Health Literacy in an Orthopedic Trauma Patient Population: A Cross-Sectional Survey of Patient Comprehension

Rishin J. Kadakia, BSc, James M. Tsahakis, BA, Neil M. Issar, BSc, Kristin R. Archer, PhD, DPT, A. Alex Jahangir, MD, Manish K. Sethi, MD, William T. Obremskey, MD, MPH, and Hassan R. Mir, MD

Objectives: The aim of this study was to evaluate the level of comprehension in an orthopedic trauma patient population regarding injury, surgery, and postoperative instructions and to determine if educational background is associated with inadequate comprehension.

Design: This involved a prospective observational cohort.

Setting: The study was conducted at an Academic Level 1 trauma center.

Patients: From April to June 2011, 248 orthopedic trauma patients with an operatively fixed isolated fracture were found to be eligible for inclusion. One hundred forty-six eligible questionnaires were collected (58.9% response rate).

Intervention: The patients were administered a questionnaire during their first postoperative visit before being seen by a physician. The questionnaire included demographic information and questions regarding (1) which bone was fractured; (2) the type of implanted fixation; (3) weight-bearing status; (4) expected recovery time; and (5) need for deep vein thrombosis (DVT) prophylaxis. Multivariable logistic regression analyses were used to examine the association between educational level and questions regarding surgical procedure and discharge instructions.

Results: The overall mean score of all the patients on the patient comprehension portion was 2.54 ± 1.27 correct responses out of 5. Only 47.9% of patients knew the bone they fractured, and 18.5% knew their expected healing time. Of the patients, 66.4% knew the type of implanted fixation, and 45.2% knew their weight-bearing status. The patients (74.0%) knew their DVT prophylaxis medication(s). The mean score for patients in the group ≤ HS (high-school education or less) was 2.26, whereas the mean score for patients in the group > HS (more than high-school education) was 3.00 ($P = 0.0009$). The patients in the group > HS were 2.54 times more likely to know the bone they fractured ($P = 0.01$), 3.82 times more likely to know the recovery time ($P = 0.004$), and 2.79 times more likely to know their DVT prophylaxis medication(s) than patients in the group ≤ HS.

Conclusions: Orthopedic trauma patients demonstrated limited comprehension of their injuries, surgeries, and postoperative instructions. Patients with lower educational levels did significantly worse on the questionnaire than those with higher educational levels. The results of the study highlight a lack of comprehension within this patient population and suggest that an increased focus on patient communication by orthopedic providers may be necessary.

Key Words: comprehension, education, discharge instructions, fracture

Level of Evidence: Prognostic Level II. See Instructions for Authors for a complete description of levels of evidence.

(*J Orthop Trauma* 2013;27:467–471)

INTRODUCTION

Health literacy includes patients' understanding of their medical conditions and postsurgical treatment plans.[1] Patients are informed about their condition and given treatment options before consenting for surgery. Postoperatively, patients are given instructions for recovery, which are critical for patients to manage their own care and avoid reinjury or complications. However, previous studies have shown that many patients have difficulty comprehending their discharge instructions,[2–8] medications,[3,6] and diagnoses,[2,4,7,8] particularly as physicians' use of medical terms combined with patients' limited health vocabulary can result in inadequate and/or confusing communication. Although discharge instructions are typically written at a grade 8–12 reading level, it has been shown that the average patient reads at a grade 6 level.[2] In addition, studies have demonstrated that a lack of comprehension reduces patient satisfaction and compliance[9–11] and that the frequency of postdischarge adverse events attributable to gaps in information transfer may be as high as 30%.[12] The problem may also be exacerbated by physicians overestimating patients' understanding of discharge instructions and postsurgical treatment plans. For example, Calkins et al[13] surveyed 99 patients and their attending physicians and found that physicians believed that 95% of patients understood when to resume normal activities, whereas only 58% of patients reported that they understood. This prevalent lack of patient comprehension can have a detrimental effect on health outcomes and healthcare costs. A recent review by Berkman et al[14] showed that health literacy, including comprehension of print material and

From the University Vanderbilt Orthopaedic Institute Center for Health Policy, Nashville, TN. Department of Orthopaedic Surgery, Vanderbilt.

The authors report no conflict of interest.

Reprints: Hassan R. Mir, MD, Vanderbilt University, Suite 4200 MCE—South Tower, Nashville, TN 37232-8774 (e-mail: hassan.mir@vanderbilt.edu).

adherence to medication regimens, was directly associated with health outcomes. They analyzed 96 studies and found that patients with low health literacy were less likely to identify all of their medications, could not manage medications in a mock exercise, and were associated with more hospitalizations and greater use of emergency care.

The postoperative period involves significant patient vulnerability and the transfer of increasingly complex instructions to patients of variable literacy and educational levels. This is especially evident in the high acuity setting of orthopedic trauma. Identifying the patients who are most at risk for inadequate comprehension of their discharge instructions would allow for targeted interventions to improve outcomes. However, there is ongoing debate regarding which patient factors are associated with inadequate patient comprehension and correlated poor health outcomes. Age,[6,15,17] education,[7,16–18] and socioeconomic status[17] have all been cited in the literature, though most evidence lends credence to patients' level of education having the most consistent effect on comprehension. Accordingly, this study aims to examine orthopedic trauma patients' comprehension regarding injury, surgery, and postoperative instructions, and to determine whether or not education level is associated with inadequate comprehension.

MATERIALS AND METHODS

The study was approved by the Institutional Review Board of our medical center. From April to July 2011, questionnaires were distributed to trauma patients in the orthopedic trauma clinic at our institution, which is an academic level 1 trauma center. The questionnaire consisted of 12 questions divided into 2 basic categories—demographic information and patient comprehension assessment. The demographic portion consisted of 7 questions regarding gender, age, living situation, socioeconomic status, health insurance, employment status, and level of education. The patient comprehension portion consisted of 5 questions constructed specifically for this study to gauge the level of understanding regarding surgery and discharge instructions. Patients were asked to indicate the bone fractured, fixation method used for repair, weight-bearing status, healing time, and deep vein thrombosis (DVT) prophylaxis medication(s). All the patient comprehension questions were structured in a yes/no format with additional space provided for written answers to allow for confirmation of the responses. The knowledge tested in the 5 questions on patient comprehension was communicated verbally to each patient preoperatively and postoperatively by the orthopedic surgeon or associated nurse practitioner, and print outs of x-ray films were given to each patient postoperatively. Patients also received a standard hospital discharge packet that consisted of information pertaining to their medications, activity, diet, and future appointments. This discharge instruction procedure was the standard of care for all orthopedic trauma patients at this institution.

Questionnaires were distributed to orthopedic trauma patients at their first follow-up appointment (usually 2–3 weeks) after surgical repair, before being seen by a healthcare provider. Only first-time trauma patients who underwent surgical repair for a single fracture were considered eligible for this study. Eligibility was determined by reviewing the medical record of the patient. The patients who were unable to comprehend the questionnaire due to a language barrier or illiteracy were also excluded. Each questionnaire consisted of a brief disclaimer explaining the purpose of the study and ensuring patient confidentiality; patient participation was optional, and consent forms were signed. Questionnaire data were stored in a secured deidentified dataset to protect patient confidentiality. Incomplete questionnaires were excluded from data analysis.

Statistical analysis was performed using STATA 10 (Stata Corp, 4905 Lakeway Dr, College Station, TX). The questionnaire was graded by comparing patient responses with their medical records, and a total score of correct responses was calculated. Responses that were nonspecific were reviewed by the authors and a majority decision determined if the response was scored as correct or incorrect, with the trend being toward leniency. Association between education level and mean total correct response score was analyzed using the Student *t*-test. Separate multivariable logistic regression analyses were used to examine the association between education level and each patient comprehension question, controlling for age, gender, and income. The level of significance was set at $P < 0.05$.

RESULTS

Two hundred and forty-eight patients were determined to be eligible for the study during the specified time period, and 146 completed the questionnaire and consent form, resulting in a response rate of 58.9% (146/248). The mean score for all trauma patients on the comprehension portion of the questionnaire was 2.54 ± 1.27 out of 5 (50.8%). Seventy-four percent [108 out of 146, 95% confidence interval (CI) 66.9%–81.1%] of the patients correctly named the medication (s) they were prescribed for DVT prophylaxis, but only 18.5% (27 out of 146, 95% CI 12.2%–24.8%) knew their expected healing time after surgery. The patients (66.4%;97 out of 146, 95% CI 58.8%–74.1%) knew what type of fixation was implanted. Patient performance on questions regarding weight-bearing status and knowledge of which bone was fractured was found to be 45.2% (66 out of 146, 95% CI 37.1%–53.3%) and 47.9% (70 out of 146, 95% CI 39.8%–56.0%), respectively (Table 1, Fig. 1).

The patients were also subdivided into 2 groups based on education level for individual variable analysis. The group $\leq$ HS consisted of 95 patients (65.1%) whose highest education level was a high-school degree or less, and the group $>$ HS consisted of 51 patients (34.9%) whose education level exceeded a high-school degree. A statistically significant difference was found between the mean scores of patients in the group $\leq$ HS [2.26 (SD: 1.2)] and the group $>$ HS [3.0 (SD: 1.26)] on the patient comprehension portion of the questionnaire ($P = 0.0009$; Table 2). Although the survey does have good face validity, any conclusions drawn from these mean scores must be made with care due to the lack of internal questionnaire validation; the questions exhibited poor internal

TABLE 1. Overall Performance by All Patients on Health Literacy Questions (N = 146)

Health Literacy Question	Correct Response Frequency (N = 146) N(%)	95% CI
Q1. Can you name what bone you broke?	70 (47.9%)	39.8%–56.0%
Q2. Do you know how it was fixed?	97 (66.4%)	58.8%–74.1%
Q3. Do you know how much weight you can bear on your extremity?	66 (45.2%)	37.1%–53.3%
Q4. Do you know how long your bone will take to heal?	27 (18.5%)	12.2%–24.8%
Q5. Are you supposed to be on a medicine to prevent blood clots?	108 (74.0%)	66.9%–81.1%

consistency as measured by the coefficient of reliability test ($\alpha = 0.42$; $\alpha > 0.7$ is desirable).

Multivariable logistic regression analyses were performed to analyze the effect of education on patients' health literacy. Age, gender, and annual household income were controlled for in each analysis. Patients in the group > HS performed significantly better than the patients in the group ≤ HS on 3 questions; they were 2.54 times more likely to know which bone was fractured ($P = 0.01$), 3.82 times more likely to know their expected healing time after surgery ($P = 0.004$), and 2.79 times more likely to be able to correctly name the medication(s) they were prescribed for DVT prophylaxis ($P = 0.03$). Patients in the group > HS performed moderately better than patients in the group ≤ HS on 1 question; they were 2.15 times more likely to know the type of implanted fixation ($P = 0.06$). However, patients in the group > HS were no more likely than patients in the group ≤ HS to know their postoperative weight-bearing status (Table 3).

The questionnaire was structured in such a way as to gauge the difference between patients' presumed comprehension and actual comprehension of postoperative instructions. Patients answered "Yes" or "No" as to whether they knew the answer to each question and then attempted to answer the question itself (Table 4). The largest gap between presumed and actual comprehension was exhibited by the question concerning DVT prophylaxis—52.6% of the patients who answered the DVT question incorrectly thought they did in fact know the correct answer. The χ^2 statistical analysis was performed to determine if the proportion of discordant responses was statistically different between the group > HS and group ≤ HS (data not shown); only the question pertaining to weight-bearing status exhibited a significant difference ($P = 0.02$).

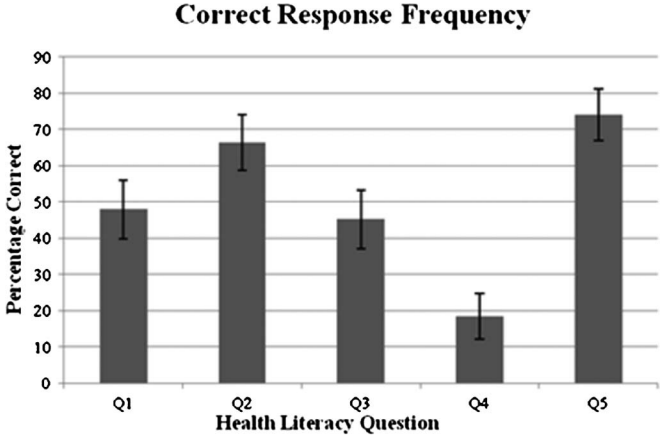

FIGURE 1. Distribution histogram of correct response frequencies and CIs for health literacy questions.

TABLE 2. General Frequency for the Group ≤ HS Versus the Group > HS and the Student *t*-Test Comparison of the Mean Score Between Groups (N = 146)

Patient Subgroups	N (%)	Mean Score	Standard Deviation
Group ≤ HS	95 (65.1%)	2.26	1.20
Group > HS	51 (34.9%)	3.00	1.26
t-Test *P* value			0.0009*

*indicates significance; *p*-value <0.05.

Note: mean score ranges from 0 to 5 based on performance on patient comprehension portion of questionnaire.

DISCUSSION

Proper comprehension of injury, treatment, and instructions plays an integral role in a patient's health management and recovery process after a surgical procedure. Although a knowledge of which specific bone was fractured or what hardware was used in the repair may not have a direct impact on a patient's recovery, improper comprehension of the expected healing time, weight-bearing status, and DVT prophylaxis could lead to negative patient outcomes.

This study indicates inadequate comprehension of surgery and discharge instructions in the orthopedic trauma patient population at an academic level 1 trauma center. Of the patients in this study, 52% were unable to correctly name the bone they broke and 33% could not identify the hardware used in their procedure. Previous studies have linked increased health literacy and comprehension with positive health outcomes in specific medical populations such as patients with heart failure and diabetes.[17,19,20] Although these studies were conducted on patients with chronic medical conditions, they highlight the role of understanding and comprehension on a patient's health-related outcomes. In addition, questions regarding DVT prophylaxis and weight-bearing status may have a more immediate impact on the patient's recovery as opposed to knowledge of the bone broken or repair method. The percentage of patients (26%) unable to name their prescribed medication for DVT prophylaxis was concerning. Without proper DVT prophylaxis, orthopedic surgery patients are at risk for the development of DVT and pulmonary embolism, which can be serious or fatal complications of a variety of surgical procedures. Proper understanding of DVT prophylaxis among orthopedic surgery patients is vital and could help prevent unnecessary readmissions and fatalities. Patient understanding of weight-bearing status also plays an important role in the recovery process;

TABLE 3. Multivariable Logistic Regression for Association Between Patient Education and Health Literacy Questions (N = 146)

	Q1 OR (95% CI)	Q2 OR (95% CI)	Q3 OR (95% CI)	Q4 OR (95% CI)	Q5 OR (95% CI)
Education level > high school versus ≤ high school (ref)	2.54 (1.22,5.29)*	2.15 (0.96,4.81)	0.80 (0.38,1.68)	3.82 (1.54,9.46)*	2.79 (1.12,6.92)*

*Significance, P value <0.05, models controlled for age, gender, and income.

Q1, Can you name what bone you broke?; Q2, Do you know how it was fixed?; Q3, Do you know how much weight you can bear on your extremity?; Q4, Do you know how long your bone will take to heal?; Q5: Are you supposed to be on a medicine to prevent blood clots? Ref, reference.

failure to follow weight-bearing guidelines could lead to further injury or reinjury. Of the patients, 54.8% in this population did not know their weight-bearing status after surgery. Accordingly, medical professionals should develop methods to improve patient understanding of postoperative instructions to prevent unnecessary complications.

Surprisingly, 81% of the patients did not know their estimated healing time. The percentage of incorrect responses to this question was much larger than any of the other questions. A possible explanation for this could be disparate interpretations of the word "heal." Although a physician may consider healing time to refer to the time for a fracture to unite after surgery, a patient may consider complete healing to be related to the physical activities of which they were capable before the procedure. For example, a patient who underwent surgery to repair an ulnar shaft fracture may not consider herself completely healed until she is able to play tennis or lift weights. Although knowledge of healing time may not have a direct impact on surgical outcomes, this disparity in the meaning of the word "heal" highlights an area of inadequate communication between the orthopedic surgeon and the patient. The mean score on the patient comprehension portion of the questionnaire (2.54 out of 5) indicates decreased overall understanding among orthopedic trauma patients. Interestingly, patients in the group ≤ HS (high-school education or less) had significantly lower mean scores than those in the group > HS (high-school education or more). In addition, multivariable analysis on individual questions showed that patients in the group > HS were more likely to answer correctly 4 out of the 5 questions. However, higher educational background was not significantly correlated to better performance on the question pertaining to weight-bearing status. These results suggest that patients with a lower education level may serve as a target population for interventions aimed at improving comprehension after surgery.

Of note, in addition to a general lack of patient comprehension, there seems to be a considerable lack of insight on the part of the patients as to their degree of comprehension. This is evidenced by the overall gap between presumed and actual patient comprehension—31.5% of incorrect responses were believed to be correct by the patients offering those responses. This lack of insight was most pronounced in the question concerning DVT prophylaxis. The χ^2 analysis determined that individuals with higher educational backgrounds were more likely to misinterpret their comprehension regarding weight-bearing status. This could reflect overconfidence in this patient population; however, no significant difference was noted in the other questions. This lack of insight seems to be an issue for the entire patient population regardless of educational background. These results highlight the fact that many patients may have a lack of self-assessment in addition to their lack of comprehension, and it is important for health providers to be cognizant of this gap. For example, simply asking Yes/No questions may not be sufficient to determine patients' levels of comprehension.

Because this study is questionnaire based, it has several inherent limitations. There may be some response bias by patients who are hesitant to truthfully answer questions pertaining to income or educational background. The patients were assured of the confidentiality of their responses in an attempt to minimize bias via a consent form. There may also be some volunteer bias, as certain types of patients could be more willing to fill out the questionnaire than others. In particular, patients who are more conscientious and knowledgeable about their procedures may be more likely to participate, which, in turn, could result in an underestimation of patient misunderstanding. In addition, because patients were given the questionnaire approximately 2–3 weeks after discharge at their first follow-up appointment, they may have forgotten some of the details of their conditions, surgeries, and instructions. This may have been exacerbated if the patient were taking opioids for pain management in the days

TABLE 4. Evaluation of Discordant Responses

Question	Incorrect Responses	Frequency of Those Originally Answering 'Yes'
Q1: Can you name what bone you broke?	76/146	31/76 = 40.1%
Q2: Do you know how it was fixed?	49/146	21/49 = 42.9%
Q3: Do you know how much weight you can bear on your extremity?	80/146	24/80 = 30.0%
Q4: Do you know how long your bone will take to heal?	119/146	18/119 = 15.1%
Q5: Are you supposed to be on a medicine to prevent blood clots?	38/146	20/38 = 52.6%
Totals	362/730	114/362 = 31.5%

Note: The left column indicates the proportion of incorrect responses, and the right column indicates the proportion of patients who incorrectly answered the question but originally thought they knew the correct answer.

after surgery, which could alter comprehension of written and verbal instructions given at discharge. Finally, this study was conducted at an academic level 1 trauma center; therefore, the results may not be generalizable to other traumatic injury populations.

CONCLUSIONS

Orthopedic trauma patients showed limited comprehension regarding their injuries, surgeries, and postoperative instructions. The patients with lower educational levels in particular performed significantly worse than those with higher education levels on both the overall mean score and on specific questions. Although this subset of patients may serve as a possible target for intervention, the overall low score of all the patients regardless of educational background is of concern. The results of this study suggest that an increased focus on patient communication by orthopedic providers may be necessary to improve comprehension of surgical procedures and discharge instructions in this patient population.

REFERENCES

1. Baker DW. The meaning and the measure of health literacy. *J Gen Intern Med.* 2006;21:878–883.
2. Spandorfer JM, Karras DJ, Hughes LA, et al. Comprehension of discharge instructions by patients in an urban emergency department. *Ann Emerg Med.* 1995;25:71–74.
3. Hwang SW, Tram CQ, Knarr N. The effect of illustrations on patient comprehension of medication instruction labels. *BMC Fam Pract.* 2005;6:26.
4. Makaryus AN, Friedman EA. Patients' understanding of their treatment plans and diagnosis at discharge. *Mayo Clin Proc.* 2005;80:991–994.
5. Heng KW, Tham KY, How KY, et al. Recall of discharge advice given to patients with minor head injury presenting to a Singapore emergency department. *Sing Med J.* 2007;48:1107–1110.
6. Maniaci MJ, Heckman MG, Dawson NL. Functional health literacy and understanding of medications at discharge. *Mayo Clin Proc.* 2008;83: 554–558.
7. Chugh A, Williams MV, Grigsby J, et al. Better transitions: improving comprehension of discharge instructions. *Front Health Serv Manage.* 2009;25:11–32.
8. Engel KG, Heisler M, Smith DM, et al. Patient comprehension of emergency department care and instructions: are patients aware of when they do not understand? *Ann Emerg Med.* 2009;53:454–461.
9. Clarke C, Friedman SM, Shi K, et al. Emergency department discharge instructions comprehension and compliance study. *CJEM*. 2005;7:5–11.
10. Clark PA, Drain M, Gesell SB, et al. Patient perceptions of quality in discharge instruction. *Patient Educ Couns.* 2005;59:56–68.
11. Watt D, Wertzler W, Brannan G. Patient expectations of emergency department care: phase I—a focus group study. *CJEM*. 2005;7:12–16.
12. Tsilimingras D, Bates DW. Addressing postdischarge adverse events: a neglected area. *Jt Comm J Qual Patient Saf.* 2008;34:85–97.
13. Calkins DR, Davis RB, Reiley P, et al. Patient–physician communications at hospital discharge and patients' understanding of the postdischarge treatment plan. *Archiv Intern Med.* 1997;157: 1026–1030.
14. Berkman ND, Sheridan SL, Donahue KE, et al. Low health literacy and health outcomes: an updated systematic review. *Ann Intern Med.* 2011; 155:97–107.
15. Hastings SN, Barrett A, Weinberger M, et al. Older patients' understanding of emergency department discharge information and its relationship with adverse outcomes. *J Patient Saf.* 2011;7:19–25.
16. Paasche-Orlow MK, Parker RM, Gazmararian JA, et al. The prevalence of limited health literacy. *J Gen Intern M.* 2005;20:175–184.
17. Peterson PN, Shetterly SM, Clarke CL, et al. Health literacy and outcomes among patients with heart failure. *JAMA*. 2011;305:1695–1701.
18. Green JA, Mor MK, Shields AM, et al. Prevalence and demographic and clinical associations of health literacy in patients on maintenance hemodialysis. *Clin J Am Soc Nephrol.* 2011;6:1354–1360.
19. Schillinger D, Grumbach K, Piette J, et al. Association of health literacy with diabetes outcomes. *JAMA*. 2002;288:475–482.
20. Chinn D. Critical health literacy: A review and critical analysis. *Soc Sci Med.* 2011;73:60–67.

Click here to confirm that you have read the article and receive Trauma Education Credit