ORIGINAL ARTICLE

Adherence to vaccination recommendations after traumatic splenic injury

Ahmet Korkut Belli, M.D.,[1] Cem Dönmez, M.D.,[1] Önder Özcan, M.D.,[1] Özcan Dere, M.D.,[1] Selmin Dirgen Çaylak, M.D.,[2] Funda Dinç Elibol, M.D.,[3] Cenk Yazkan, M.D.,[1] Nevin Yılmaz, M.D.,[4] Okay Nazlı, M.D.[1]

[1]Department of General Surgery, Muğla Sıtkı Koçman University Faculty of Medicine, Muğla-*Turkey*
[2]Department of Infectious Disease, Muğla Sıtkı Koçman University Faculty of Medicine, Muğla-*Turkey*
[3]Department of Radiology, Muğla Sıtkı Koçman University Faculty of Medicine, Muğla-*Turkey*
[4]Department of Gastroenterology, Muğla Sıtkı Koçman University Faculty of Medicine, Muğla-*Turkey*

ABSTRACT

BACKGROUND: The occurrence of a serious infection called overwhelming post-splenectomy infection (OPSI) increases more than 50 times in patients who have hyposplenia. The aim of this study was to investigate the adherence to vaccination recommendations after traumatic splenic injury.

METHODS: We identified patients who underwent total splenectomy due to abdominal trauma between May 2012 and March 2016. We recorded the clinical, laboratory, and pathological features of the patients. We calculated the vaccination proportions before discharge, after discharge, and final.

RESULTS: Twenty-seven patients underwent total splenectomy. For the vaccination status before discharge, after discharge, and final, the number of patients who received all the three vaccinations were 0 (0%), 0 (0%), and 8 (18.5%) and those who received none were 13 (48.2%), 11 (40.8%), and 9 (33.4%), respectively. The data of 17 patients were available for developing OPSI. The median follow-up time was 17.8 (4.4–41.2) months, and no OPSI cases were observed.

CONCLUSION: Adherence to vaccination recommendations remains still low. Establishing a vaccination tracking system and following vaccination recommendations will be helpful to prevent serious infections, such as OPSI, after traumatic splenectomy.

Keywords: Gastroenterology; infection; microbiology; spleen; trauma; vaccination.

INTRODUCTION

The spleen is the most vulnerable organ in blunt abdominal trauma.[1] It has critical functions according to its histological regions, i.e., the red and white pulp. Using the red pulp, it filters and removes senescent erythrocytes in the circulation and recycles iron for the production of new erythrocytes. Using the white pulp, it functions as a secondary lymphoid organ and generates both humoral and cellular immune responses.[2]

The occurrence of a serious infection called overwhelming post-splenectomy infection (OPSI) increases more than 50 times in patients with hyposplenia.[3,4] *Streptococcus pneumoniae, Neisseria meningitidis*, and *Haemophilus influenzae* Type b (HIB) are encapsulated bacteria that can potentially cause severe sepsis, meningitis, or pneumonia after splenectomy.[5] OPSI is an emergent condition which may develop as a mild infection and rapidly progress to sepsis with 50%–70% risk of mortality despite treatment.[6] Although the true incidence of OPSI has not been completely identified, Newland et al.[7] reported that the incidence was 0.18%–0.42% per year, with a lifetime risk of 5% after splenectomy.

Cite this article as: Belli AK, Dönmez C, Özcan Ö, Dere Ö, Dirgen Çaylak S, Dinç Elibol F, et al. Adherence to vaccination recommendations after traumatic splenic injury. Ulus Travma Acil Cerrahi Derg 2018;24:337-342.

Address for correspondence: Ahmet Korkut Belli, M.D.
Muğla Sıtkı Koçman Üniversitesi Tıp Fakültesi, Genel Cerrahi Anabilim Dalı, Menteşe, 48000 Muğla, Turkey
Tel: +90 252 - 211 10 00 E-mail: ahmetbelli@gmail.com

Ulus Travma Acil Cerrahi Derg 2018;24(4):337-342 DOI: 10.5505/tjtes.2017.84584 Submitted: 20.03.2017 Accepted: 10.11.2017 Online: 21.06.2018

To avoid OPSI, vaccination against *S. pneumoniae, N. meningitidis*, and HIB are recommended in addition to a yearly influenza vaccine. However, the administration of these vaccines is recommended after the postoperative day 14 to increase the immune response in patients who have undergone splenectomy due to trauma. Moreover, a booster dose is needed for pneumococcal and meningococcal vaccines after the fifth year of vaccination.[8–11] However, the adherence to vaccination recommendations and timing of the vaccinations vary depending on surgeons' practice.

To the best of our knowledge, there are few studies which reported the vaccination adherence after splenectomy in the literature. The aim of this study was to investigate the adherence to vaccination recommendations after traumatic splenic injury by our surgeons and to analyze the factors that affect the vaccination status.

MATERIALS AND METHODS

Patient Selection

We identified patients who underwent total splenectomy due to abdominal trauma between May 2012 and March 2016 by questioning the surgical code of total splenectomy from the database of our institution. Informed consent was obtained from each patient before the surgery. We investigated each patient's records and recorded patient name, sex, date of surgery, duration of hospital stay, intensive care unit (ICU) transfer status, Glasgow coma scale (GCS), initial and control vital sign, hemograms, number of transfusions, erythrocyte suspension (ES), and fresh frozen plazma (FFP) packs.

We excluded the patients who had nontraumatic splenectomy, nonoperative management, or partial splenectomy and who deceased during per- or postoperative period (Fig. 1).

We searched for additional organ injuries other than those of the spleen from the patient charts and identified the organ injury scale (AIS) scores. Then, we calculated ISS scores for each patient according to the calculator defined by Baker et al.[12]

Patients who had a mean arterial pressure (MAP) of <65 mm Hg in the control vital signs and/or Hct decrease of >20% were defined as hemodynamically unstable. Our radiologist reevaluated the CT images of all the patients according to the American Association for the Surgery of Trauma (AAST) grading system.

Vaccination Status

We investigated both doctors' directives and nursery notes from the patients' charts during the hospital stay to identify whether vaccinations for S. pneumoniae, N. meningitidis, and HIB were administered. The ideal categorization of the patients was grouping them into those vaccinated in 14 days and after 14 days of splenectomy. However, we did not have any vaccination tracking system; hence, we could not find the exact dates of the vaccinations after discharge. If a patient had any of the recommended vaccinations before or after discharge, we considered that patient to be vaccinated to analyze the effective factors for vaccination status.

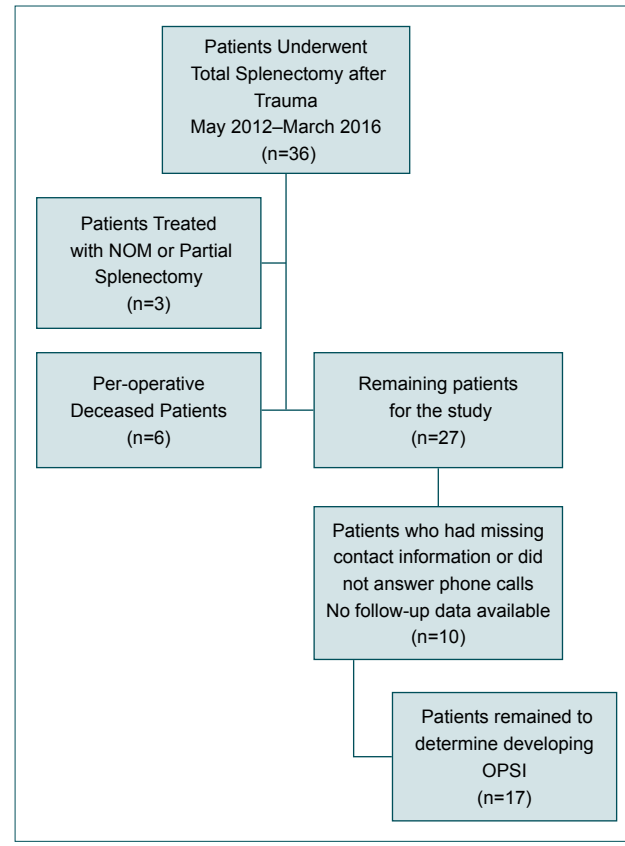

Figure 1. Study population selection criteria and the time period.

For pneumococcal vaccine, 23 valent pneumococcal polysaccharide vaccine (PPSV-23) and 13 valent pneumococcal conjugate vaccine (PCV-13) statuses were separately recorded and categorized into 3 groups: before discharge, which was recorded from the patient charts; after discharge, which was determined by calling the patients who had missing vaccinations before discharge; and final, which displayed the maximum completion of vaccination by inviting and prescribing the missing vaccines. Furthermore, we categorized all possible combinations of the 3 vaccines and displayed them in Table 1.

Identification of OPSI Development

While we called the patients to determine the missing vaccinations after discharge, we also asked if they had any severe infection, such as pneumonia, meningitis, or sepsis-related disease, or any condition which required hospitalization. The time period between the interview with the patients and discharge date was recorded as the follow-up time.

Statistical Analysis

We compared two categorical data with either the Pearson

Chi-Square or Fischer's exact test. We used parametric or nonparametric independent samples t tests to compare categorical variables and scale data according to the normality analysis. For the comparison between two scale data, we used the Pearson correlation test. We classified the grades I–III and IV–V as mild and severe grades, respectively, for statistical analysis.

RESULTS

We identified 36 patients with traumatic splenic injury between May 2012 and March 2016. Of these, 2 were treated nonoperatively, 1 underwent partial splenectomy, and 33 underwent total splenectomy. Six patients had deceased per- or postoperatively due to injuries other than those of the spleen. Of the remaining 27 patients, 19 (70.4%) were male and 8 (29.6%) were female. The median age was 33 (7–49) years. The median hospital stay duration was 8 (0–31) days. The numbers of patients who had at least one of the recommended vaccinations before discharge, after discharge, and final were 14 (51.8%), 16 (59.3%), and 18 (66.7%), respectively. For the vaccination status before discharge, after discharge and final, the number of patients who received all the three vaccinations were 0 (0%), 0 (0%), and 8 (18.5%) and those who received none were 13 (48.2%), 11 (40.8%), and 9 (33.4%), respectively. Other combinations of the vaccines administered to the patients are given in Table 1.

For the 14 (51.8%) vaccinated and 13 (48.2%) unvaccinated patients before discharge, the median age was 32 (22–48) and 40 (7–49) years (p>0.05), male/female ratio was 8:5 and 11:3 (p>0.05), number of patients requiring intensive care was 6 (22.2%) and 6 (22.2%) (p>0.05), median hospital stay durations was 8.5 (5–31) and 8 (0–20) days (p>0.05), median ISS score was 19 (4–75) and 25 (4–75; p>0.05), and median GCS score was 15 (3–15) and 15 (3–15; p>0.05), respectively. The data of 17 patients who developed OPSI were available. The median follow-up duration was 17.8 (4.4–41.2) months, and no OPSI cases were observed (Table 2).

DISCUSSION

We investigated the adherence to vaccination recommendation after traumatic splenic injury in our institution and found that patients did not receive all the recommended vaccines after splenectomy due to trauma.

Splenectomy decreases the number of memory B cells and marginal zone monocytes, thereby deteriorating the immune response to capsulated bacteria.[13] Although vaccinations are recommended at least 14 days before splenectomy for non-traumatic cases, they are recommended after postoperative day 14 for traumatic causes when splenectomy is not foreseeable.[14]

Table 1. Vaccination statuses of the patients before discharge, after discharge, and final

Vaccine	Before discharge n (%)	After discharge n (%)	Final status n (%)	Number of patients followed for OPSI after discharge	Median follow-up time (months) (min-max)	OPSI
Pneumococ	8 (29.6)	7 (25.9)	5 (18.5)	4	29.4 (4–41.2)	–
PPSV-23	5 (18.5)	4 (14.8)	2 (7.4)	3	33.1 (4–41.2)	–
PCV-13	3 (11.1)	3 (11.1)	3 (11.1)	1	25.7	–
Meningococ	0 (0)	0 (0)	0 (0)	–	–	–
HIB	0 (0)	0 (0)	0 (0)	–	–	–
Pneumococ+Meningococ	1 (3.7)	4 (14.8)	7 (25.9)	4	12.2 (11.2–15.2)	–
PPSV-23+Meningococ	1 (3.7)	3 (11.1)	4 (14.8)	3	11.2 (11.2–13.3)	–
PCV-13+Meningococ	0 (0)	1 (3.7)	3 (11.1)	1	15.2	–
Pneumococ+HIB	5 (18.5)	5 (18.5)	1 (3.7)	4	23.4 (14.2–36.3)	–
PPSV-23+HIB	4 (14.8)	4 (14.8)	1 (3.7)	3	14.5 (14.2–36.3)	–
PCV-13+HIB	1 (3.7)	1 (3.7)	0 (0)	1	32.3	–
Meningococ+HIB	0 (0)	0 (0)	0 (0)	–	–	–
Pneumococ+Meningococ+HIB	0 (0)	0 (0)	5 (18.5)	–	–	–
PPSV-23+Meningococ+HIB	0 (0)	0 (0)	4 (14.8)	–	–	–
PCV-13+Meningococ+HIB	0 (0)	0 (0)	1 (3.7)	–	–	–
Unvaccinated	13 (48.2)	11 (40.8)	9 (33.4)	5	29.4 (5.2–36.9)	–
Total	27 (100)	27 (100)	27 (100)	17	17.8 (4.4–41.2)	–

HIB: Hemophilus Influenza type b; PPSV-23: 23 valent pneumococcal polysaccaride vaccine; PVC-23: 23 valent pneumococcal polysaccharide vaccine; OPSI: Overwhelming post-splenectomy infection; Min: Minimum; Max: Maximum.

Table 2. Clinical and pathological features of the vaccinated and unvaccinated patients before discharge

	Vaccinated	Unvaccinated	p
Number of patients	14 (51.8%)	13 (48.2%)	
Age	32 (22–48)	40 (7–49)	0.45
Gender			
Male	8 (29.6%)	11 (40.7%)	0.29
Female	5 (18.5%)	3 (11.1%)	
AAST grade			
I–III	8 (29.6%)	8 (29.6%)	0.56
IV-V	6 (22.2%)	5 (18.5%)	
Total erytrocyte suspension	3 (0–10)	3 (0–18)	0.75
Total fresh frozen plazma	2 (0–6)	2 (0–6)	0.96
Duration of surgery (minutes)	105 (50–165)	120 (60–150)	0.59
Injury Severity Score	19 (4–75)	25 (4–75)	0.61
Glasgow Coma Scale	15 (3–15)	15 (3–15)	0.44
Hemodynamic Status			
Stable	9 (33.3%)	7 (25.9%)	0.43
Unstable	5 (18.5%)	6 (22.2%)	
Intensive care unit status			
Required	6 (22.2%)	6 (22.2%)	0.58
Not required	8 (29.6%)	7 (25.9%)	
Hospital stay	8.5 (5–31)	8 (0–20)	0.48
Number of consultations	3 (1–7)	3 (1–7)	0.79

AAST: American Association for Surgery of Trauma.

Several studies reported the adherence to vaccination recommendations after splenectomy. Martino et al.[15] reported in their series that 15.1% of the patients had one of the recommended vaccines, and vaccination proportions against S. pneumoniae, N. meningitides, and HIB were 12.6%, 7.8%, and 6%, respectively. Nived et al.[16] stated that of the 79 patients who had splenectomy in their series, vaccination proportions against *S. pneumoniae*, *N. meningitides*, and HIB were 81%, 22.8%, and 51.9%, respectively.

The first guideline for infection prevention in hyposplenia was determined by the British Committee for Standards in Hematology. The following items were the key recommendations for patients with hyposplenia: 1) Patients should have any document which indicates that they have hyposplenia and are in a high-risk infection condition to alert health professionals 2) Education should be given regarding traveling to infection endemic areas, such as those for malaria 3) Patient records should be marked to display the potential risk of infection 4) All patients should receive pneumococcal, meningococcal, HIB, and yearly influenza vaccinations. 5) Revaccination times for pneumococcal, meningococcal, and influenza vaccines should be clearly identified 6) Lifelong prophylactic antibiotics, oral penicillin, or macrolides should be advised to patients at high risk of pneumococcal infection. 7) Patients must carry adequate antibiotics for an emergency infection 8) Patients should be educated to avoid animal bites and tick- or mosquito-borne diseases.[10]

For pneumococcal and meningococcal vaccines, the CDC Advisory Committee on Immunization Practices suggests a repeat dose after the fifth year of splenectomy for both adults and children.[8,9] Kealey et al.[17] assessed the initial and revaccination proportions in patients who underwent splenectomy due to trauma. They reported that initial vaccination proportions were 76%, 75%, and 68% for *S. pneumoniae*, *N. meningitides*, and HIB, respectively, and the revaccination proportions were 39% and 15% for *S. pneumoniae* and *N. meningitides*, respectively. Therefore, education of health care workers and patients is crucial and establishing a vaccination tracking system can improve the completion of the vaccination course. Booster administration of the vaccines was also evaluated by Wang et al.;[3] they reported it to be 76.9% between 2 and <10 years, 82.2% between 10 and <30 years, and 76.7% for ≥30 years after splenectomy. Boam et al.[18] studied the adherence to vaccination recommendations after splenectomy for all indications and reported that 91.5% of their patients received HIB, meningococcus C, and pneumococcus vaccinations peri-operatively, with 84% booster dose administrations for pneumococcus and that 95% of the

patients received annual influenza vaccine. They stated that utilizing electronic health records by general practitioners improved the documentation of health records so that vaccinations can be better administered. However, we do not have any vaccination tracking system currently to improve the vaccination status of our patients.

We also investigated the effective factors for the vaccination status after traumatic splenic injury before the patients were discharged and found no difference. We observed in our clinical experience that some surgeons prescribed either only pneumococcal or all the vaccines, but the administration of the vaccines depended on the availability in the pharmacy. For example, HIB vaccine has been available at different time periods in the Turkish Pharmacy because of the import policy. On the other hand, some surgeons referred their patients to infectious disease clinic for the prescription of necessary vaccines, however, the completion of vaccination depended on the proportion of patients visiting such a clinic. Furthermore, we observed that many physicians did not recommend yearly influenza vaccine and booster doses for PPSV-23 and meningococcal vaccines in this patient group. Nevertheless, this was out of scope of our study, but further investigations on this topic or the establishment of a vaccination tracking system may be helpful to improve the completion of the vaccination course in adequate time.

The benefits of this study included creating awareness regarding missing vaccinations or timing of the vaccination after traumatic splenic injury. Moreover, to the best of our knowledge, there has been no study that reported the ratio of administered vaccines and identified OPSI development according to the combinations of the vaccines, except our study. Furthermore, we limited our study population to only those with traumatic splenic injury, unlike other studies which also included nontraumatic cases. The limitations of our study were as follows: Most patients who had low-grade injury with hemodynamic stability underwent total splenectomy instead of nonoperative management; we had relatively less number of patients and designed our study retrospectively because traumatic splenectomy is not a frequent procedure; and the follow-up time for developing OPSI was <5 years.

Conclusion

Adherence to vaccination recommendations after traumatic splenic injury remains low in our practice. Establishing a vaccination tracking system and following vaccination recommendations will be helpful to prevent serious infections, such as OPSI, after traumatic splenectomy.

Financial Support: None

Conflict of interest: None declared.

REFERENCES

1. Cirocchi R, Boselli C, Corsi A, Farinella E, Listorti C, Trastulli S, et al. Is non-operative management safe and effective for all splenic blunt trauma? A systematic review. Crit Care 2013;17:R185. [CrossRef]
2. Fraker DL. Spleen. In: Doherty GM, editor. Current Diagnosis & Treatment: Surgery. 13th ed. Columbus, OH: The McGraw-Hill Companies, Inc; 2010.
3. Wang J, Jones P, Cheng AC, Leder K. Adherence to infection prevention measures in a statewide spleen registry. Med J Aust 2014;200:538–40.
4. Hansen K, Singer DB. Asplenic-hyposplenic overwhelming sepsis: post-splenectomy sepsis revisited. Pediatr Dev Pathol 2001;4:105–21.
5. Sinwar PD. Overwhelming post splenectomy infection syndrome - review study. Int J Surg 2014;12:1314–6. [CrossRef]
6. Morgan TL, Tomich EB. Overwhelming post-splenectomy infection (OPSI): a case report and review of the literature. J Emerg Med 2012;43:758–63. [CrossRef]
7. Newland A, Provan D, Myint S. Preventing severe infection after splenectomy. BMJ 2005;331:417–8. [CrossRef]
8. Prevention of pneumococcal disease: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recomm Rep 1997;46:1–24.
9. Cohn AC, MacNeil JR, Clark TA, Ortega-Sanchez IR, Briere EZ, Meissner HC, et al; Centers for Disease Control and Prevention (CDC). Prevention and control of meningococcal disease: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recomm Rep 2013;62:1–28.
10. Davies JM, Lewis MP, Wimperis J, Rafi I, Ladhani S, Bolton-Maggs PH; British Committee for Standards in Haematology. Review of guidelines for the prevention and treatment of infection in patients with an absent or dysfunctional spleen: prepared on behalf of the British Committee for Standards in Haematology by a working party of the Haemato-Oncology task force. Br J Haematol 2011;155:308–17. [CrossRef]
11. Carlino C, Zaratti L, Lucciola G, Franco E. National Vaccine Prevention Plan (PNPV) 2012-2014 in the Italian Regions. Ig Sanita Pubbl 2013;69:131–43.
12. Baker SP, O'Neill B, Haddon W Jr, Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. J Trauma 1974;14:187–96. [CrossRef]
13. Leone G, Pizzigallo E. Bacterial Infections Following Splenectomy for Malignant and Nonmalignant Hematologic Diseases. Mediterr J Hematol Infect Dis 2015;7:e2015057. [CrossRef]
14. Shatz DV, Schinsky MF, Pais LB, Romero-Steiner S, Kirton OC, Carlone GM. Immune responses of splenectomized trauma patients to the 23-valent pneumococcal polysaccharide vaccine at 1 versus 7 versus 14 days after splenectomy. J Trauma 1998;44:760–5. [CrossRef]
15. Martino C, Gallone MS, Quarto M, Germinario C, Tafuri S. Immunization coverage among splenectomized patients: Results of an ad hoc survey in Puglia Region (South of Italy). Hum Vaccin Immunother 2016;12:1277–9. [CrossRef]
16. Nived P, Jørgensen CS, Settergren B. Vaccination status and immune response to 13-valent pneumococcal conjugate vaccine in asplenic individuals. Vaccine 2015;33:1688–94. [CrossRef]
17. Kealey GP, Dhungel V, Wideroff MJ, Liao J, Choi K, Skeete DA, et al. Patient education and recall regarding postsplenectomy immunizations. J Surg Res 2015;199:580–5. [CrossRef]
18. Boam T, Sellars P, Isherwood J, Hollobone C, Pollard C, Lloyd DM, Dennison AR, Garcea G. Adherence to vaccination guidelines post splenectomy: A five year follow up study. J Infect Public Health; 2017;10:803–8.

ORİJİNAL ÇALIŞMA - *ÖZET*

Travmatik dalak yaralanmalarından sonra aşılama rehberlerine uyum

Dr. Ahmet Korkut Belli,[1] Dr. Cem Dönmez,[1] Dr. Önder Özcan,[1] Dr. Özcan Dere,[1] Dr. Selmin Dirgen Çaylak,[2] Dr. Funda Dinç Elibol,[3] Dr. Cenk Yazkan,[1] Dr. Nevin Yılmaz,[4] Dr. Okay Nazlı[1]

[1]Muğla Sıtkı Koçman Üniversitesi Tıp Fakültesi, Genel Cerrahi Anabilim Dalı, Muğla
[2]Muğla Sıtkı Koçman Üniversitesi Tıp Fakültesi, Enfeksiyon Hastalıkları Anabilim Dalı, Muğla
[3]Muğla Sıtkı Koçman Üniversitesi Tıp Fakültesi, Radyoloji Anabilim Dalı, Muğla
[4]Muğla Sıtkı Koçman Üniversitesi Tıp Fakültesi, Gastroenteroloji Anabilim Dalı, Muğla

AMAÇ: Postsplenektomi sepsis hiposplenizm gelişen hastalarda 50 kat artan ciddi bir enfeksiyondur. Bu çalışmanın amacı travmatik dalak yaralanmalarından sonra aşılama rehberlerine ne kadar uyulduğunun tespit edilmesidir.

GEREÇ VE YÖNTEM: Mayıs 2012–Mart 2016 tarihleri arasında karın travması sebebiyle total splenektomi yapılan hastalar çalışmaya dahil edildi. Hastların klinik, labaratuvar ve patoloji verileri kaydedildi. Taburculuk öncesi, sonrası ve de nihai aşılanma oranları ayrı ayrı belirlendi.

BULGULAR: Yirmi yedi hastaya total splenektomi yapılmıştı. Taburculuk öncesi, sonrası ve nihai aşılama oranları sırasıyla şu şekildeydi: Her üç aşının yapılma oranı 0 (%0), 0 (%0) ve 8 (%18.5) idi. Hiç aşılama yapılmama oranları ise 13 (%48.2), 11 (%40.8) ve 9 (%33.4) idi. Postsplenektomi sepsis gelişmesi açısından 17 hastanın verisi mevcuttu. Ortanca takip süresi 17.8 (4.4–41.2) aydı ve hiçbir olguda postsplenektomi sepsis gelişmedi.

TARTIŞMA: Aşılama rehberlerine uyum düşük seyretmektedir. Aşılama takip sistemi kurulması ve aşılama rehberlerine daha fazla uyum sağlanması postsplenektomi sepsis gibi ciddi enfeksiyonları önleyecektir.

Anahtar sözcükler: Aşılama; dalak; enfeksiyon; gastroenteroloji; mikrobiyoloji; travma.

Ulus Travma Acil Cerrahi Derg 2018;24(4):337-342 doi: 10.5505/tjtes.2017.84584