A multicenter study on definitive surgery for isolated hip fracture within 24 hours

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INTRODUCTION: Isolated hip fractures (IHFs) in the elderly are high-frequency, life-altering events. Definitive surgery ≤24 hours of admission is associated with improved outcomes. An IHF process management guideline (IHF-PMG) to expedite definitive surgery ≤24 hours was developed for a multihospital network. We report on its feasibility and subsequent patient outcomes.

METHODS: This is a prospective multicenter cohort study, involving 85 levels 1, 2, 3, and 4 trauma centers. Patients with an IHF between 65 and 100 years old were studied. Four cohorts were examined: (1) hospitals that did not implement any PMG, (2) hospitals that used their own PMG, (3) hospitals that partially used the network IHF-PMG, and (4) hospitals that used the network's IHF-PMG. Multivariable logistic regression with reliability adjustment was used to calculate the expected value of observed to expected (O/E) mortality. Statistical significance was defined as $p < 0.05$.

RESULTS: Data on 24,457 IHF were prospectively collected. Following implementation of the IHF-PMG, overall IHF O/E mortality ratios decreased within the hospital network, from 1.13 in 2017 to 0.87 in 2018 and 0.86 in 2019. Hospitals that developed their own IHF-PMG or used the enterprise-wide IHF-PMG had the lowest inpatient O/E mortality at 0.59 and 0.65, respectively.

CONCLUSION: Goal-directed IHF-PMG for definitive surgery ≤24 hours was implemented across a large hospital network. The IHF-PMG was associated with lower inpatient mortality. (*J Trauma Acute Care Surg.* 2021;90: 113–121. Copyright © 2020 American Association for the Surgery of Trauma.)

LEVEL OF EVIDENCE: Therapeutic/ Care management, Level III.

KEY WORDS: Prospective; isolated hip fractures; trauma; elderly; process management guideline.

Falls are the leading mechanism of nonfatal and the second leading cause of fatal traumatic injury in the United States, because of the growing geriatric population.[1,2] One of the most common orthopedic injuries resulting from falls in the elderly is an isolated hip fracture (IHF), accounting for up to 300,000 hospitalizations each year.[3] Isolated hip fractures in geriatric patients lead to significant morbidity and mortality and are often life-altering events.[4] Past evidence suggests and recent statements from orthopedic societies have recommended that these injuries are optimally repaired within 48 hours.[5] Recent studies, however, indicate that surgical stabilization of IHF within 24 hours of admission is associated with lower morbidity and mortality[6,7] or lower hospital length of stay (LOS).[8] Earlier definitive repair is thought to address the patient's pain and immobility, leading to lessened risk for mortality and complications associated with immobilization, such as pneumonia, venous thromboembolic disease, urinary tract infection, decubitus skin lesions, and delirium. However, it is not uncommon for IHF to be delayed for definitive surgery because of medical (particularly cardiac) evaluation, optimization of medical conditions, or availability of operating rooms and surgeons.

An IHF process management guideline (IHF-PMG) was developed for a large multihospital network to achieve the goal of ≥70% definitive surgery in less than 24 hours. Our hypothesis was that the IHF-PMG would improve outcomes for IHF patients.

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PATIENTS AND METHODS

Population and Study Design

This is a prospective multicenter cohort study involving 85 US trauma centers (TCs) from the years 2017 to 2019. Patients between 65 and 100 years old with IHF were included. Patients were excluded if they had any other injuries. Isolated hip fracture was defined as *International Classification of Diseases, Ninth Revision*, 820.xx and *International Classification of Diseases, Ninth Revision*, S72.00xx, S72.01xx, S72.04xx, S72.05xx, S72.09xx, S72.14xx, and S72.2xxx. All participating TCs are part of a single health care system in the United States and use the same electronic medical record software. A comprehensive enterprise-wide IHF-PMG was introduced to the TCs within the hospital system in the first quarter of 2017 (Fig. 1). An integral part of the PMG was to standardize and expedite the decision making regarding the need for further cardiac evaluation. The need for preoperative cardiac workup was assessed by using an electronic medical record order set capable of calculating the Metabolic Equivalent of Task[9] and the Revised Cardiac Risk Index (RCRI) for preoperative risk.[10,11]

Monthly meetings were held to review the IHF-PMG with all TCs interested in implementing this guideline or portions of the guideline. Other TCs with already established IHF-PMGs were encouraged to discuss their unique situations and means of achieving early definitive surgery. While all TCs were encouraged either to have a unique IHF-PMG or adopt the enterprise-wide IHF-PMG, participation was voluntary. To track outcomes, a benchmark was set for all TCs to have at least 70% of all IHF patients receive definitive treatment within 24 hours (defined as time from patient arrival to the hospital, to patient arrival in the operating room). Participating TCs periodically received a global clinical performance report developed for performance improvement. The data were entered into a centralized trauma data set in a secured server within the hospital system's clinical data warehouse and subsequently abstracted as deidentified data. Formal institutional review board approval was obtained for this analysis.

Outcome and Cohort Groups

The primary outcome was inpatient mortality. Secondary outcomes included overall complication rates, hospital LOS,

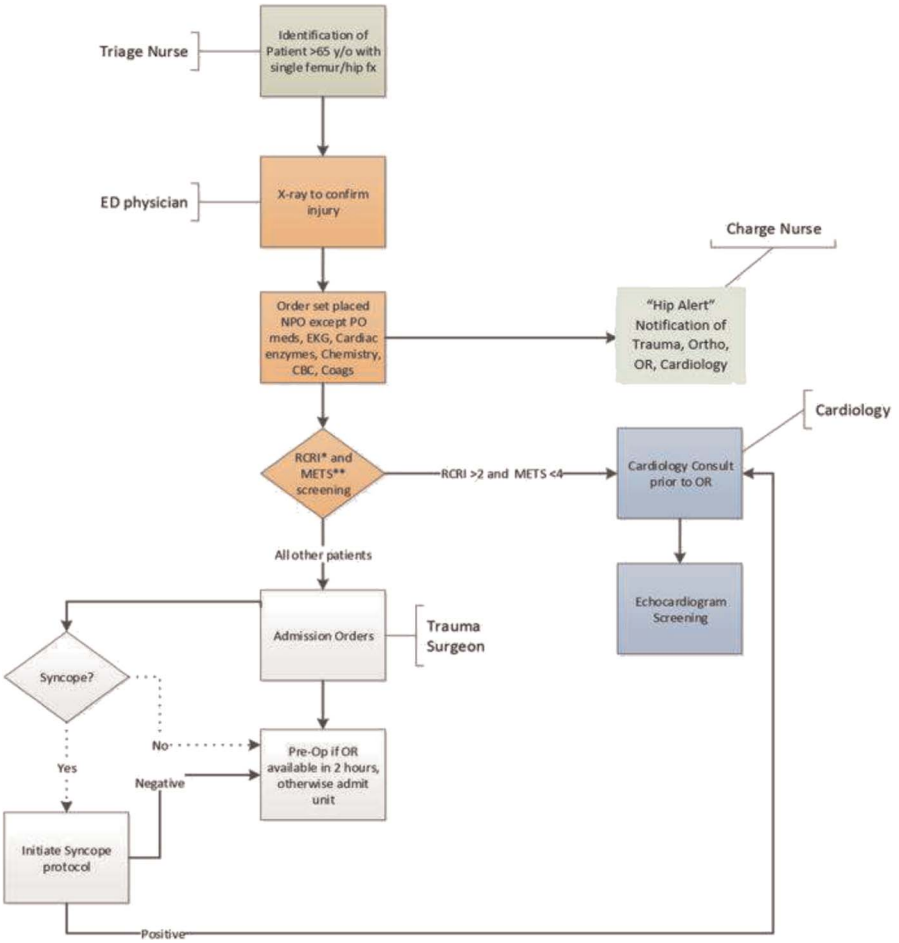

Figure 1. Enterprise-wide IHF-PMG flow diagram.

and individual complications (pneumonia, urinary tract infections, arrhythmias, sepsis, wound infection, cardiac events, deep venous thrombosis, pulmonary embolism, and coagulopathy). Four patient cohorts were examined: (1) group N, patients treated in hospitals that did not implement any PMG; (2) group O, patients treated in hospitals that used their own IHF-PMG; (3) group P, patients treated in hospitals that used partial elements of the enterprise-wide IHF-PMG; and (4) group E, patients treated in hospitals that used the complete enterprise-wide IHF-PMG. Before the study period, no hospital had an existing protocol to expedite IHF repair before 24 hours. One hospital was chosen to pilot the enterprise-wide protocol before dissemination.

Statistical Analysis

All data were analyzed using SAS version 9.4 (SAS Institute Inc., Cary, NC). Normally distributed data expressed as proportions were evaluated by χ^2 tests, and the continuous parametric data were compared using the *t* test. Nonnormally distributed data were evaluated by Fisher exact test for proportions and the Wilcoxon rank sum test for continuous data. Multivariable logistic regression with reliability adjustment was used to calculate the expected value for the observed to expected (O/E) mortality ratio. Confounders were considered for the multivariable risk adjusted analysis if it was reasonable to assume that these variables had an independent effect on mortality in trauma patients. In addition, several variables were chosen if they closely matched the last known Trauma Quality Improvement Process (TQIP) regression model published in 2012 and if they were available in our data set.[12] A total of five variables from the TQIP model were chosen out of the seven variables in our regression model. The final risk-adjusted multivariable regression model for trauma patients included age, sex, race, insurance status, International Classification Injury Severity Score, year (if the analysis was not stratified by year), and comorbidities by the Charlson Comorbidity Index. Instead of adjusting for individual comorbidities as in the TQIP model, we chose to use a validated score such as the Charlson Comorbidity Index and adjusted for year when not comparing or stratifying by year since it was an apparent confounder. At the onset, the regression model also underwent reliability adjustment, using a Bayesian random effects model, to account for sample size variations among the different hospitals through hierarchical regression methods.[13,14] For comparison, the American College of Surgeons' TQIP risk-adjusted benchmarking tool for IHF was used to validate trends in our IHF outcomes (Fig. 2 and Table 5).

RESULTS

Data on 24,457 IHFs were prospectively collected. From 2017 to 2019, there were significant differences in discharge

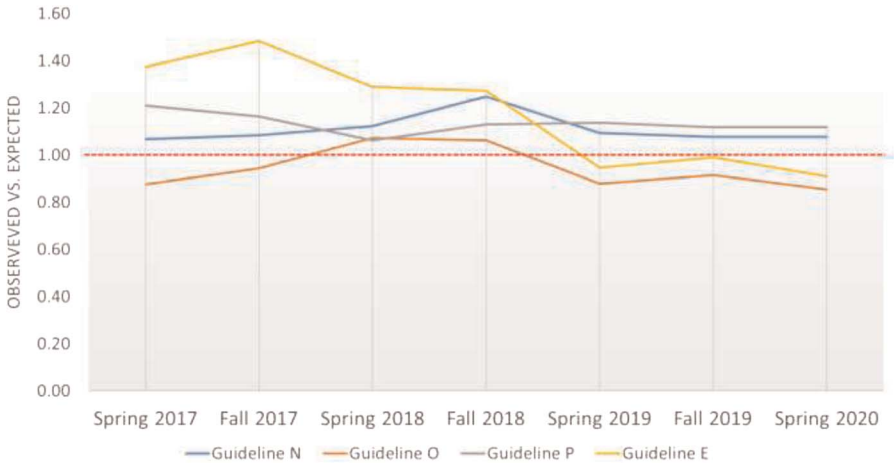

Figure 2. Trauma quality improvement program (TQIP) quarterly risk adjusted mortality observed to expected (O/E) ratios. Guideline N (no IHF-PMG), guideline O (hospital's own IHF-PMG), guideline P (partial IHF-PMG), and guideline E (enterprise level IHF-PMG).

status for the entire treated population (Table 1). In 2019, more patients were discharged home with home health services, and fewer patients were discharged to inpatient rehabilitation facilities, compared with both 2017 and 2018. Over time, more patients were discharged to a skilled nursing facility year to year.

When the data were divided into cohorts by treatment PMG, the largest cohort had IHF patients who did not receive definitive fixation guided by an IHF-PMG (11,298) (Table 2). The next largest cohort had patients who were treated in TC with only partial implementation (group P) of the system-wide

TABLE 1. Sociodemographic Characteristics and Outcomes of IHF Patients From 2017 to 2019

	2017 (n = 8,086)		2018 (n = 9,309)		2019 (n = 7,062)			
	n	%	n	%	n	%	*p*	*p**
Age, y								
65–74	1,876	23.2%	2,113	22.7%	1,659	23.5%	0.47	
75–84	2,849	35.2%	3,488	37.5%	2,661	37.7%	<0.01	
85–100	3,361	41.6%	3,708	39.8%	2,742	38.8%	<0.01	
Sex								
Male	2,372	29.3%	2,880	30.9%	2,205	31.2%	0.02	
Discharge status								
Home or self care (routine discharge)	433	5.4%	496	5.3%	360	5.1%	0.74	
Home under care of organized home health service	1,069	13.2%	1,348	14.5%	1,099	15.6%	<0.01	
Skilled nursing facility with Medicare	4,172	51.6%	4,839	52.0%	3,742	53.0%	0.21	
Inpatient rehabilitation facility	1,736	21.5%	1,918	20.6%	1,364	19.3%	<0.01	
Expired	158	2.0%	142	1.5%	109	1.6%	0.07	
Hospice	213	2.6%	255	2.7%	222	3.1%	0.14	
Others	305	3.8%	311	3.3%	162	2.3%	<0.01	
Overall complications	1,822	22.5%	2,059	22.1%	1,450	20.5%	0.01	<0.01
Pneumonia	270	3.3%	341	3.7%	252	3.6%	0.50	0.66
Urinary tract infection	1,330	16.5%	1,497	16.1%	1,001	14.2%	<0.01	<0.01
Arrhythmias	47	0.6%	45	0.5%	51	0.7%	0.14	0.16
Sepsis	25	0.3%	20	0.2%	20	0.3%	0.46	0.44
Wound infection	17	0.2%	19	0.2%	17	0.2%	0.87	0.90
Cardiac arrest	63	0.8%	52	0.6%	45	0.6%	0.19	0.12
DVT	84	1.0%	115	1.2%	76	1.1%	0.43	0.43
Coagulopathy	66	0.8%	65	0.7%	51	0.7%	0.64	0.58
PE	35	0.4%	55	0.6%	46	0.7%	0.17	0.19
LOS, median (IQR), d	5 (4–7)		5 (3–7)		5 (3–8)		0.10	
LOS, mean (SD), d	6.2 (±4.2)		6.2 (±4.2)		6.2 (±4.3)		0.94	0.34

*Risk adjusted by age, sex, race, insurance status, International Classification Injury Severity Score, Charlson Comorbidity Index, and reliability.
DVT, deep vein thrombosis; IQR, interquartile range; PE, pulmonary embolus.

TABLE 2. Sociodemographic Characteristics and Outcomes Between Patient Cohort Groups Based on Their Hospital's IHF-PMG Status

	Guideline N* (n = 11,298)		Guideline O* (n = 2,221)		Guideline P* (n = 8,834)		Guideline E* (n = 2,104)		
	n	%	n	%	n	%	n	%	*p*
Age, y									
65–74	2,501	22.1%	578	26.0%	2,125	24.1%	444	21.1%	<0.01
75–84	4,184	37.0%	810	36.5%	3,225	36.5%	778	37.0%	0.86
85–100	4,613	40.8%	833	37.5%	3,484	39.4%	878	41.9%	<0.01
Sex									
Male	3,438	30.4%	719	32.4%	2,721	30.8%	578	27.5%	<0.01
Discharge Status									
Home or self care (routine discharge)	562	5.0%	196	8.8%	433	4.9%	98	4.7%	<0.01
Home under care of organized home health service	1,862	16.5%	296	13.3%	1,103	12.5%	255	12.1%	<0.01
Skilled nursing facility with Medicare	5,729	50.7%	1,149	51.7%	4,677	52.9%	1,198	56.9%	<0.01
Inpatient rehabilitation facility	2,290	20.3%	405	18.2%	1,914	21.7%	409	19.4%	0.01
Expired	199	1.8%	26	1.2%	160	1.8%	24	1.3%	0.09
Hospice	307	2.7%	64	2.9%	257	2.9%	62	3.0%	0.84
Others	349	3.1%	85	3.8%	290	3.3%	54	2.6%	0.10
Overall complication	2,561	22.7%	409	18.4%	1,947	22.0%	412	19.7%	<0.01
Pneumonia	387	3.4%	93	4.2%	288	3.3%	387	4.5%	0.01
Urinary tract infection	1,868	16.5%	255	11.5%	1,435	16.2%	269	12.8%	<0.01
Arrhythmias	84	0.7%	9	0.4%	32	0.4%	18	0.9%	0.01
Sepsis	33	0.3%	7	0.3%	19	0.2%	6	0.3%	0.71
Wound Infection	29	0.3%	4	0.2%	17	0.2%	3	0.1%	0.63
Cardiac arrest	75	0.7%	12	0.5%	60	0.7%	13	0.6%	0.90
DVT	131	1.2%	37	1.7%	86	1.0%	21	1.0%	0.04
Coagulopathy	85	0.8%	13	0.6%	64	0.7%	20	1.0%	0.57
PE	59	0.5%	12	0.5%	49	0.6%	16	0.8%	0.61
LOS, d	6.3 (±4.3)		6.1 (±4.6)		6.3 (±4.1)		5.8 (±4.1)		<0.01
LOS, median (IQR), d	5 (3–7)		5 (3–7)		5 (4–8)		5 (3–7)		<0.01

*Guideline N (no IHF-PMG), guideline O (hospital's own IHF-PMG), guideline P (partial IHF-PMG), and guideline E (enterprise level IHF-PMG).
**Risk adjusted by age, sex, race, insurance status, International Classification Injury Severity Score, Charlson Comorbidity Index, year, and reliability.
DVT, deep vein thrombosis; PE, pulmonary embolus.

IHF-PMG (8,834). Discharge status was significantly different between the treatment cohorts. More patients were likely to go home with self-care in group O (hospital's own IHF-PMG), while more patients were likely to go home under home health services among those treated with no guidelines. Following risk adjustment, there was no significant difference in overall complication rates between groups O and E compared with groups N and P ($p = 0.35$). Similarly, after risk adjustment, there was no significant difference in hospital LOS across the groups ($p = 0.99$).

The mortality rate was 1.7% regardless of TC level ($p = 0.93$). The mortality rate compared by low (1–99), medium (100–499), and high (≥500) IHF volumes for the study period was not significantly different (1.9% vs. 1.8% vs. 1.5%, $p = 0.25$). After implementation of the IHF-PMG, IHF mortality decreased within the hospital network, from 2.0% in 2017 to 1.5% in 2018 and 1.6% in 2019 ($p = 0.07$, Table 1). The mortality was lower than expected by 2019, with the risk adjusted O/E over the 3 years at 1.13, 0.87, and 0.86, respectively (Table 3). This trend was also observed in the 2017 to 2019

TABLE 3. Risk Adjusted O/E Mortality With and Without Reliability Adjustment

Year	No. IHF Patients	Observed Mortality	Expected Mortality	Mortality O/E*
2017	8,086	157	138.4	1.13
2018	9,309	142	163.9	0.87
2019	7,062	109	126.2	0.86

*Risk adjusted by age, sex, race, insurance status, International Classification Injury Severity Score, Charlson Comorbidity Index, and reliability.

TABLE 4. Risk Adjusted O/E Mortality of Patient Cohort Groups Based on Their Hospital's IHF-PMG Status

Guidelines	No. IHF Patients	Observed Mortality	Expected Mortality	Mortality O/E*
Guideline N**	11,298	199	196.6	1.01
Guideline O**	2,221	26	44.0	0.59
Guideline P**	8,834	159	151.1	1.05
Guideline E**	2,104	24	36.9	0.65

*Risk adjusted by age, sex, race, socioeconomic status, International Classification Injury Severity Score, Charlson Comorbidity Index, year, reliability.
**Guideline N (no IHF-PMG), guideline O (hospital's own IHF-PMG), guideline P (partial IHF-PMG), and guideline E (enterprise level IHF-PMG).

TABLE 5. Comparing TQIP Versus Study O/E Ratios by Year

	2017		2018		2019	
	TQIP O/E	Study O/E*	TQIP O/E	Study O/E*	TQIP O/E	Study O/E*
Guideline N	1.08	1.38	1.25	0.83	1.08	0.84
Guideline O	0.94	0.63	1.06	0.72	0.92	0.39
Guideline P	1.16	1.11	1.13	1.01	1.12	1.05
Guideline E	1.48	0.59	1.27	0.59	0.99	0.79

*Guideline N (no IHF-PMG), guideline O (hospital's own IHF-PMG), guideline P (partial IHF-PMG), and guideline E (enterprise level IHF-PMG).

**Risk adjusted by age, sex, race, insurance status, International Classification Injury Severity Score, Charlson Comorbidity Index, and reliability.

TQIP reports for IHF. Trauma centers that developed their own IHF-PMG (group O) or used the enterprise-wide IHF-PMG (group E) had the lowest mortality (1.2% and 1.3%, respectively), and those who had no guideline (group N) or used a partial guideline (group P) had a higher mortality rate (both at 1.8%, $p = 0.09$, Table 2). After risk adjustment, group O continued to have the lowest mortality with an O/E ratio of 0.59 (Table 4). The ACS TQIP average O/E ratios by guideline group (Fig. 2) have similar findings seen in Tables 4 and 5. Hospitals who had their own IHF-PMG groups had improved trends in mortality in both TQIP and the study O/E ratios, whereas groups with no or partial guidelines did not, and hospitals who used the hospital guideline improved by TQIP but did not with the study's O/E. By 2019, 70.1% of all TC had met the 24-hour benchmark to definitive care. Of the TCs that did not meet the 24-hour benchmark, most were in group P, accounting for 56%, and next by group N at 25%. Group O had the lowest number of hospitals that failed to reach the 24-hour benchmark at 6.2%, with group E hospitals next at 12.5%. Average time to surgery was less than 24 hours for the IHF guideline groups O and E (22.0 ±16.4 hours and 23.1 ± 16.8 hours) versus the groups N and P without guidelines (24.2 ± 18.8 hours and 25.1 ± 18.3 hours; $p < 0.01$, adjusted $p = 0.83$).

On average, the majority (70%) of patients did not require preoperative medical consultation or additional tests (such as echocardiogram) throughout the 3 years of the study. However, when stratified by PMG cohort, more echocardiograms were ordered in group E (46.3%). But group E had fewest cardiology consultations (0.1%), suggesting that this group preferred to order the echocardiogram over consulting the cardiologist despite the protocol. Most patients who were deemed moderate to high risk were still able to have their definitive operations within 24 hours, even though their postoperative disposition may have led to a higher acuity setting (such as a step down or intensive care unit) (Table 2).

DISCUSSION

While IHFs are relatively low impact injuries in the spectrum of trauma, they represent a significant volume of overall trauma care. Some TCs have reported that IHF can account for up to 20% of admissions and 48% of hospital LOS, while conveying a 38% mortality.[15] The rising prevalence of IHF in the growing geriatric population[16] means that TCs across the country, regardless of level of designation, are faced with a daily decision about how best to manage this population.[17]

The model of care for IHF in this study has the trauma service overseeing injury care from emergency department admission to the definitive operation. This approach was taken because TCs offer a consistent clinical pathway and quality infrastructure for these patients. Timing to definitive care was chosen as the collective goal because it has been shown potentially to improve patient outcome, is easily measured, and is available to all TCs regardless of availability of other specialty resources. The focus on time to definitive care does not diminish the importance of postoperative care. It is also recognized that, while there are many variables that positively influence the clinical outcomes of IHF, such as a large multidisciplinary team with geriatricians and psychologists,[18] not all TCs have access to these limited specialty resources. All TCs, on the other hand, have an opportunity to expedite definitive care through their hospital system. Strategies to expedite care include limiting unnecessary testing, dedicating operating room resources, and obtaining consensus among clinicians for IHF treatment goals. In many cases, this is a culture change for physicians of multiple specialties, as well as operating room staff and administrators.

The results of this study suggest that it is possible to implement a protocol that expedites IHF definitive repair in 24 hours or less in a large health care network of hospitals. The majority of TCs in the IHF-PMG cohort groups were able to achieve the benchmark for definitive surgery within 24 hours. This correlated with expeditious care, as the percentage of IHF receiving definitive surgery within 24 hours progressively increased each year in the hospital system. Similar to other studies,[19] barriers to definitive care were multifactorial and included clinical and system issues. For the study population, three fourths of the patients did not require preoperative medical clearance or additional testing. Using an objective quantitative score based on the Metabolic Equivalent Test (Metabolic Equivalent of Tasks Score) and cardiac risk determination using the RCRI led to twice as many echocardiograms; however, once the goal of 24 hours to surgery was adopted, these tests were obtained expeditiously, and there were fewer cardiologists consulted. While there were lower overall complication rates in both cohorts that used a structured IHF-PMG (cohorts O and E), the echocardiograms did not lead to lower cardiopulmonary complications (Table 2). A reason for this may be that measurements like the RCRI are less accurate in quantifying specific cardiac morbidity and may, instead, be markers for overall chronic morbidities with poor conditioning and limited physiologic reserve.[10]

All the hospitals implementing a comprehensive IHF-PMG developed a multidisciplinary team to address issues related to physician compliance and hospital resources. Each team oversaw the implementation of the IHF-PMG and met regularly with stakeholders at each institution. This process improved physician buy-in across multiple specialties. The hospital system provided a report to each hospital that included individual institutional progress and an enterprise-wide benchmark for specific outcomes, such as timing to definitive surgery. While hospital-based clinical pathways for reduction of hospital LOS and mortality in IHF patients are not new,[20] this is the first study to show that the successful implementation of a clinical pathway can improve IHF patient outcomes in a large hospital system. This was seen not only in our

own risk-adjusted analysis (Table 2) but also in the hospital system's ACS-TQIP report trend over several quarters (Fig. 2).

Our hypothesis was based on the premise that an IHF-PMG would lead to more patients receiving definitive surgery within 24 hours and that this would lead to better patient outcomes. Two groups (O and E) had IHF-PMG that were geared toward achieving this goal, and both groups had risk adjusted O/E mortality ratios below expected at 0.59 and 0.65, respectively. Similar to our enterprise-wide IHF-PMG, many medical societies offer guidelines applicable to all health systems for specific diseases and injuries, including IHF.[5,21] However, our results suggest that PMGs geared toward hospital-specific strengths while addressing hospital-specific weaknesses result in better compliance and outcomes. This offers insight into future regional or national clinical protocol implementation. Hospitals should be encouraged to build their own PMGs based on simple, impactful evidence-based benchmarks. An enterprise-wide PMG, although useful, cannot account for nuances at each hospital that may inhibit progress and efficiency. Stakeholders, resources, and barriers vary from hospital to hospital.

This study has several limitations. Because this is not a prospective randomized intervention trial, we cannot attribute cause and effect to having an IHF-PMG for IHF definitive care within 24 hours. Rather, the results of this study suggest that there is a strong association between hospital and enterprise specific IHF-PMGs and lower mortality. Risk-adjusted complication rates and LOS were not significant between groups using complete guidelines and those that did not. We also cannot comment on the adherence to guidelines, particularly for the hospital-derived guide groups. We used the 24-hour benchmark as a proxy of successful implementation of the guideline. However, future studies of the time to definitive surgery should use benchmarks of protocol adherence to determine which protocol elements have the greatest impact. Although the large sample size allowed us to find significance between PMG groups, some of these differences were small and may not be clinically significant. This study involved voluntary and variable participation, rather than randomization with a mandated standard protocol. Thus, the results may be subject to bias, which may be unaccounted in our regression models. Our statistical model differs from that of the ACS-TQIP risk-adjusted model because the current TQIP statistical model is not publicly available, and we were only able to use variables that were available within our data set. Because of the differences in selection criteria for our risk-adjusted model, there is variation in the estimation of hospital mortality.[22] Our model tended to overestimate the risk of mortality, which is evident in some O/E ratios being less than one for the four guideline groups when stratifying by year. While we cannot directly compare the TQIP O/E ratios to the study's O/E ratios, it did not affect our conclusion that the IHF-PMG groups had a lower standardized mortality ratio compared with those who had partial or no guidelines. This was further supported by the TQIP model, which showed that the groups with IHF protocols decreased their mortality over time compared with those that did not (Fig. 2). Finally, while this study may represent practice patterns within the United States, the enterprise-wide IHF PMG may not be feasible for all TCs because of logistical constraints and clinical issues. Based on our results, the best IHF-PMG will be adapted or specific to each hospital.

CONCLUSIONS

The implementation of an IHF process management guideline in a large nationwide hospital network was associated with lower inpatient mortality. Hospital-specific IHF-PMGs achieved the best results.

AUTHORSHIP

D.A., J.A., M.Z., and G.M. contributed in the study design. G.M., M.D., H.L., and J.N. contributed in the data acquisition. D.A., J.A., M.Z., J.A., P.O., M.M., D.P., S.F., E.G., and H.L. contributed in the and analysis and interpretation. D.A., J.A., M.Z., J.A., P.O., M.M., D.P., S.F., E.G., H.L., M.D., G.M., J.N., R.N., and M.C. contributed in the drafting. D.A., J.A., M.Z., J.A., P.O., M.M., D.P., S.F., E.G., H.L., M.D., G.M., J.N., R.N., and M.C. contributed in the critical revision.

DISCLOSURE

The authors declare no conflicts of interest.

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DISCUSSION

ALICIA MANGRAM, M.D. (Phoenix, Arizona): Hi, everybody. I don't know if it's "good morning" or "good afternoon."

So, Dr. Ang, nice paper. Nicely presented. Thank you for letting me have the paper in advance because I know nothing about what I'm doing on this computer.

But, you know, you talked about – you know you presented this multicenter study on definitive surgery for isolated hip fractures. And, as you know and I know and Clay knows and everybody else listening knows, we really didn't think isolated hip fractures had anything to do with trauma.

As weird as it may seem, we, you know, you could fall and break your hip and that's not trauma because trauma, if we didn't operate, it wasn't trauma. We've all changed a lot. I hope we're still changing.

And I hope we know that – you know, if my mother or me, if I fall and break my hip I'm a trauma patient. I'm not coming in for my high blood pressure or my diabetes or nothing else; I've been in a traumatic event. So, again, I'm going to always express that as much as I can to the world because I think we get confused.

So the main question addressed in this paper is whether isolated hip fractures process management guidelines improve overall outcomes for the isolated hip fracture patient.

The isolated hip PMG, which is our process management guideline, the goal is to achieve definitive surgery within 24 hours, which I think is amazing and great, for 70 percent or more of the patients with isolated hip fractures.

This proposal is built on emerging new findings regarding the 24-hour benchmark and contrasts sort of what is, that whole current process that if we get them to definitive surgery within 48 hours we're doing a good job.

So we're always pushing ourselves, which is great, because 48 hours is not good for me to lay there with my isolated hip fractures. Twenty-four hours really isn't good but I'll take it.

The 48-hour criteria was recommended by orthopedic societies, so the orthopedic surgeons; therefore, this manuscript here sort of acknowledges or they want to acknowledge 24- versus 48-hours.

The multicenter study methodology used as the authors was systematic, it was a robust study, all those things I agree with. And it used four independent cohorts, et cetera, et cetera.

There is a lot of strengths in this study, sufficient data involving 24-hours. You have 457 patients, prospective design, et cetera, et cetera.

So first question, how was a partial PMG defined? And why did the authors leave out the important finding that isolated hip fracture/PMG was associated with lower complication rates from the conclusion of the study.

And, secondly, traditionally, clinical guidelines, protocols, clinical pathways statements are formulated based on expert opinion, on consensus by professional societies.

Because a randomized controlled trial is the gold standard for safety and efficacy concerns do the authors plan to conduct – you know what we want to know – a randomized, controlled trial as a follow up?

Great job. I'm sorry about all this technical stuff. I wish I could be there.

DARWIN ANG, M.D., Ph.D., M.P.H. (Ocala, Florida): Thank you, Dr. Burlew and Dr. Mangram for reviewing the manuscript and allowing me the privilege of the podium at the AAST.

Dr. Mangram, I want to thank you, specifically, for starting the G-60 program which laid a lot of the groundwork for what we are doing today. So this is really an extension of what you started back in 2009.

Let me answer your first question, "What was the partial PMG and why we defined it that way?" Well, those are the people that kind of "half-way" did it, if you know what I mean. They didn't really follow through and they did not have a formal process.

And when we asked them, "put it down on paper what you are going to do" their answer was always like, well, we took the echo part or – but we didn't do the overhead alert part and things like that. In short, they didn't have a formal written process.

They were in the category that didn't fit in with the other well-defined categories. They behaved more like the no process management guideline group.

The other question was, "why we didn't emphasize the complication differences?". Well, that's because those differences were very small and did not likely have clinical significance. You may have seen this mentioned as a limitation in the manuscript. After our regression model analysis, some of those differences basically went away.

To your third question about whether or not a randomized, controlled study should be warranted, I absolutely think this would be a great way for all of us to collaborate, particularly the trauma centers that are geriatric patient heavy.

Hopefully, this prospective cohort study lends some credence towards looking at a prospective randomized trial in the near future.

CARL J. HAUSER, M.D. (Boston, MA): Repair of a hip fracture can mean a lot of things from simple nailing to redo hip replacement. Were changes seen in the so-called "definitive" operations performed as your protocol was enforced?

STANLEY OKOSUN, M.D. (Scottsdale, Arizona): What problems did you encounter working with the orthopaedic group to achieve surgery within 24 hours?

PASCAL O. UDEKWU, M.D., M.B.A., M.B.B.S. (Raleigh, North Carolina): Anecdotally, many patients with hip fracture repair have care limited or withdrawn by their families.

Pressing for repair within 24 hours limits the ability of the system to fully integrate frailty and long-term expectations. What are your thoughts?

DARWIN ANG, M.D., Ph.D., M.P.H. (Ocala, Florida): Thank you, these are great questions. To answer the first question, we defined hip fracture as primarily limited to the femur and not involving the pelvis. So complete hip replacements were not part of the study. Our study population was limited to femoral head and neck, trochanter and subtrochanteric fractures, all which are relatively straightforward. Because of this, there were no changes to the operative treatment to these fractures, even with the 24 hour benchmark goal.

Just to emphasize how standard and global these operations were, we examined mortality rates between different levels of trauma centers as well as mortality rates based on volume.

We showed in our analysis that there were no significant differences in mortality, in either the the level of trauma center or the volume of isolated hip fracture operations performed. This suggested that these are relatively low-complexity surgeries.

I feel that the second question is the million dollar question: "So how do you get the orthopaedic surgery group to agree with a 24-hour benchmark when their primary group basically says 48 hours or less?" That, admittedly, was a challenge. And that's probably why we had a lot more "no participation" than "participation."

The orthopaedic surgeons who we won over, acknowledged that there was a good body of evidence supporting the 24-hour benchmark for definitive surgery for these injuries.

In addition, similar to Dr. Mangram in her G-60 initiative, we approached it in a collaborative and multidisciplinary fashion including them in our planning. In the end, we partnered up with a good number of orthopaedic surgeons who supported that culture and as a result, other orthopedic surgeons were influenced by that as well.

The other thing that really helped was having the operating room available for rapid access to repair these fractures. All surgeons like to operate and this was an obvious incentive.

We also found that the TQIP data helped to motivate not only the trauma service, but it also showed the orthopedic surgeons how everyone else in the country was doing. Basically, according to TQIP, the median time to surgery for most trauma centers was less than 24 hours. So if everyone else was achieving this, so could we.

For my group of orthopedic surgeons, it was the population based study from Canada that provided the strongest data. This was the study, where they treated time was a continuum and showed that the 24-hour benchmark was not arbitrary. It just happened to be at the inflection point. This was one of the biggest misconceptions that we could clarify for them.

Finally, the third question: "Are we rushing these patients to surgery with the risk of missing frailty and long-term expectations?" Personally, I don't think so. One day should be plenty of time to assess a patient's frailty and have meaningful discussions with them and their families about post-operative expectations as well as non-operative alternatives. We do know that the longer we wait, the higher the risk of adverse outcomes and I don't think either the patient or families would want that. Instead, if their wish was to not go through surgery they would want to expedite their discharge from the hospital to their next destination whether it is a rehab or home with hospice. If they decided on surgery, they would want to have it done sooner to relieve their pain and immobility.

In our experience, most geriatric patients are very independent. If they survived their co-morbidities they usually wanted the same type of care younger patients received. For those who were infirmed or required a proxy to make decisions for them, we simply followed their living will or the decisions of their health care power of attorney.