Diagnosis of depression in adolescents following traumatic fracture:

A retrospective review

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Abstract:

Background

Despite the fact that physical injury is the leading cause of death and disability in youth, research on the impact of physical trauma on child and adolescent mental health is inconclusive with reported rates of post-injury depression ranging from 7 to 41%. In the current study, we sought to further clarify the risk of co-morbid depression in youth following traumatic fracture.

Method

Using the University of Virginia (UVA) Clinical Data Repository (CDR), we generated a patient population of 1121 adolescents, aged 12 to 19, who were hospitalized overnight for fracture(s) between 2000 and 2009. We retrospectively determined the number of these adolescents who received a new diagnosis of depression at UVA within the first year following their injury.

Results

By the end of the first year, 37/913 adolescents (4.1%) who had at least one follow-up visit at our institute after their fracture were diagnosed with depression. When patients with a concomitant spinal cord injury and those with a facial/skull fracture with or without an associated brain injury were excluded, this percentage dropped to 3.2% and 1.1%, respectively.

Conclusions

The results support our initial hypothesis that the percentage of adolescents diagnosed with depression following a traumatic fracture, determined retrospectively, would be lower than those previously reported in related prospective studies. We discuss some difficulties encountered with regard to the diagnosis of depression in this age group, several possible explanations for our findings and the clinical indications for further research.
**Introduction:**

According to the World Health Organization, major depressive disorder is the leading cause of disability among Americans age 15 to 44. Lower educational attainment, substance abuse and an increased risk of suicide are just a few of the numerous and well-documented adverse consequences of depression.\(^1\) An estimated 11\% of adolescents have a depressive disorder by age 18\(^6\) and depression in youth often recurs, persists into adulthood and is associated with more severe illness in adult life.\(^7\) It is therefore critical to identify populations of youth who are at an increased risk for depression in order to facilitate prevention, early diagnosis and treatment.

Several studies suggest that children and adolescents who experience a traumatic, physical injury may be at an increased risk for depression and other psychiatric disorders.\(^8\)-\(^17\) Reported rates of post-injury depression are highly variable ranging from 7 to 41\% in children and adolescents following different types of traumatic physical injury.\(^8, 12, 14-16\) These rates appear alarmingly high when compared to the yearly prevalence of depression in the general population of children and adolescents - estimated to be 4.3\% in 9 to 17 year olds and 9\% in 12 to 17 year olds\(^18, 19\) and are of particular concern in light of the fact that physical injury has been identified as the leading cause of death and disability in youth aged 1 to 19.\(^20\) Although fractures are the most common type of serious physical injury in youth,\(^21\) only a handful of published studies have focused on the psychiatric consequences of traumatic fracture in this population\(^22-25\) and no studies to date have looked specifically at post-fracture depression in youth.

To our knowledge, this study is the first to retrospectively assess the frequency with which adolescents are clinically diagnosed with depression following hospitalization for traumatic fracture(s). We anticipated that our retrospective approach would yield lower rates of depression compared to those previously reported in prospective studies and hypothesized that depression would probably be less common among adolescents whose injuries were primarily limited to fracture(s) of the appendicular
skeleton, vertebral column and/or thoracic cage, compared to those sustaining concomitant spinal cord and/or brain injuries and those suffering from facial/skull fractures.
Methods:

We performed a retrospective analysis using the Clinical Data Repository (CDR) of the University of Virginia Health System to determine the percentage of adolescents aged 12 to 19 years diagnosed with clinical depression after a traumatic fracture. The CDR is an enterprise-wide data warehouse located and managed by the Division of Clinical Informatics in the Department of Health Evaluation Sciences of the UVA School of Medicine.\textsuperscript{26,27} It contains over ten years of data from patients seen at the University of Virginia Health System, providing researchers and clinicians with direct access to detailed, flexible and rapid retrospective views of clinical, administrative and financial patient data. These data include patient demographics, inpatient and outpatient visit details, diagnoses, procedures, laboratory results, inpatient medications, financial transactions, attending physician(s), payers, costs, charges, and reimbursement.

The CDR supports HIPAA-compliant data de-identification for research and educational purposes. The CDR can be accessed directly through a custom-developed web-based interface that allows flexible query creation and a wide selection of canned and custom reports. The CDR extracts and links data from several UVA clinical and administrative computer systems and is enriched with clinical details from additional internal and external sources, including the Virginia Department of Health death certificate data. All data was de-identified and aggregated. No information accessed or reported could be used to identify any patient individually. In consultation with members of the UVA IRB, our study was determined to meet criteria for non-human subjects research and was therefore exempt from formal review.

We began our database search by generating a population of adolescents aged 12 to 19 who experienced traumatic fracture(s) from the beginning of 2000 to the end of 2009. Fractures of the skull and face, hip, ribs, sternum, vertebral column and upper and lower limbs were among those included. For a complete listing of all ICD-9 codes for fracture included in our initial database search, please see
Appendix F-1. In order to exclude very minor fractures which would be unlikely to cause significant trauma, we only included adolescents whose fracture(s) resulted in inpatient hospitalization with a length of stay (LOS) > 1 day. To avoid duplicating patients in the parent population who may have been admitted for the same fracture(s) and/or additional fracture(s) resulting from separate incidents of trauma occurring within the ten year study period, we only considered the first fracture admission for each patient. We were unable to consistently differentiate between patients who experienced multiple fractures versus a single fracture, one limitation of our study. We derived sub-populations of patients by excluding those who experienced a spinal cord injury (Appendix F-2) and/or facial or skull fracture(s) with or without resultant brain injury (Appendix F-3).

Further, we identified and excluded patients in our fracture populations who had a depressive diagnosis appearing in their chart at the time of their hospital admission. It was not possible to determine which of these diagnoses were past, recent or current using the de-identified CDR data. A patient with a diagnosis of depression, whether past or current, appearing in his or her chart on admission would be counted in the number of patients with a “post-injury” depressive diagnosis (whether or not the diagnosis was made after their injury). Therefore, we decided to exclude these patients in order to increase the chances that any depressive diagnosis identified by the CDR search of patient records from visits that occurred after each patient's fracture hospitalization would represent a depressive diagnosis made at UVA in the post-injury period.

A retrospective review of patient chart information available electronically in the CDR was used to generate the number of adolescents diagnosed with depression at UVA during specific time intervals following each patient's traumatic fracture. Diagnoses of major, atypical and neurotic depression as well as depression not elsewhere classified (NEC) were among those included in our search. For a complete listing of ICD-9 codes that were included, please see Appendix D. We report the numbers of adolescents diagnosed with depression during specific time intervals following traumatic
fracture as percentages of the total number of adolescents seen in follow-up during those time intervals at UVA after hospitalization for traumatic fracture.
Results:

From 2000 through 2009, 1121 adolescents ages 12-19 years old were admitted with non-fatal traumatic fracture(s) of the upper extremity, lower extremity, skull, face, hip or other bone requiring hospitalization for more than one day at our institute according to the Clinical Data Repository (CDR). Of these, 53 patients had a diagnosis of depression (either past or current) included in their records at the time of admission. To focus on patients who received a “new” depressive diagnosis in the post-injury period, we excluded these patients leaving 1068 total. Of these, 913 (81.4%) were seen in follow-up at least once at our center in the year after their fracture(s). 4.1% (37/913) of these adolescents were diagnosed with depression at our institute by the end of this first year.

Most patients who were diagnosed with depression at our center after their fracture (31/37, > 80%) received this diagnosis within the first two months post-injury. By six months, the number of adolescents diagnosed with depression following any type of fracture reached a plateau (Table 1). After excluding patients who sustained a concomitant spinal cord injury (a total of 86), 982 patients remained, and 842 of these were seen in follow-up. About 3.2% (27/842) of these patients were diagnosed with post-injury depression by the end of the first year following their hospitalizations (Table 2). When patients who suffered a traumatic facial or skull fracture with or without an associated brain injury were also excluded, 491 remained. Among these 491 adolescents who were hospitalized for traumatic fracture(s) that did not include facial or skull fractures or concomitant spinal cord or brain injuries, 5 of the 443 seen at our center for follow up during the first year following their injury (1.1%) were diagnosed with depression (Table 3). The findings from Tables 1, 2 and 3 are combined and presented in a graph (Figure 1) which illustrates that more depressive diagnoses were made at our center in the first two months post-injury.
Discussion:

Earlier, prospective studies report alarmingly high rates of depression in youth who completed self-report questionnaires within the first few weeks or months following various types of physical injury. Han et al. report that 41% of injured adolescents met criteria for depression at discharge using the Children's Depression Inventory (CDI). Injury severity score, involvement of more than three body regions, low socioeconomic status, the presence of family members injured at the scene and a history of suicidal ideation or attempts were all associated with this increased risk of post-injury depression. Ellis et al. report that 23% of youth met criteria for depression in the months following a car accident-related physical injury (a score of 8 or higher on the Short Form of the Mood and Feelings Questionnaire). In another study, 19% of adolescents met criteria for depression (CES-D score >27) at baseline when they were interviewed roughly 11 days after an injury. Stallard et al. report that 17.7% of youth met criteria for clinical depression when screened one-month after sustaining car accident-related injuries using the Birleson Depression Inventory.

Unlike most earlier studies that do not distinguish between different types of traumatic physical injury, we designed our study to focus on fractures. We hypothesized initially that fractures, as opposed to other types of physical injury which may not heal as quickly or completely, are associated with lower rates of depression. For instance, one might expect brain injury to be more closely associated with co-morbid psychiatric problems compared to a femur fracture. In one retrospective study, Zatzick
& Grossman reviewed the charts of young people who had sustained a variety of traumatic injuries, including traumatic brain injury (TBI), and report that 7.4% of injured adolescents received a diagnosis of depression within one year of their injury. When we excluded patients in our own study who sustained concomitant brain and/or spinal cord injuries in addition to their fracture(s), the rate of depression was reduced.

Only two studies report on the psychosocial impact of fracture, specifically. Stancin et al. report that “functional limitations” in children age 6 to 12 and “family stress” can be observed up to six months after a traumatic fracture and tend to be more significant among children with lower extremity fractures and those whose treatment involved lengthy immobilization. Interestingly, these researchers report that the psychological and behavioral impact of traumatic fracture in this population assessed prospectively at six months and one year is minimal after the first six months. Unfortunately, these researchers did not distinguish between depression and other types of psychological consequences, which limits comparison of their results to our own. In another study of Croatian children ages 10 to 18, researchers report that self-reported symptoms of depression and anxiety, collectively, were increased immediately after injury but were greatly reduced beyond the first six months. Although these studies did not focus specifically on depressive diagnoses made post-injury, they suggest that the psychological impact of orthopedic injury in children and adolescents may be limited to the acute post-injury period, a finding that is consistent with our own.

In our study, a greater number of adolescents were diagnosed with depression at our center within the first two months after their injury. Although this finding suggests, as others have, that the psychological consequences of traumatic fracture are more pronounced in the acute post-injury period, it may also reflect greater exposure to health care providers – and therefore increased opportunities for diagnosis – in the early post-injury period when follow-up visits were scheduled more frequently. Beyond six months post-injury, it is likely that more patients were seen by community providers
outside of our health system. If diagnoses of depression were made by these providers, they would have been missed in our retrospective review of the CDR.

Unlike earlier studies already discussed, we did attempt to focus on new, presumably injury-related depression in our population by excluding patients with a known pre-morbid diagnosis of depression. This aspect of our study design is yet another factor that might have contributed to the lower rate of depression that we report. The de-identified data provided by the CDR did not permit us to differentiate between patients who had a past, recent or current diagnosis of depression at the time of their admission for fracture. Excluding patients with a depressive diagnosis in their record at the time of admission means that we excluded an unknown number of patients with a prior history of depression who might therefore have been particularly likely to develop post-injury depression.

Finally, while the higher rates of depression reported by earlier studies may in part reflect the considerable symptom overlap between PTSD, acute stress disorder and depression, and/or the potentially confounding effects of pain, medication side effects and the stress of hospitalization on self-reported depression symptoms assessed in the acute post-injury period, the lower rates that we report may reflect clinical under-diagnosis of depression. Our retrospective approach might have “missed” cases of sub-clinical depression. We have no data to indicate if and how patients were evaluated for depression during their follow-up visits at our institute.

Theoretically, traumatic injury that requires hospitalization and follow-up care presents an opportunity to screen for depression in adolescents who ordinarily do not frequent doctor's offices. Unfortunately, recent evidence suggests that adolescents often lack an identifiable primary care provider (PCP) and therefore do not benefit from such screening after injury. As one recent study reports, 40% of adolescents who were hospitalized following a traumatic physical injury reported no source of primary care. Among the 60% of adolescents who did identify a primary care provider (PCP), fewer than one in four followed up with their PCP following their injury. Although depression affects
a significant proportion of the general population of adolescents, somewhere between 4.3% and 9% according to some studies, only a fraction of depressed adolescents consult a PCP for their treatment.\textsuperscript{19,28} In the 2004 National Survey on Drug Use and Health, only 25% of surveyed adolescents aged 12 to 19 had consulted their family doctor and just 5% had seen another medical doctor for their depression over the previous year.\textsuperscript{19} There is an apparent need for the establishment of better long-term relationships between adolescents and PCPs. As others have suggested, there is also a need for improved coordination of care between trauma centers and PCPs who may be in a position to improve prevention, detection and treatment of psychiatric disorders in this population.\textsuperscript{9,28,29}

The lack of other studies focusing specifically on orthopedic fracture and post-injury depression limits direct comparison of our results to others. Most of the studies reporting very high rates of depression following different types of traumatic injury prospectively screened for post-injury depression, and results of these studies vary considerably. More studies are needed to clarify the relationship between traumatic injury and depression in adolescents. In our retrospective review, we were not able to control for a wide variety of potentially confounding factors that might determine an individual's risk for post-injury depression. It would be interesting, for example, to consider whether adolescents with a known history of depression, those experiencing multiple fractures rather than a single fracture, and/or those with a history of other psychiatric disorders that might contribute to increased risk-taking behavior are more predisposed to depression following a traumatic fracture.

However, regardless of whether or not (or how much) the risk of depression is increased in youth post-injury, our findings may be viewed as supporting concerns regarding the general under-diagnosis and under-treatment of depression in adolescents. When more routine and active screening for depression was undertaken post-injury in various prospective studies, a greater number of adolescents were identified as having symptoms of depression. Our finding that a relatively small percentage of adolescents seen in follow-up were clinically diagnosed with depression in the first year
following a traumatic fracture may indicate that different types of physical injury, such as fracture, are associated with less post-injury depression than others. However, our findings may also be viewed as further evidence that supports the need for improved depression screening efforts, especially in the post-injury period.
References:


