Journal of Pediatric Surgery 56 (2021) 385–389

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

journal homepage: www.elsevier.com/locate/jpedsurg

Pediatric trauma telemedicine in a rural state: Lessons learned from a 1-year experience

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ARTICLE INFO

Article history:
Received 12 October 2020
Accepted 20 October 2020

Key words:
Interfacility transfer
Traumatic brain injury
Telehealth
Teletrauma

ABSTRACT

Background: Previous research from our center has shown that 27% of the pediatric trauma transfers from referring facilities are potentially preventable. Our hospital is the only level 1 pediatric trauma center (PTC) in our state, and we are developing a pediatric trauma telehealth network to help keep certain injured children closer to home. We instituted a pediatric trauma telehealth program with a partnering community-based hospital in our state and aim to report our experience over the first year.
Methods: All pediatric trauma patients that presented to our partnering hospital from January 2019 to February 2020 were reviewed. Disposition was: a) telehealth consultation, b) admission to the children's unit without a telehealth consultation per our head trauma protocol, or c) transfer without telehealth consultation. Data on demographics, hospital course, and disposition were collected via chart review.
Results: Eight patients underwent telehealth consults and another 8 patients were admitted to the partnering hospital's children's unit based on the head trauma protocol without a telehealth consult. Patient's ages ranged from 7 months to 15 years. Of the patients that underwent telehealth consult, 7 presented with a head injury and 1 presented with a rib fracture/small pneumothorax. The patient with a pneumothorax was observed for 6 h and discharged home after a repeat chest x-ray was stable. All 15 patients with head injuries were observed and discharged from either the emergency department or children's unit after passing concussion testing. No patients required transfer to our PTC after observation, and none were readmitted. Fifty-six patients were transferred without telehealth consultation, and 3 of these patients could potentially have avoided transfer with a telehealth consultation.
Conclusions: Telehealth in pediatric trauma can be a safe mechanism for preventing the transfer of patients that can be safely observed at a partnering hospital. From a facility that transfers an average of 30 trauma patients per year to our hospital, this program prevented 16 such transfers. Development of a head trauma protocol in collaboration with a pediatric neurosurgeon leads to an unexpected number of patients being admitted to the partnering hospital for observation without utilization of a telehealth consultation.
Type of study: Retrospective study.
Level of evidence: III

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Trauma is the leading cause of mortality in children and adolescents, and children treated at designated pediatric trauma centers have a 1.7–6.7 times decreased odds of mortality as compared to those treated at a non-pediatric trauma center [1–3]. However, in theory, 30% of injured children are unable to be transported to a pediatric trauma center within an hour of injury [4]. In reality, only 20–30% of pediatric trauma patients are treated at pediatric trauma centers [1,2].

Especially in more rural regions and with regionalization of healthcare becoming the reality, telemedicine is increasingly playing a role in making sure patients are treated at the appropriate level of care. While telemedicine is often used in non-emergent settings, such as primary care, it has also been utilized in trauma to assist with the immediate treatment of traumatically injured patients, including in making resuscitation decision and performing life-saving procedures [5,6]. Further, telemedicine can improve the suitability of transfers to a trauma center and allow for appropriate patients to stay close to their home [7].

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https://doi.org/10.1016/j.jpedsurg.2020.10.020
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In Utah, specifically, injured children have a higher mortality compared to children in the US as a whole. However, if a child is transferred to our pediatric trauma center, the only level 1 pediatric trauma center in our state, the risk of death decreases to the national average [8]. Contrarily, Fenton et al. previously demonstrated that 27% of the pediatric trauma transfers to our level 1 pediatric trauma center were potentially preventable [9]. Clearly, there is room for improvement in making sure the right patients are treated in the appropriate setting. Our pediatric trauma center developed a trauma telemedicine program in conjunction with a partnering hospital in Utah in January 2019. We aim to describe our 1-year experience with this trauma telemedicine program.

1. Methods

A retrospective review of all pediatric trauma patients that presented to our partnering hospital from January 2019 to February 2020 was performed. Demographic data, hospital course, and disposition information were abstracted from the medical record. Disposition from our partnering hospital fell into one of three possible categories: a) telehealth consultation, b) admission to the children's unit without a telehealth consultation per our head trauma protocol, or c) transfer without telehealth consultation.

The process of performing a pediatric trauma telemedicine consult starts with the emergency medicine physician at the partnering hospital using an application on a mobile phone or on the computer to send a request for consultation. This message is routed to the pediatric trauma advanced practice provider (APP) smart phone, and the APP returns the call within 5 min to schedule a video conference within 15–20 min. The APP and pediatric trauma surgeon then use video conferencing software to obtain a history from the parent and patient, examine the patient with the local team, and view pertinent imaging and labs. Finally, the pediatric trauma team gives their recommendation with regards to treatment and disposition including transfer to our PTC, if appropriate.

All pediatric trauma patients that are stable and that the emergency department physician and hospitalist feel are safe to potentially stay at the referring hospital are eligible for telehealth consultation. In addition, a head trauma protocol was created in collaboration with a pediatric neurosurgeon to assist emergency medicine physicians at the partnering hospital in decision-making regarding disposition of head-injured children (Fig. 1). Based on this protocol, patients could be transferred from or admitted to the partnering hospital without telehealth consultation.

A review of all trauma patients that presented to our partnering hospital was performed monthly. At this meeting, an emergency department physician and pediatric hospitalist at the partnering hospital and a pediatric trauma surgeon from our PTC review the transferred patients in order to determine which patients that were transferred without telehealth consultation may have been able to stay at the partnering hospital had telehealth consultation been performed. In addition, this meeting was a forum at which any issues with the telehealth consultation process could be discussed and resolved.

2. Results

Eight patients underwent telehealth consults during the study period. Patient ages ranged from 7-months-old to 15-years-old. All patients remained at the partnering hospital after consult. Seven of these patients presented with a head injury. Three of these patients had small, non-depressed skull fractures, 2 had small brain contusions, and 2 had normal head CT scans. All of these patients were observed and

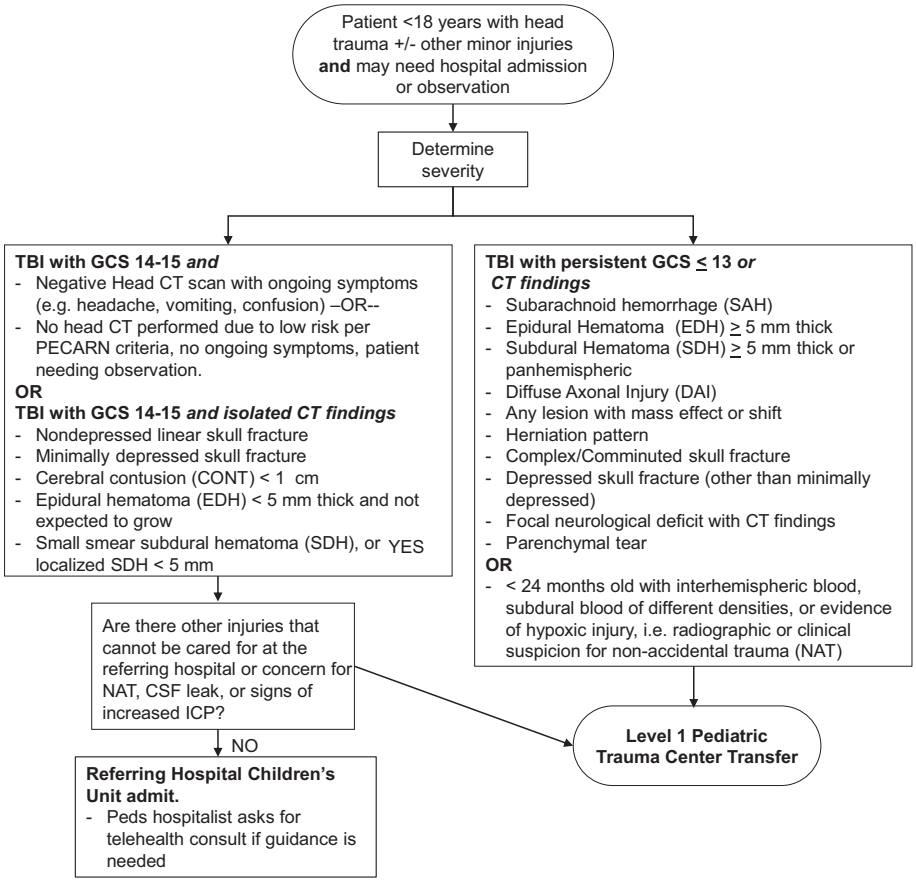

Fig. 1. Pediatric traumatic brain injury protocol to help guide disposition of patients using a pediatric trauma telemedicine program.

discharged from either the emergency department of the children's unit after passing concussion testing. The final patient was a 15-year-old female, who presented with a rib fracture and small pneumothorax. She was maintaining adequate pulse oximetry saturations on room air. After telehealth consult, she was observed for 6 h and discharged home after a repeat chest x-ray was stable. No patients required transfer to our PTC after observation, and none were readmitted.

Eight additional patients were admitted to the partnering hospital's children's unit based on the head trauma protocol without a telehealth consult. Patient's ages ranged from 9-months-old to 15-years-old. Five of these patients had small, non-depressed skull fractures, and 2 had normal head CT scans. All of these patients were observed and discharged from either the emergency department or children's unit after passing concussion testing. No patients required transfer to our PTC after observation, and none were readmitted.

Fifty-six patients were transferred without telehealth consultation, and 3 of these patients could potentially have avoided transfer with a telehealth consultation. One patient was a 7-year-old male who presented after blunt head trauma with a GCS of 14, multiple episodes of emesis, and no reported loss of consciousness. A head CT was negative for injury. He was subsequently transferred to our PTC and was discharged 14 h after admission with no additional treatment or labs. The second patient was an 8-year-old female who presented with blunt abdominal and chest trauma with abdominal pain. Her liver function tests were mildly elevated, but CT of the abdomen was normal. She did not have any other abdominal symptoms including vomiting or intolerance of oral intake. A chest x-ray demonstrated a possible small pulmonary contusion, but she continued to maintain appropriate pulse oximeter saturations on room air. She was discharged from the emergency department at our PTC 2 h after transfer. The third patient was a 16-year-old male with blunt chest trauma, who was identified to have a pulmonary contusion on CT scan of the chest. He did have one episode of hemoptysis shortly after the trauma occurred, but this subsequently resolved. He maintained adequate pulse oximetry saturations on room air. He was discharged from our PTC 12 h after transfer without any additional treatment.

3. Discussion

We report our 1-year experience with a pediatric trauma telemedicine program with a partnering hospital. Many benefits of this program were realized of the course of this year including reducing transfers, improving the experience for the patient and family, and forming a working relationship with the providers at the partnering hospital. In addition, many lessons were learned from this experience such as the need for a physician "champion" at the partnering hospital and the need for consistent education of the partnering hospital's physicians, nurses, and staff responsible for the function of telemedicine.

Through this program, we were able to safely keep these 16 patients at our partnering hospital. From a system standpoint, prevention of these transfers improves the efficiency of the healthcare system and decreases the cost of care for both the system and the patient. Fenton et al. previously calculated the cost of a transfer to our PTC that may have been preventable to be an average of more than $5000 [9]. Prevention of these charges offloads the healthcare system and, potentially, eliminates significant financial strain on the family.

An unintended benefit of our telemedicine program was the education of the emergency medicine providers on pediatric traumatic brain injury treatment using the head trauma protocol we developed for the program. Prior to implementation of this partnership, minor traumatic brain injuries were being transferred to our PTC only to be discharged less than a day later after a brief period of observation. While we anticipated these unnecessary transfers would decrease using telemedicine, we discovered that physicians at our partnering hospital became increasingly comfortable admitting head-injured patients utilizing the protocol without actually performing a telemedicine consult. This comfort was rooted in the fact that these physicians knew they could contact the physicians at our PTC without any hesitation if they had any questions in the care of these patients.

Further, unnecessary transfers are not only financially taxing to a patient's family but can also be emotionally taxing. Transfer to a hospital that is distant from home can significantly limit the social support a patient or guardian has available [10]. Additionally, while parents will obviously have their children transferred if necessary, our telemedicine program allowed them access to speak to a pediatric trauma expert without traveling far from home, which has been shown to help reassure parents of sick and injured children [10]. Finally, this program was shown to be a safe means of keeping injured children close to home if possible. Of the 16 children that remained at our partnering hospital due to telemedicine or to our head injury protocol, none required subsequent transfer to our PTC and none were readmitted after being discharged.

Moreover, this program allowed us to develop a great working relationship with the emergency medicine and pediatric physicians at our partnering hospital. Prior to implementation of this program, there was minimal communication between the physicians at our two institutions. After development of the telemedicine program, the amount of communication increased significantly. Physicians at our partnering hospital developed an understanding that they could reach out to the physicians at our PTC at any time and for any reason, and this communication helped elevate the level of pediatric trauma care delivered.

Through this process, we discovered the importance of having a "champion" of the telemedicine program at our partnering hospital. At our partnering hospital, we had two champions: an emergency medicine physician and a pediatric hospitalist. In the emergency department, our physician champion helped constantly remind his fellow emergency medicine physicians that this program was available and should be utilized. Our partnering hospital has a high-volume emergency department with a lot of providers, and, without sustained prompting to utilize our telemedicine program, many of these physicians may not know or remember to take advantage of this program. Our pediatric hospitalist champion played an important role in ensuring both his fellow pediatric hospitalists and the pediatric nurses were comfortable in taking care of these patients and knowing what signs and symptoms to monitor for that may suggest need to escalate to a higher level of care. The necessity of a champion at the partnering hospital in a telemedicine relationship has been demonstrated in other telemedicine programs as well [11,12].

We also learned that frequent education of partnering hospital's physicians, nurses, and staff responsible for the function of telemedicine is vital to the success of the program. This included monthly educational "technology checks" to ensure those involved at both facilities know how to operate the telemedicine apparatus. We also performed monthly meetings to discuss the previous month's trauma cases to determine how we could improve the process and which cases may have benefitted from telemedicine. We held quarterly educational conferences to provide education to nurses and providers about care of a pediatric trauma patient including signs and symptoms to monitor for in a worsening patient and discharge needs such as follow-up in a concussion clinic for patients with TBI.

Finally, as this program is still in its infancy, defining patients that are appropriate for telehealth and treatment at the referring hospital is a moving target. Protocols, such as the head trauma protocol discussed above, are a useful starting point for development of a trauma telehealth program because they suggest a defined patient population that would benefit from telehealth consultation. Taking the subjectivity out of the process helps referring physicians that are not specialized in pediatric trauma care feel comfortable utilizing the program, especially in the beginning of program development. Because of this, we are working to develop further protocols for other patient populations and have recently rolled out a solid organ injury protocol for utilization with our partnering hospital (Fig. 2). However, we noticed during the first year

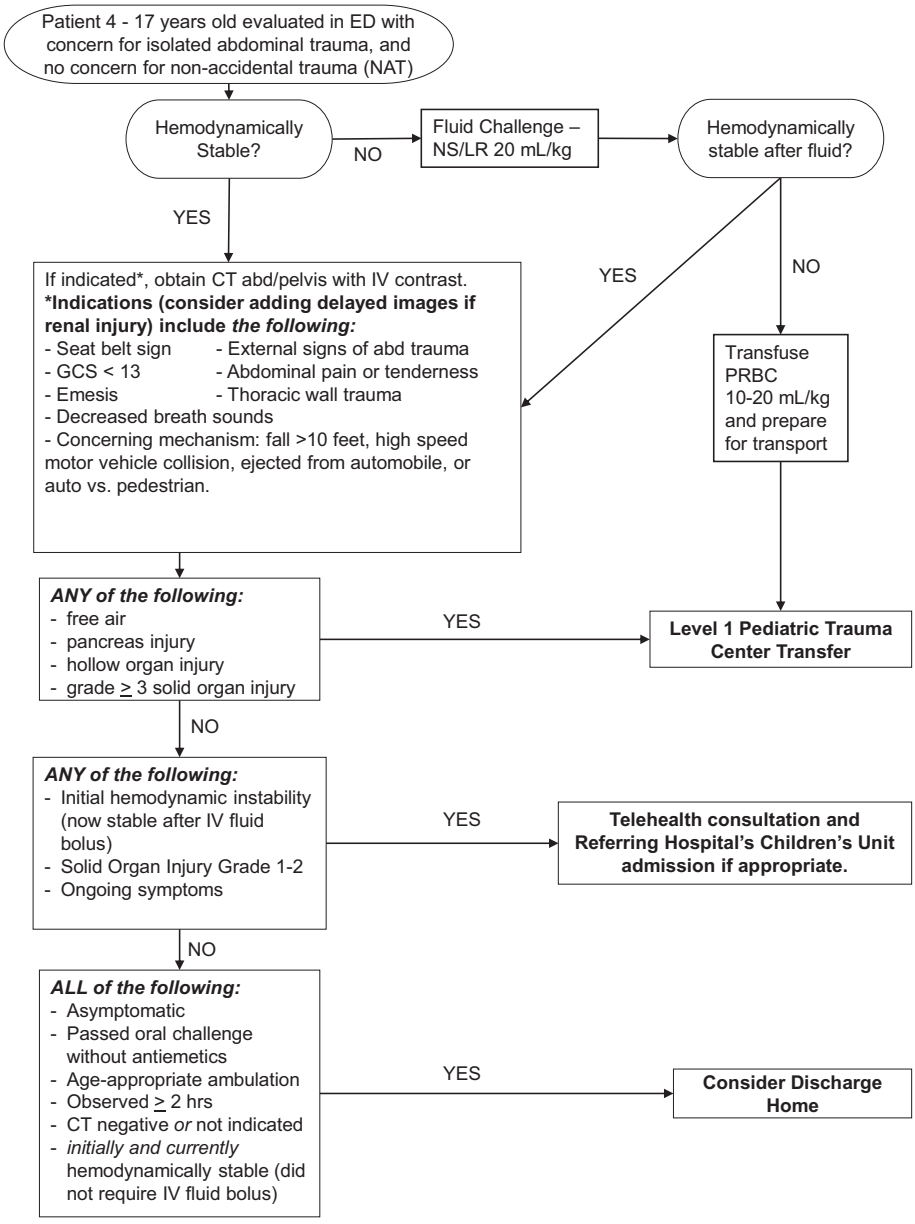

Fig. 2. Pediatric solid organ injury protocol to help guide disposition of patients using a pediatric trauma telemedicine program.

of this program that, as the relationship between the physicians at each hospital matured, the referring physicians became more comfortable calling about patients outside of the established protocol that they felt may be appropriate for observation at the referring hospital's children's unit. The development of this relationship was a surprising and encouraging finding and reinforced the importance for flexibility in criteria for telehealth consultation.

This study is limited by the single center design. While we have learned many lessons from our experience, these may not be applicable for a telemedicine program in a different setting. Further, these lessons are anecdotal. Survey methodology may have helped uncover other benefits of the program or lessons learned or differing opinions on the telemedicine program.

4. Conclusion

Telemedicine in pediatric trauma prevented the transfer of patients that could be safely observed at a partnering hospital. Development of a head trauma protocol in collaboration with a pediatric neurosurgeon lead to an unexpected number of patients being admitted to the partnering hospital for observation without utilization of a telehealth consultation. A champion of the program and frequent education at the partnering hospital are vital to the success of our pediatric trauma telemedicine program.

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