EXPERIMENTAL STUDY

Which common test should be used to assess spleen autotransplant effect?

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ABSTRACT

BACKGROUND: Historically, total splenectomy was the only choice of treatment for traumatic splenic injuries. However, non-operative management and spleen-preserving surgical techniques are preferred in modern medicine. In some situations in which the surgeon has to perform splenectomy, spleen autotransplant may preserve the splenic function. Selecting the best method for evaluating the splenic autotransplant effect has been debated for several years. In this study, we compared three common tests in evaluating the implanted spleen function.

METHODS: Participants included 10 patients who were candidates for laparotomy and splenectomy. After performing splenectomy, we implanted five pieces of the spleen in the greater omentum of each patient. After 3 months, the implanted spleen function was evaluated by nuclear red blood cell (RBC) scan, serum immunoglobulin (Ig) M level, and presence of Howell–Jolly (HJ) bodies in the peripheral blood smear.

RESULTS: All patients had normal peripheral blood smear. The IgM level was lower than normal in one patient, and scintigraphy did not demonstrate the transplanted spleen in another patient.

CONCLUSION: All these tests may have comparable results, but because of availability and low cost of peripheral blood smear, which is also easily performed, it can be considered as the first option to evaluate the implanted spleen function.

Keywords: IgM level; nuclear red blood cell scan; spleen autotransplant; spleen function; splenectomy.

INTRODUCTION

Spleen is a lymphoid organ and plays an important role in the immune system, especially in filtration processes, phagocytosis, and immunoglobulin production.[1,2]

Historically, total splenectomy was the only treatment option for splenic injuries. For a long time, the general belief was that living without the spleen does not cause any significant consequences.[1,3–5] An increased knowledge of the importance of the immunological functions of the spleen and recognition of overwhelming postsplenectomy infection resulted in the development of spleen-preserving procedures such as splenorrhaphy and partial splenectomy. However, in cases of shattered spleens and complete hilum avulsion, the only choice is total splenectomy in which reimplanting spleen in the omentum is the suggested procedure.[1,3,6,7] In order to prevent hematological and immunological disorders, 10% and 25% of the splenic tissue should be preserved, respectively.[2,8] Smaller fragments are insufficient to prevent encapsulated bacterial infections.[9,10]

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While splenectomy is inevitable in some trauma cases, spleen autotransplantation is well-accepted as one of the standard procedures, especially in young patients to preserve their splenic function.[11,12]

The evaluation of active and functional autotransplanted spleen slices is usually based on the nuclear red blood cell (RBC) scan, serum immunoglobulin (Ig) M level, and capability of these fragments in the blood filtration of Howell–Jolly (HJ) bodies.[13–16] The aim of this study was to evaluate the false-negative and false-positive rates of these tests after spleen autotransplantation.

MATERIALS AND METHODS

This prospective study was conducted from September 2011 to June 2014. The study was approved by the ethics committee of Mashhad University of Medical Sciences. Participants included 10 patients (8 males and 2 females) with traumatic splenic rupture in whom total splenectomy was performed. Patients with other concomitant abdominal injuries and those who were not accessible for follow-up were excluded from the study. After completion of the splenectomy, the spleen was cut into five fragments (3×40×40 mm), which were implanted into the omentum. No drain was used.

All patients were operated by the same surgeon. Vaccinations against pneumococcus, meningococcus, Haemophilus influenza, and influenza viruses were administered. Moreover, the patients were informed about the risks and symptoms of overwhelming postsplenectomy infection. Ten days postoperatively, the patients were visited by the surgeons and were recommended to restrict their sports activities for 4 weeks. Three months later, the success rate of the autotransplantation was evaluated by measuring the serum IgM level, examining the peripheral blood smears (PBS) for detection of HJ bodies, and using scintigraphy (nuclear RBC scan). All examinations were performed in a standardized manner in the same teaching hospital.

RESULTS

The mean age of the patients was 20.7 (16–30) years. Abdominal blunt trauma was the main reason for splenic rupture in the participants. The causes of trauma were road traffic accidents in 80%, civil strife in 10%, and falls in 10%. The mean hospital stay was 4 (3–5) days. No significant complications including deep or portal vein thrombosis, severe thrombocytosis, hematoma, intra-abdominal bleeding, and surgical site infection were observed. Chronic vague mid-abdominal pain was the chief complaint in six patients, which was resolved in all patients during the follow-up period.

Results of the examinations performed 3 months postoperatively indicated normal peripheral blood smear in all patients, which means that the HJ bodies were not detected in their PBS and the implanted spleen was functional. At this time, only in one patient, the IgM level decreased. This patient was a 22-year-old male whose PBS and nuclear RBC scan findings were normal. The nuclear RBC scan did not show detectable absorption in the implantation area in a 25-year-old woman with normal PBS and IgM level (Fig. 1). Table 1 demonstrates the results of different types of examination used in the evaluation of the implanted spleen function.

Table 1. Results of different types of examination in evaluating the implanted spleen function

Patient	Age	Gender	PBS	Ig M level	Nuclear scan
1	17	Male	Normal	Normal	Positive
2	19	Male	Normal	Normal	Positive
3	22	Male	Normal	Abnormal	Positive
4	17	Male	Normal	Normal	Positive
5	25	Female	Normal	Normal	Negative
6	19	Male	Normal	Normal	Positive
7	30	Male	Normal	Normal	Positive
8	16	Female	Normal	Normal	Positive
9	21	Male	Normal	Normal	Positive
10	21	Male	Normal	Normal	Positive

PBS: Peripheral blood smear; IgM: Immunoglobulin M.

DISCUSSION

Today, because of improvements in roads' and vehicle's safety

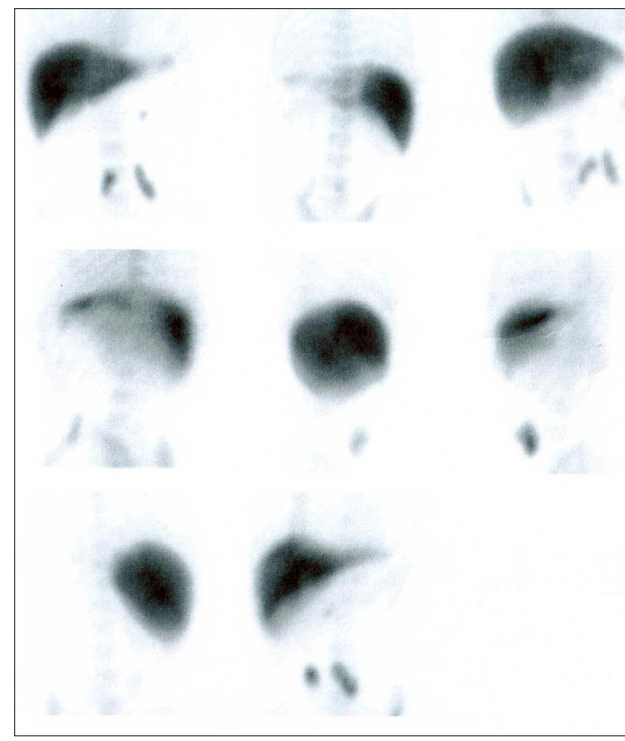

Figure 1. Nuclear RBC scan in a 25-year-old woman with normal PBS and IgM level.

and more restrictive traffic rules, the number of emergent laparotomies for trauma has decreased. In addition, our knowledge about the importance of spleen's immune function has led to the development of new management methods such as non-operative therapy and spleen-preserving surgeries such as splenic artery embolization, splenic artery binding, splenorrhaphy, and partial splenectomy.[6,17–19] Moreover, when total splenectomy is mandatory or inevitable, splenic autotransplantation is recommended.[20,21] Preserving the spleen can prevent reduction in antibodies, which without transplantation decreases up to less than one-tenth of those in healthy individuals.[22] In addition, the chemotaxis ability of not only antibodies but also macrophages and neutrophils reduces in patients without spleen,[1,23] which can be prevented by new treatment methods. Recent studies have revealed the role of the spleen in preventing atherosclerosis by lipid metabolism, which highlights the importance of spleen preservation.[24]

Since 1986 when spleen autotransplantation was performed in animals, several reports of human spleen autotransplantation have been presented.[1,25–27] Although the effectiveness of spleen autotransplantation on different parts of the body, such as the omentum, peritoneal cavity, retroperitoneum, intraportal, abdominal muscle, armpits, and liver, has been proven, the greater omentum has been favored as the appropriate location for autotransplantation.[1,2,6,21,25,28] There are some advantages and disadvantages of selecting the omentum. The advantages include suitable compliance, free space for implanted spleen slices to grow, and efficient revascularization. The disadvantages attributed to the selection of this location are intrabdominal implant migration, increasing the rate of intrabdominal adhesions, and abscesses formation.[1,2,4,8,21]

The next step after spleen autotransplantation is evaluating the effectiveness and success of the operation. Because blood filtration is an important function of the spleen, determining the presence of HJ bodies is recognized as a method for evaluating the viability of the implanted spleen. The spleen acts as a voluminous filter removing senescent and altered erythrocytes and particles such as HJ, Heinz, and Pappenheimer bodies.[3,30,31] Although the presence of HJ bodies in PBS is not pathognomonic, it is considered as suggestive of splenic dysfunction or aspleny.[3,32] It is known that although in patients with slight hypospleny, HJ bodies may not be present, their presence denotes a degree of splenic dysfunction and represents the risk of fulminant infection onset.[3] In this study, all patients had normal PBS, which showed that the filtration function of the spleen slices was acceptable.

Because of the main role of Ig production in the spleen, we expect that by enough regeneration of the spleen slices, the plasma or serum IgM level will elevate to normal levels. This has been suggested in previous studies, and normal IgM levels suggest normal function of the regenerated implants.[32,33] In our study, only in one patient, enough IgM level was not observed. The patient's other tests were normal, which suggested that the implants were alive and functional.

Furthermore, as the normal spleen tissue can absorb nuclear RBCs by 99mTc-denatured red blood cells, scintigraphy has been one of the popular tests for evaluating implants.[29,33,34] In our study, only one patient had negative nuclear RBC scan, although results of other tests were satisfactory or normal.

Our findings demonstrate that all these three tests could be acceptable for evaluating alive and functional autotransplanted spleen slices, and each one can be substituted if the others are not available.

According to our findings, positive and negative predictive values of these three tests are comparable. However, considering cost–benefit and availability, PBS may be the best option. However, when the test results are ambiguous or not predicted, we should re-examine the results through an alternative method.

Despite the limitations of our study, including small sample size, we recommend using PBS as the first option in paraclinical evaluation of alive and functional implanted spleen due to its availability and low cost, which can be easily performed.

Finally, to achieve a comprehensive conclusion, we suggest a larger multicentric study to be planned appropriately.

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Conflict of interest: None declared.

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DENEYSEL ÇALIŞMA - *ÖZET*

Dalak ototransplatının etkisini değerlendirme? Hangi sık kullanılan testi seçelim?

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AMAÇ: Eskiden total splenektomi travmatik dalak yaralanmalarında tek seçimdi. Ancak modern tıpta cerrahidışı tedavi ve dalağı koruyucu teknikler tercih edilmektedir. Cerrahın splenektomi uygulamaya sevk edildiği bazı durumlarda dalağın ototransplantasyonu dalak fonksiyonunu koruyabilir. Dalak ototransplantı etkisini en iyi değerlendirme yönteminin seçimi yıllarca tartışma konusu olmuştur. Bu çalışmada implante edilmiş dalağın fonksiyonunu değerlendirmede çokça kullanılan üç testi karşılaştırdık.

GEREÇ VE YÖNTEM: Laparotomi ve splenektomi adayı 10 hasta çalışma katılımcılarını oluşturmuştu. Splenektomi yaptıktan sonra her hastanın omentum majusu içine beş dalak parçası implante ettik. Üç ay sonra implante edilmiş dalağın fonksiyonu nükleer eritrosit sintigrafisi, periferik kanda serum immünoglobülin M (IgM) düzeyif ve Howell-Jolly (HJ) cisimciklerinin varlığıyla değerlendirildi.

BULGULAR: Hastaların hepsinde periferik kandan yapılan yayma testi patolojik değildi. Yalnızca bir olguda IgM düzeyi normalden düşüktü, başka birinde sintigrafi nakledilen böbreği göstermemişti.

TARTIŞMA: Bu testlerin tümünde benzer sonuçlar alınabilir. Ancak bulunabilirliği, düşük maliyeti ve kolayca uygulanabilirliği nedeniyle periferik kandan yayma preparatının implante edilmiş dalak fonksiyonunu değerlendirmede ilk seçenek olduğu düşünülebilir.

Anahtar sözcükler: Dalak fonksiyonu; dalak ototransplantı, IgM düzeyi; nükleer eritrosit taraması; splenektomi.

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