mortality, and more than 30% required readmission. Complication rates for SLTL were comparable to those reported for emergency general surgery procedures. Patients should be educated on signs and symptoms of the most common complications before discharge following SLTL. Further investigation should focus on the factors associated with the development of these complications. (*J Trauma Acute Care Surg.* 2019;86: 565–572. Copyright © 2018 American Association for the Surgery of Trauma.)

LEVEL OF EVIDENCE: Prognostic and epidemiologic study, level III.

KEY WORDS: Laparotomy; trauma; mortality; complication; single-look trauma laparotomy.

The introduction of damage control surgery has significantly decreased mortality for patients with severe abdominal trauma.[1–4] This management strategy has been studied in detail and is associated with high rates of readmission, multiple subsequent surgical procedures, wound infections, incisional hernias, and small-bowel obstructions.[1,2,5–8] Similarly, the complication rates of laparotomy for elective and emergency general surgical procedures have been well documented, with rates of incisional hernia ranging from 11% to 20% and small-bowel obstruction ranging from 2.8% to 5.0%.[9–17] In contrast, outcomes after a single abdominal operation for trauma, or single-look trauma laparotomy (SLTL), a procedure that is much more common than damage control laparotomy, have not been well described. The goals of this study were to describe short-term and long-term outcomes following SLTL and to determine the factors associated with these outcomes using a population of trauma patients who underwent SLTL in California during an 8-year period.

METHODS

With the approval of the California Health and Human Services Agency Committee for the Protection of Human Subjects and the Scripps Institutional Review Board, we conducted a historical cohort study of patients hospitalized in California between January 1, 2007 and December 31, 2014. Data originated from the California Office of Statewide Health Planning and Development (OSHPD) patient discharge database that contains

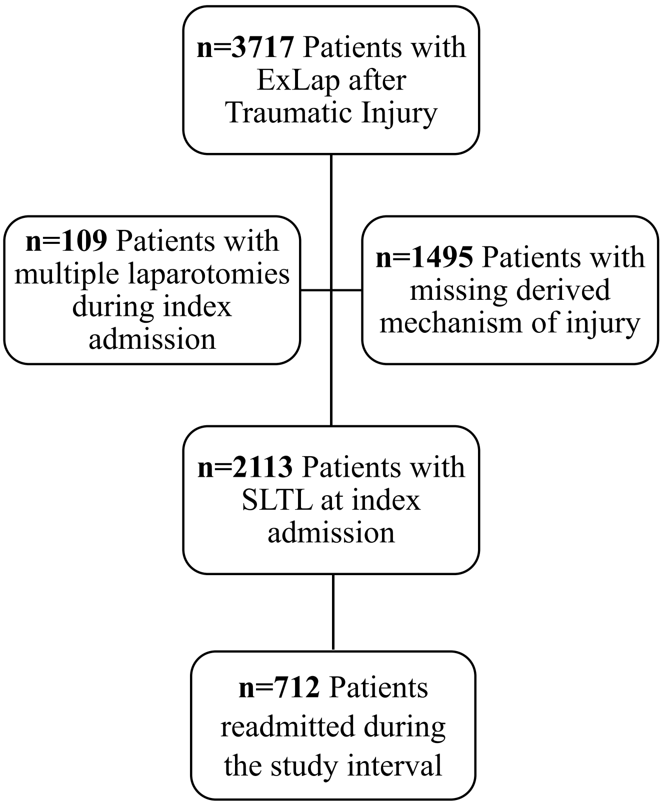

Figure 1. Patient population flow diagram.

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TABLE 1. Demographic and Clinical Injury Characteristics at Index Admission

Characteristics	All SLTL Patients (N = 2113)
Age, mean (SD), years	37.3 (17.2)
Male sex, n (%)	1694 (80.2)
Hospital days, median (IQR)	5 (3–10)
Head AIS, median (IQR)	0 (0–0)
Chest AIS, median (IQR)	0 (0–3)
Abdominal AIS, median (IQR)	2 (1–3)
Penetrating injury, n (%)	1280 (60.6)
ISS, median (IQR)	11 (4–19)
Death, n (%)	278 (13.2)
Stomach injury, n (%)	45 (2.1)
Small-bowel injury, n (%)	149 (7.1)
Large-bowel injury, n (%)	163 (7.7)
Unspecified GI injury, n (%)	187 (8.9)
Liver injury, n (%)	398 (18.8)
Spleen injury, n (%)	204 (9.7)
Kidney injury, n (%)	146 (6.9)
Bladder/Urethra injury, n (%)	89 (4.2)

AIS, Abbreviated Injury Scale score; GI, gastrointestinal; IQR, interquartile range.

patients' records from all licensed, nonfederal California hospitals mandated to report all hospitalizations. Patients in the OSHPD database are provided record linkage numbers, allowing prior and subsequent admissions to be tracked to unique patients for the evaluation of temporally distant outcomes during hospitalization. Data include unique record linkage numbers, demographics, admission factors, discharge disposition, and *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) external causes of injury codes, and diagnosis and procedure codes.

The study population consisted of adult trauma patients aged 18 years and older who underwent an SLTL during their index admission. The index admission was defined as the first admission with a procedure code for exploratory laparotomy (54.11), an external cause of injury code, and a diagnosis code in the range of 800 to 959 for traumatic injury. Patients with evidence of multiple laparotomies during the index admission were excluded from the primary analysis. The records of SLTL patients were then analyzed for procedure and diagnosis codes related to various abdominal procedures, injuries, and surgical complications (Supplemental Digital Content 1, http://links.lww.com/TA/B256). Timing of the SLTL was dichotomized as early (within the first day of admission) and late (after the first day of admission). Patients who lacked a valid record linkage number were excluded from the analysis of postdischarge factors and outcomes. Patients with diagnosis codes for cancer of the digestive organs or peritoneum, or inflammatory bowel disease were also excluded.

Other variables evaluated included age at admission, race and ethnicity, admission year, length of stay, and characteristics of the admitting hospital including unique code, type, county, and US zip code. Age was dichotomized as elderly (age 65 and older at index admission) and nonelderly. The Trauma Mortality Prediction Model probability of death and the New Injury Severity Score (ISS) (NISS) were calculated after conversion of relevant *ICD-9-CM* codes to the Abbreviated Injury Scale. The NISS was dichotomized as severe (NISS >15) and nonsevere (NISS, 1–14). Other variables identified through this process included mechanism of injury (blunt vs. penetrating). Patients with a missing mechanism of injury were excluded.

The primary outcomes of interest were surgical complications, including small-bowel obstruction, hernia, fistula, surgical wound infection, surgical wound dehiscence, and evisceration (Supplemental Digital Content 1, http://links.lww.com/TA/B256). Surgical complications were evaluated both during the index admission and after discharge. Surgical procedures performed after discharge that were evaluated included hernia repair, exploratory laparotomy, reopening of the abdomen,

TABLE 2. Perioperative and Postoperative Complications at Index Admission

Characteristics	All SLTL Patients (N = 2113)
Small-bowel obstruction, n (%)	204 (9.7)
Hernia, n (%)	62 (3.0)
Fistula, n (%)	3 (0.1)
Infection, n (%)	44 (2.1)
Dehiscence, n (%)	4 (0.2)
Evisceration, n (%)	12 (0.6)

TABLE 3. Clinical Characteristics and Postoperative Complications at Index Admission in Blunt Versus Penetrating Trauma

Characteristics	Blunt (n = 833)	Penetrating (n = 1280)	*p*
Age, mean (SD), years	44.7 (19.6)	32.4 (13.4)	<0.0001
Male sex, n (%)	552 (66.2)	1154 (90.2)	<0.0001
Hospital days, median (IQR)	8 (3–18)	4 (3–7)	<0.0001
Head AIS, median (IQR)	0 (0–3)	0 (0–0)	<0.0001
Chest AIS, median (IQR)	2 (0–3)	0 (0–3)	<0.0001
Abdominal AIS, median (IQR)	2 (1–3)	2 (1–3)	<0.0001
ISS, median (IQR)	18 (10–27)	9 (2–13)	<0.0001
Death, n (%)	225 (27.0)	53 (4.1)	<0.0001
Required readmission, n (%)	298 (35.7)	414 (32.3)	0.103
Small-bowel obstruction, n (%)	87 (10.4)	117 (9.1)	0.321
Hernia, n (%)	25 (3.0)	37 (2.9)	0.883
Fistula, n (%)	1 (0.1)	2 (0.2)	1.000
Infection, n (%)	26 (3.1)	18 (1.4)	0.007
Dehiscence, n (%)	1 (0.1)	3 (0.2)	1.000
Evisceration, n (%)	6 (0.7)	6 (0.5)	0.452
Stomach injury, n (%)	9 (1.1)	36 (2.8)	0.007
Small-bowel injury, n (%)	75 (9.0)	74 (5.8)	0.005
Large-bowel injury, n (%)	61 (7.3)	102 (8.0)	0.587
Unspecified GI injury, n (%)	108 (13.0)	79 (6.2)	<0.0001
Liver injury, n (%)	185 (22.2)	213 (16.6)	0.001
Spleen injury, n (%)	152 (18.3)	52 (4.1)	<0.0001
Kidney injury, n (%)	69 (8.2)	77 (6.0)	0.045
Bladder/Urethra injury, n (%)	68 (8.1)	21 (1.6)	<0.0001

AIS, Abbreviated Injury Scale score; GI, gastrointestinal; IQR, interquartile range.

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TABLE 4. Clinical Characteristics and Postoperative Complications in Readmitted Patients

Characteristics	Overall (n = 712)	Blunt (n = 298)	Penetrating (n = 414)	*p*
Age, mean (SD), years	39.7 (17.1)	45.2 (18.9)	35.8 (14.5)	<0.0001
Male sex, n (%)	560 (78.7)	195 (65.4)	365 (88.2)	<0.0001
Hospital days, median (IQR)	7 (4–15)	14 (6–27)	5 (3–10)	<0.0001
Abdominal AIS, median (IQR)	2 (1–3)	2 (2–3)	2 (1–3)	0.0002
ISS, median (IQR)	11 (4–22)	18 (9–25)	9 (2–14)	<0.0001
Death, n (%)	37 (5.2)	28 (9.4)	9 (2.2)	<0.0001
Number of readmissions, median (IQR)	1 (1–3)	2 (1–4)	1 (1–2)	<0.0001
Days to first readmission, median (IQR)	110 (6–531)	42 (1–341)	168 (11–693)	<0.0001
Small-bowel obstruction, n (%)	126 (17.7)	54 (18.1)	72 (17.4)	0.801
Hernia, n (%)	84 (11.8)	33 (11.1)	51 (12.3)	0.611
Fistula, n (%)	9 (1.3)	5 (1.7)	4 (1.0)	0.664
Infection, n (%)	65 (9.1)	31 (10.4)	34 (8.2)	0.317
Dehiscence, n (%)	8 (1.1)	1 (0.3)	7 (1.7)	0.148
Evisceration, n (%)	17 (2.4)	4 (1.3)	13 (3.1)	0.141
Any subsequent complication, n (%)	214 (30.1)	90 (30.2)	124 (30.0)	0.943

AIS, Abbreviated Injury Scale score; IQR, interquartile range; ISS, Injury Severity Score.

operations on the small bowel, operations on the large bowel, operations on the liver, operations on the kidney, operations on the spleen, operations on the stomach, appendectomies, operations on the rectum, operations on the gallbladder or bile duct, operations on the bladder or ureter, vascular anastomoses, or vessel suturing.

Descriptive statistics for covariates and outcomes were calculated using the *t*-test, the rank sum test, and the χ^2 test. Competing risks survival analysis was performed to evaluate associations between laparotomy timing, elderly status, mechanism of injury, injury severity, and patient's sex at the index admission with postdischarge complications, accounting for mortality after discharge and without a complication as a competing event. The Wei-Lin-Weissfeld marginal proportional hazards model was used to evaluate the association between the aforementioned risk factors at the index admission and the risk for recurrent surgical procedures on the abdomen during subsequent readmissions. Statistical significance was defined as $p < 0.05$. Data were managed and analyzed using Stata MP version 11.2 (StataCorp LLP, College Station, TX).

RESULTS

Among more than 18 million records in the OSHPD database, we identified 3717 patients who underwent exploratory laparotomy after a traumatic injury (Fig. 1). Patients who underwent multiple laparotomies during their index admission and those for whom mechanism of injury could not be determined were excluded from our analysis. A total of 2113 patients with SLTL during the index admission met study criteria for inclusion in the primary analysis.

Patients requiring SLTL during index admission were predominantly male with a penetrating mechanism of injury and a relatively short length of hospital stay (Table 1). More than 85% survived to discharge. Hepatic injury was the most common abdominal injury identified followed by injury of the spleen and unspecified gastrointestinal injury (18.8%, 9.7%, and 8.9%, respectively). The mortality rate for traumatically injured patients requiring SLTL was 13% (n = 278). The most common postoperative complications occurring during the index admission were small-bowel obstruction, incisional hernia, and infection (Table 2).

Characteristics and outcomes at the index admission by mechanism of injury are shown in Table 3. Patients with a penetrating injury were significantly more likely to be male and younger than those with a blunt injury. Blunt-injured patients had a significantly higher ISS, a longer length of stay, and a higher mortality rate compared with patients with a penetrating injury. Injuries of the liver, spleen, kidney, small bowel, and bladder as well as unspecified gastrointestinal injuries were significantly more common with a blunt mechanism of injury. In contrast, gastric injury was more common with a penetrating injury mechanism. Except for a higher rate of infection among blunt-injured patients, complication rates did not significantly differ by mechanism during the index hospitalization.

Of the patients who underwent SLTL, 712 (33.7%) were readmitted with a median time to first readmission of 110 days (interquartile range, 6–531 days). Characteristics and outcomes at readmission, both overall and by index mechanism of injury, are shown in Table 4. Readmission following penetrating injury occurred after an interval four times longer than that following blunt trauma. More than 30% of all readmitted patients had

TABLE 5. Median Time to First Incidence of Post-SLTL Complication

Complication	Time to First Incidence
Small-bowel obstruction, median (IQR), days	156 (13–602)
Hernia, median (IQR), days	655 (337–1216)
Fistula, median (IQR), days	450 (24–1267)
Infection, median (IQR), days	22 (9–435)
Dehiscence, median (IQR), days	17 (11–430)
Evisceration, median (IQR), days	55 (5–392)

IQR, interquartile range.

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some type of complication. Median times to first incidence of post-SLTL complications in all readmitted patients are shown in Table 5. The most common complications requiring readmission were similar to those most common in the index admission: small-bowel obstruction, incisional hernia, and infection. Fistula, dehiscence, and evisceration were relatively uncommon. Blunt-injured patients had a significantly shorter time to their first readmission compared to patients with a penetrating injury. There were no significant differences in the complication rates between patients with a blunt mechanism of injury and those with a penetrating mechanism. However, blunt-injured patients had significantly more readmissions than patients with penetrating injuries. Most (87%) of the patients requiring readmission were managed nonoperatively. Additionally, approximately 84% of patients in our cohort received their initial operation at Level I or Level II trauma centers. There was no significant difference in the rate of any subsequent complications at follow-up admissions by trauma center level designation.

Among the 712 patients with a readmission record, there were 1822 total subsequent admissions (range, 3–74). Despite detailed analysis, no variables were found to be statistically significantly associated with postdischarge complications. During the 1822 subsequent admissions, 206 (11.3%) included a related surgical procedure. However, no variables were found to be associated with the risk of requiring a surgical procedure.

DISCUSSION

In this population-based study, we identified more than 2100 injured patients who underwent SLTL during their index admission. One third of these patients required readmission, and more than 30% were due to a surgical complication. Small-bowel obstruction was the most common cause for readmission followed by incisional hernia and infection. Among those who were readmitted, penetrating mechanism of injury was more common but was associated with a markedly longer time to the first readmission. However, overall, almost 90% of those readmitted were managed nonoperatively.

The outcomes following SLTL described in our study have not been previously evaluated. In contrast, outcomes associated with the index admission after the surgical management of abdominal trauma have been studied in detail. The reported mortality rate during the index admission following traumatic injury requiring laparotomy ranges from 13% to 28%, with studies examining damage-control laparotomy reporting rates at the higher end of this range.[1,2,6,18–21] Using the OSHPD database, we found a similar mortality rate of 13% during the index admission after SLTL. We also found that patients with blunt trauma requiring SLTL had significantly higher rates of mortality than patients with a penetrating mechanism of injury. This finding is likely related to their significantly higher ISS. The higher rates of mortality and injury severity characteristic of our blunt-injured SLTL patients also comports with previously published reports.[1,19,20,22]

Our study is unique in that we were able to identify a significant number of injured patients who required SLTL and had subsequent follow-up during the 8-year study period. There is limited published literature examining complications in traumatically injured patients beyond the index admission. In the largest study to date, Li et al.[18] examined long-term outcomes after trauma laparotomy among 484 patients over an 11-year period. They found that rates of small-bowel obstruction and incisional hernia were significantly higher in patients who underwent surgical management of traumatic injuries compared with patients managed nonoperatively. In their smaller cohort, the authors noted a rate of readmission for small-bowel obstruction (6.6%) similar to that in our cohort (6.0%). However, their overall rate (10.5%) of incisional hernia was higher than ours (4.0%). This may have been due to their inclusion of patients requiring multiple laparotomies during the index admission. Moreover, while Li et al.[18] identified specific mechanisms, they failed to describe differences in the rates of complications between blunt and penetrating mechanism. In our study, we did not identify differences in the rates of complications based on mechanism.

The rates of readmission and small-bowel obstruction in our cohort are also similar to those identified in emergency and elective general surgery studies. In a 10-year study of more than 12,000 patients undergoing open lower abdominal surgery, Parker et al.[23] found the rate of readmission to be 32.6% and the rate of readmission for adhesive small-bowel obstruction to be 7.3%. We found a similar rate of small-bowel obstruction at readmission (6.0%). However, in a more recent study, the same group reported a rate of readmission for adhesive small-bowel obstruction of 13.8%.[9] A meta-analysis of more than 400,000 patients undergoing laparotomy found an overall incidence of small-bowel obstruction of 4.6%.[16] Those findings suggest that our rate of less than 10% likely reflects the true risk of subsequent small-bowel obstruction after SLTL.

The rate of incisional hernia on readmission in our cohort (4.0%) was lower than the rates for elective and nontraumatic emergency laparotomy. Studies conducted among cohorts in those settings have reported rates ranging from 9% to 20% with 1 year of follow-up and up to 23% with 3 years of follow-up.[11,12] The higher rates of incisional hernia identified in their cohorts may be due to more thorough follow-up compared with that in our study, which relied on hospital readmissions to identify complications. The difference may also be related to the older mean age of their cohorts compared to the cohort in our study (64 years vs. 37 years). Age greater than 45 years has previously been shown to be a risk factor for incisional hernia.[24,25]

Our study has limitations. The administrative nature of our data set, which relied on the *ICD-9-CM* coding system, precluded providing a full description of the circumstances of each admission or the patients' specific details including vital signs or laboratory data. Additionally, identification of complications during the 8-year study period relied on readmissions to licensed nonfederal hospitals in the state of California. Thus, our data set did not include data collected at outpatient facilities. Moreover, given the time period described, our patients had varying lengths of follow-up depending on the date of their index admission. We were also unable to evaluate patients who either received treatment and subsequently left the state or received care at federal or unlicensed facilities. Finally, more than 1600 patients were excluded from our study. To focus solely on SLTL, 109 patients were excluded because they required multiple laparotomies during their index hospitalization. Nearly 1500 patients were excluded because of a missing mechanism of injury. These

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patients were eliminated to ensure our cohort truly reflected the population of interest.

In conclusion, patients with SLTL had postinjury morbidity and mortality and more than 30% required readmission. Complication rates for SLTL were comparable to those reported for emergency general surgery procedures. Patients should be educated on the signs and symptoms of the most common complications before discharge following SLTL. Further investigation should focus on the factors associated with the development of these complications.

AUTHORSHIP

J.M.B. conducted the literature search. J.M.B., J.B., R.Y.C., M.J.S., L.E.W., W.J.B., C.E.D., C.B.S., and V.B. designed the study. J.M.B., J.B., and R.Y.C. acquired and analyzed the data. J.M.B., J.B., R.Y.C., M.J.S., L.E.W., W.J.B., C.E.D., C.B.S., and V.B. participated in drafting the article and critically revising it. All authors approved the final version of the manuscript.

DISCLOSURE

The authors declare no conflicts of interest.

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DISCUSSION

ADIL H. HAIDER, M.D., M.P.H. (Boston, Massachusetts): Good afternoon. Come on, you can do better than that – good afternoon. Are we waking up? Alright, great. Good afternoon.

Thank you to the Association for inviting me to discuss this important paper. I say it's important, but it's also very timely, as it's directly responsive to the National Academies of Science, Engineering and Medicine's recent report on developing a national trauma care system to achieve zero preventable deaths.

The report calls for, and I quote, "development of mechanisms for incorporating long-term outcomes like patient-centered outcomes, functional outcomes, and mortality data at one year."

The authors harness the power of California's state-based administrative dataset by using it to study long-term

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outcomes. And they're able to do this as they are able to link individual patient's hospital treatments over time to truly understand what happens to a patient when they get discharged from a hospital.

Their results demonstrate why the National Academies recommends collecting long-term data. A third of patients were readmitted, and a similar third had a complication.

So, I have four questions for you: one is about the cohort; two are about the analytics; and the fourth is more of a philosophical question.

First, about cohorts. You had to exclude about 1,600 patients from a total potential annum of 3,700. Does that impact your analysis? Could you have used some sort of imputation to save nearly 1,400 patients that you had to exclude due to missing this just one variable?

Second, in the analysis you appeared to have dichotomized several variables, leading to some very large groups. For example, for age, you had an above 65 and a below 65 group. That's very broad. You know, there's a big difference between a 20-year-old trauma patient and a 50-year-old trauma patient.

Third, you report an index hospitalization mortality of 13 percent. Can you tell us exactly what kind of patients are dying?

And furthermore, could you link these patients in the OSHPD dataset with the Social Security Index data and figure out which patients actually died after they had been discharged? If you could do that, that would be a true game changer.

And four, and this is my philosophical question, do you think there will ever be a time where we can reliably use these kinds of administrative databases to understand long-term outcomes?

Or, must we be investing in prospectively collecting long-term outcome data, just like the National Academies suggest that we should?

And finally, Dr. Bowie, Jason, from your LinkedIn profile, and from your uniform, I realize that you are in the Navy. Thank you for your very fine presentation, and most of all, your service on the water protecting us – I know you were on the U.S.S. Comstock for two years – and on land, where you are trying to make trauma care better. Thank you for your amazing presentation.

DAVID J. DRIES, M.D. (St. Paul, Minnesota): I would like to thank the authors just for giving us a current statement on the treatment facts associated with single-look trauma laparotomy.

I'm wondering, though, is there any way to distinguish where was the original operation done? Did patients get their follow-up care in a different geography or a different type of hospital?

As we heard earlier today, that could have an implication for what type of follow-up care these patients received. Thank you.

JUAN A. ASENSIO, M.D. (Omaha, Nebraska): Very nicely presented study. I couldn't help but notice that the median ISS in your penetrating injury population was nine, so I would presume that the vast majority of these patients were stab wounds, probably not gunshot wounds.

I also did not see any abdominal vascular injuries.

The question is, if you have the data, and (perhaps you do or don't), could there have been some selectivity in choosing the patients that would have to undergo laparotomy?

Perhaps because a lot of people don't remember history, and the study is old I should refresh people's memory. Dr. Robert Lowe in a seminal publication from Cook County Hospital in 1972; warned us about the effects and complications of negative laparotomies, which I presume in many of your patients these laparotomies were negative.

And then of course, Dr. Gerry Shaftan, one of the great members of this society, in 1960, introduced the concept of selectivity. I look forward to your answers.

ROBERT J. WINCHELL, M.D. (New York, New York): I'm just going to take advantage of holding the pen here. You quoted a 13 percent mortality after trauma laparotomy and then warned us about the dangers of doing trauma laparotomies.

So, how do you know that high mortality is not a reason to think that you or we, collectively, didn't do enough trauma laparotomies, or didn't do them early enough, and maybe we need to be more aggressive instead of less so?

JASON BOWIE, M.D. (San Diego, California): I'd like to thank Dr. Haider for his discussion and all of you for your thoughtful questions.

With respect to the first question regarding patient exclusions, the exclusion of patients with multiple laparotomies during their index admission, We wanted to focus specifically on patients who had a single trauma laparotomy.

The exclusion of the additional 1,500 patients with a missing mechanism was to make sure we had clean data.

There's a chance with this administrative dataset that patients that had an injury during a laparotomy for another indication may have been coded as a traumatic injury code. We could have caught these cases as trauma laparotomies versus just an injury during a procedure, so we excluded those patients intentionally to prevent that from happening.

We didn't find any significant associations when we dichotomized patients into the large groups and generally when you continue to make groups smaller, you find fewer and fewer associations; however, I will discuss the potential of creating additional groups with my co-authors and see if we can identify any additional interesting associations.

With regards to the question of which patients died, as we included in our results, they were the patients with a blunt mechanisms, and higher ISS. As we all would predict, these were patients who were more severely injured.

Pulling the data to include the Social Security numbers and seeing if we can find the patients that are dying as outpatients is a good suggestion. However, it was beyond the scope of this study. It is a very good suggestion for subsequent investigation.

And then finally, I do believe that these administrative databases have a role in understanding long-term patient outcomes. Unfortunately, the granularity that they provide on individual patients during their hospital stays is not the best. However, they do provide valuable information with which we can design concurrent and prospective observational studies.

I think the ideal situation would be combining the two into a single database that we're able to access – that includes the long-term data as well as the granular data that we can get from the local databases.

Dr. Dries, your question on where were the procedures done and where was the follow-up – that was another thing that was beyond the scope of this specific study, but it is possible using this database.

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We are able to identify the trauma designation of the hospitals using the OSHPD database, but that's not something that we did specifically in this study. It would definitely be worth looking at in the future.

Dr. Asensio, the question regarding how many of these patients had a negative laparotomy, is another thing that the database doesn't allow us to pull, but is an excellent question and something that I would love to answer for you in the future.

And, Dr. Winchell, should we be doing more laparotomies? Should the number be lower? Are these patients dying, are the patients in that 13 percent, maybe should they have been operated on earlier or something along those lines? Another thing I can't answer from the data that I have, but another excellent question.

Thank you for your time, and I appreciate the honor of the podium today.

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