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ORIGINAL ARTICLE

Predictive factors associated with long-term effects of laparoscopic splenectomy for chronic immune thrombocytopenia

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Abstract The purpose of this study was to investigate the long-term effects of laparoscopic splenectomy (LS) for patients with chronic immune thrombocytopenia (ITP), and to identify predictive factors for promising hematological outcomes. We retrospectively analyzed the clinical records and follow-up data in patients who underwent LS for chronic ITP from November 2005 to August 2012. The related parameters were assessed by univariate and multivariate logistic regression analyses. The curve of life table was drawn to clarify the long-term response rate. Of the 92 included patients, 49 (53.3 %) patients achieved a complete response, 21 patients (22.8 %) a partial response, and the remaining 22 (23.9 %) showed no response to LS. Eleven patients relapsed within 1 year after LS, especially within 3 months ($n = 7$), while three patients relapsed 17, 26, and 28 months after LS, respectively. Long-term specific complications after LS were not observed. Platelet counts on postoperative month 3 (POM 3) is a significant independent predictor of long-term favorable hematological outcomes ($P < 0.001$). Based on our study, we conclude that LS is associated with promising long-term response for patients with chronic ITP, and platelet counts on POM 3 could be used as a predictor of long-term hematological outcome.

Keywords Laparoscopic splenectomy · Chronic immune thrombocytopenia · Follow-up

Introduction

Chronic immune thrombocytopenia (ITP) is a common autoimmune hematological disorder, which is characterized by antibody-mediated platelet destruction, mainly occurring in reticuloendothelial system such as spleen [1, 2], together with suppression of platelet production [3]. Corticosteroids were the initial medical treatment for patients with ITP since 1951 [4], and still considered as the front-line therapy method in ITP according to the guidelines [5, 6]. Unfortunately, with time, nearly 60–80 % of the patients will be at risk of developing steroid dependent [7], and the adverse effects of corticosteroids will become apparent. Therefore, splenectomy is regarded as the second-line treatment for patients with ITP who fail to respond to steroids [5, 8].

Since it was reported by Delaitre in 1991 [9], laparoscopic splenectomy (LS) has arisen great interest among surgeons in surgical treatment of hematological disorders, and afterwards become the standard procedure for removal of normal to moderately enlarged spleens in benign conditions, especially ITP [10]. Just like other mini-invasive surgeries, LS has shown some advantages including shorter hospital stay, reduced costs, less blood loss, and better

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cosmetic outcomes. The early results of LS for ITP are encouraging, however, the existing literature resources pertaining to ongoing long-term outcomes of LS in ITP patients are not abundant enough.

In this study, we assessed long-term therapeutic effects of LS for patients with ITP and tried to determine the strategy of platelet surveillance as well as the predictive factors for satisfying hematological outcomes.

Materials and methods

Patients

From November 2005 to August 2012, LS was consecutively performed for 142 patients with chronic ITP (including 10 patients with a preoperative platelet count of $<1 \times 10^9$/L, who were enrolled in our previous study [11]) at the Department of Hepatopancreatobiliary Surgery, West China Hospital, Sichuan University, China. Diagnosis of ITP was based on a platelet count $<100 \times 10^9$/L in the absence of other causes or disorders that may be associated with thrombocytopenia [6], and then confirmed by postoperative pathologic examination. Patients (16 years or older) with a period of follow-up at least 12 months were included, and the details for exclusion are illustrated in Fig. 1. Data were retrospectively collected from patients' medical records and personal telephones, involving age, gender, preoperative information (platelet counts just before operation, preoperative treatment, time from diagnosis to LS, length of spleen), intraoperative information (accessory spleens, estimated blood loss, operative time), short-term and long-term information (duration of follow-up, platelet counts during follow-up, and major postoperative complications, postoperative therapy). Informed consent forms were obtained from all patients in our study, which was admitted by the Ethics Committee of Sichuan University.

Ninety-two patients (including 7 duplications of the 10 patients mentioned above based on our inclusion and exclusion criteria in Fig. 1) with a median follow-up of 21.5 months (quartile 17.0–26.8 months) containing all of the above-mentioned information were available. Prior to LS, all of the patients received a regular medical treatment for 6 months, and the course of a high dose (steroid pulse) of prednisolone combined with intravenous immunoglobin (IVIG) 20 g/day (400 mg/kg) for 5 days was of the essence within these 6 months [11]. Except the period of the regular medical treatment, 43 patients received only steroids treatment, while the left 49 ones received steroids combined with others such as danazol, vincristine, platelet transfusion, and so on. Indications for splenectomy were as follows: (1) refractory symptomatic thrombocytopenia after 3–6 months of corticosteroids therapy, (2) contraindications to corticosteroid in the patient, and (3) relapse of thrombocytopenia after an initial response to medical therapy or intolerant doses of steroids are required to achieve remission [12].

Criteria of response to LS

The response criteria were defined following the recent update guideline reported by the American Society of Hematology [6]: (1) complete response (CR): a platelet count $\geq 100 \times 10^9$/L measured on 2 occasions >7 days

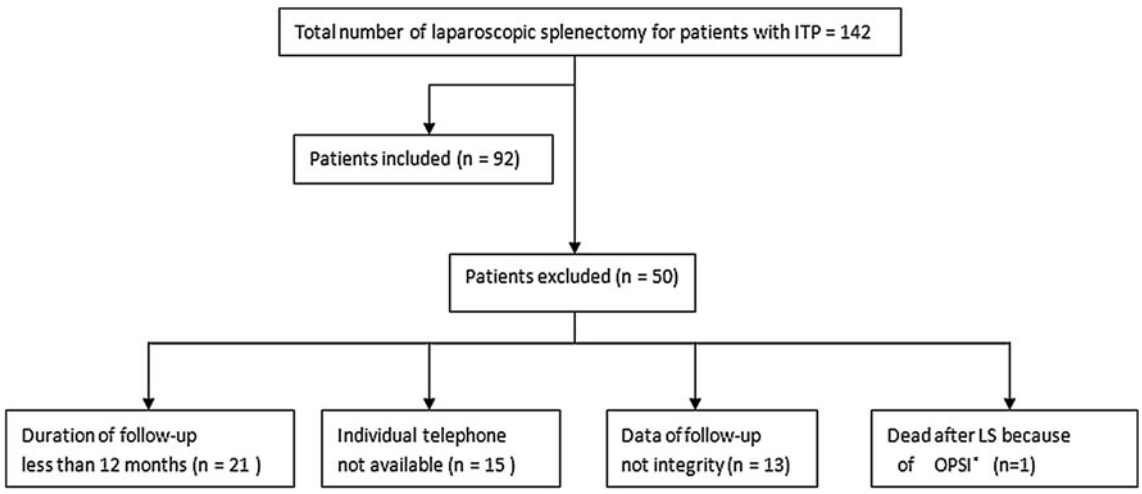

Fig. 1 Inclusion and exclusion criteria. *OPSI** overwhelming postsplenectomy infection

apart without bleeding and medical treatment. (2) partial response (PR): a platelet count $\geq 30 \times 10^9$/L and more than 2-times increase in platelet count from baseline measured on 2 occasions >7 days apart without bleeding and medical treatment. (3) no response (NR): a platelet count $<30 \times 10^9$/L, less than 2-times increase in platelet count from baseline, the presence of bleeding, or the requirement of medical treatment.

LS procedure and statistical analysis

The process of LS for ITP has been detailed in our previous reports [11, 13]. Blood samples were examined on a day before LS and postoperative days (POD) 1, 3, 5. When discharged, patients were informed to have their blood samples examined on postoperative months (POM) 1, 3, 6, moving into long-term follow-up stage afterwards. For quantitative data, the results are expressed as mean ± standard deviation, or median and quartile, while for categorical data, number of cases and percentage are applied. To facilitate statistical analysis, we combine CR group with PR group as a single one named response group (RG), and the NR group was called NG for short. The related variables were evaluated by univariate analysis using the Chi-square or Fisher's exact test for categorical data and the nonparametric Mann–Whitney U test, or Student's t test for quantitative data. Afterwards, multivariate logistic regression with the forward stepwise method and likelihood ratio was used to determine independent predictors for long-term favorable hematological outcomes. The curve of life table was plotted to describe the long-term response rate. SPSS 16.0 (SPSS, Chicago, IL, USA) for windows was used to perform statistical analyses, and a P value <0.05 was considered statistically significant.

Results

The baseline characteristics of included patients are shown in Table 1. The mean age of the patients (62 women and 30 men) was 37.8-year old. The median operative time was 105 min (quartile 80–130 min), and the median of estimated intraoperative blood loss was 60.0 mL (quartile 30.0–90.0 mL). 11 patients were found to have accessory spleens. The median of craniocaudal spleen length which was detected by computer tomography (CT) scan before LS was 11.0 cm (quartile 10.0–12.0 cm). The remission rate was 76.1 % (70 patients), with CR in 49 cases (53.3 %), and PR in 21 cases (22.8 %). 22 patients (23.9 %) had no response to LS. The incidence of major postoperative complications was 27.2 % (25 patients). Four patients were diagnosed with pancreatic leakage, and they were treated with antibiotics as well as somatostatin until the level of amylase of the drainage fluid was normal (e.g., one patient presented persist ache in upper abdomen with a fever of 38.7 °C on postoperative day 5. The concentration of amylase in the drainage fluid was 3350 U/L. Therefore, pancreatic leakage was taken into consideration, and antibiotics combined with somatostatin were put into use. On postoperative day 11, the level of amylase of the drainage fluid was normal and the manifestations of abdominal pain and fever disappeared). The eight patients diagnosed with pleural effusion or splenic fossa collections were treated by B-ultrasound-guided percutaneous drainage, combined with medicines and nutritional support. Antibiotics were used for the seven patients suffering pneumonia. Asymptomatic portal of splenic thrombosis was found in six patients by CT scan, and low-molecular-weight heparin was employed. When discharged, all of the six patients were informed return visit 3 months later, and the thrombus disappeared according to CT scan.

Table 1 Basic characteristics of all patients

Parameters	Value
Age (years)	37.8 ± 16.8
Gender (female/male)	62/30
Operative time (min)	105.0 (80.0–130.0)
Estimated intraoperative blood loss (mL)	60.0 (30.0–90.0)
Incidence of accessory spleens	11 (12 %)
Duration of follow-up (months)	21.5 (17.0–26.8)
Spleen length (cm)	11.0 (10.0–12.0)
Long-term response	
Complete response	49 (53.3 %)
Partial response	21 (22.8 %)
No response	22 (23.9 %)
Major postoperative complications	25 (27.2 %)
Pancreatic leakage	4
Pleural effusion	1
Splenic fossa collection	7
Pneumonia	7
Portal of splenic thrombosis	6

Correlations between the related variables listed in Table 2 and response to LS after long-term follow-up were examined by univariate analysis. Age, platelet counts on POD 1, 3, 5, and POM 1, 3, 6 were found to have a predictive value for long-term response. Compared with NG, the age of RG was younger (35.9 ± 16.7 vs. 43.7 ± 16.4 years, $P < 0.05$). The differences of platelet counts between NG and RG on POD 1, 3, 5, and POM 1, 3, 6 reached obviously statistical significance. All of the above-mentioned significant variables were then put into multivariate logistic regression analysis, which confirmed

Table 2 Univariate analysis of all patients related to response to LS

Variables	All patients	Response to LS		*P* value
		RG[a]	NG[b]	
Age (years)		35.9 ± 16.7	43.7 ± 16.4	0.046
Gender				
Male	30	20	10	NS[c]
Female	62	50	12	
Spleen length (cm)		11.0 (10.0–12.3)	11.0 (10.0–12.3)	NS[c]
Preoperative				
Platelet counts ($\times 10^9$/L)		12.0 (6.0–27.0)	10.5 (4.0–17.3)	NS[c]
Early response[d] ($\times 10^9$/L), days				
1		69.0 (46.3–112.0)	44.0 (9.8–66.0)	<0.001
3		188.5 (115.0–263.5)	42.5 (14.0–128.8)	<0.001
5		274.0 (175.8–393.5)	58.0 (21.0–143.8)	<0.001
Late response[e] ($\times 10^9$/L), months				
1		174.0 (104.0–300.3)	31.0 (10.3–57.3)	<0.001
3		135.5 (98.8–221.5)	23.5 (6.0–37.8)	<0.001
6		138.5 (93.8–198.3)	17.0 (8.5–48.3)	<0.001
Accessory spleens				
Yes	81	61	20	NS[c]
No	11	9	2	
Medical management				
Steroids only	43	35	8	NS[c]
Steroids and others	49	35	14	
Blood loss (mL)		60.0 (27.5–90.0)	55.0 (27.5–100.0)	NS[c]
Time from diagnosis to LS (months)		26.5 (8.5–98.0)	31.0 (23.0–63.8)	NS[c]
Preoperative platelet transfusion				
Yes	14	9	5	NS[c]
No	78	61	17	

[a] Response group including complete and partial response groups
[b] No response group
[c] No significance
[d] Platelet counts on POD 1, 3, 5
[e] Platelet counts on POM 1, 3, 6

Table 3 Multivariate analysis of all patients related to response to LS

Variables	β	SE	EXP (β)	95 % CI	*P* value
Late response (3 months)[a]	0.048	0.011	1.049	1.027–1.073	<0.001
Constant	−2.546	0.075	0.078		<0.001

[a] Platelet counts on POM 3

that only the platelet counts on POM 3 was a significant independent prognostic factor for long-term response to LS ($P < 0.001$). The details of multivariate logistic regression analysis are shown in Table 3.

The detailed information of the twenty-two patients who relapsed after LS or were refractory to LS is displayed in Table 4. Eight patients (five females, three males) had no response to LS; Eleven patients (two females, nine males) had initial response to LS, however, they relapsed 1–12 months after surgery; There were another three female patients having a long period of responding to LS, but unfortunately, they relapsed 17, 26, and 28 months after the operation, respectively. Except one, the left twenty-one patients were treated with medicines; nonetheless, the outcomes left much to be desired. Table life curve (Fig. 2) was also drawn to illustrate the long-term response, which revealed that the relapsed events mainly occurred within 1 year after LS, especially within 3 months ($n = 7$) according to our research, and the long-term response can reach 76.1 %. In consideration of quite a few censored data, the median response duration was not given (Fig. 2).

There were no deaths during follow-up. No specific complications occurred during the follow-up.

Discussion

Various degrees of mucocutaneous bleeding and menorrhagia in women are the key clinical manifestations of chronic ITP, and patients with platelet counts continuously $<30 \times 10^9$/L are at high risk of life-threatening bleeding. Corticosteroids were the first choice treatment for ITP. After a course of therapy with corticosteroids such as daily

Table 4 The information of patients who relapsed or were refractory to LS

Number	Age (years)	Gender	Preoperative platelet counts ($\times 10^9$/L)	Treatment after LS	Duration of follow-up (months)	Last platelet counts ($\times 10^9$/L)	Postoperative recurrence time (months)
1	75	F	13	PDN + TCM	28	31	1
2	21	M	3	PDN + TCM	28	34	3
3[a]	37	F	21	PDN + IVIG	24	17	–
4	47	F	47	PDN	21	21	17
5	45	M	2	PDN + DNZ + azathioprine	23	3	3
6[a]	57	F	17	PDN + IVIG + TCM	25	18	–
7[a]	23	M	7	PDN	34	13	–
8	28	M	4	PDN + DNZ	21	12	3
9[a]	58	M	4	PDN + DNZ + IVIG	17	8	–
10[a]	54	F	4	PDN + DNZ + vincristine	15	6	–
11	19	M	11	PDN + IVIG + TCM	19	77	3
12	15	M	15	PDN	21	24	3
13[a]	64	F	3	PDN + DNZ	17	39	–
14	46	M	14	PDN + TCM	32	17	3
15	38	M	10	PDN	12	67	12
16	63	M	12	–	24	4	6
17	48	M	7	PDN	17	43	6
18[a]	41	M	69	PDN + TCM	16	7	–
19	61	F	18	PDN + TCM	19	31	26
20	18	F	9	PDN + DNZ	19	35	6
21[a]	49	F	6	PDN + DNZ + IVIG	16	29	–
22	47	F	24	PDN	21	42	28

PDN prednisolone, *TCM* traditional Chinese medicine, *IVIG* intravenous immunoglobin, *DNZ* danazol

[a] Patients refractory to LS

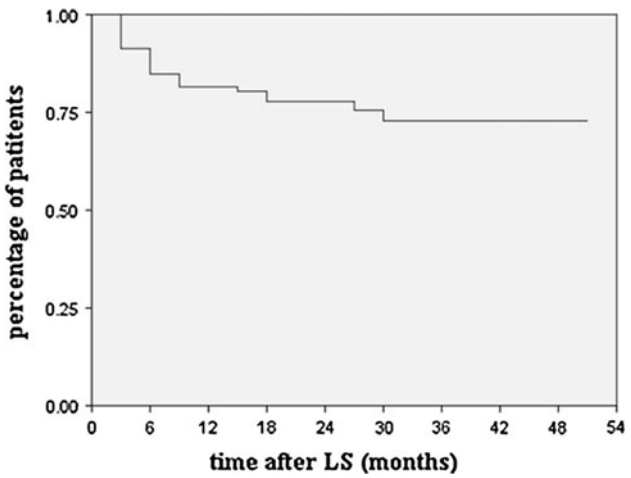

Fig. 2 Curve of response to LS

oral prednisone, the complete remission rate ranges from 10 to 30 % [14]. Where high-dose, pulsed dexamethasone used, the complete remission would reach as much as 60–80 % [15, 16]. However, as time goes on, about 12–36 % of patients will relapse [17–20], nearly 60–80 % of the patients will develop steroid dependent [7], and the severe side effects of steroids such as hypertension and diabetes should be taken into consideration. Along with the advancement in understanding the pathogenesis of ITP, some novel treatments such as anti-CD20 antibodies [21] and thrombopoietin receptor agonists (TPO-RAs) [22, 23] have come into being; however, their efficacy and safety should be compared with splenectomy, and it is important to re-examine and analyze the long-term effects of LS and the predictive factors for good outcomes.

Splenectomy due to ITP, the therapeutic rationale of which is for removing both the primary site of platelet destruction and an important site of antiplatelet antibody production, [24] is recommended as the standard second-line treatment for patients with ITP after failure of steroids [5, 8, 10]. A systematic review including 135 case-series published between 1996 and 2004 documented that 66 % of the patients with a median duration of follow-up of 28 months reached complete and long-term response [8]. A current systematic review of 23 articles including 1223 ITP patients undergoing LS revealed that 72 % of the patients achieved response lasting for 5 years [25]. Although LS

has a high success rate, relapse cases should not be ignored. In our study, most of the relapses occurred within the first year after LS, especially within 3 months, which is in agreement with the previous study [26]. Three female patients were observed to have late relapses up to 17, 26, and 28 months respectively.

Although encouraging short-term hematological outcomes and postoperative advantages of LS for ITP were investigated, it would be beneficial to explore predictive factors for long-term favorable hematological results. Published studies [19, 20, 27–29] have determined the predictive factors for success after surgery, involving age, previous response to medical treatment, interval from diagnosis to splenectomy, preoperative platelet counts, site of platelet sequestration and platelet survival. However, their conclusions were based on different definitions of response.

Our definition of response to splenectomy is based on the latest practice guideline reported by the American Society of Hematology [6]. According to this criteria, younger patients were found likely to have better hematological results than older ones (35.9 ± 16.7 vs. 43.7 ± 16.4 years, $P < 0.05$), which is in agreement with some studies [20, 30], but at variance with others [17, 31]. Regretfully, age did not play a significant role in predicting long-term response independently when being put into multivariate logistic regression analysis. Duperier et al. [19] pointed out that patients with a preoperative platelet count greater than 70×10^9/L would benefit more after LS, while other authors [29, 32] have failed to consider preoperative platelet counts as an ideal predictor regarding response to LS. In our study, we found no significant difference of preoperative platelet counts between RG and NG. Analyzed by univariate and multivariate logistic regression methods, the parameter of preoperative platelet counts was not our desired predictor. Although their roles of predictive effect with respect to responding to LS were controversial, like age and preoperative platelet counts, the valuables in our study including gender, spleen length, accessory spleen, medical management, intraoperative estimated blood loss, time from diagnosis to LS, and preoperative platelet transfusion were not statistically significant predictors.

In regard to postoperative predictive factors, it was reported that the change of platelet count within 4 weeks after surgery significantly correlated with the response to splenectomy [19, 26]. In our study, dynamic monitoring platelet counts of all included patients revealed that the variable of platelet counts on POM 3 was a statistically significant independent prognostic factor according to univariate and multivariate logistic regression analyses. There may be two reasons resulting in the different conclusions: (1) comparing the basic characteristics of patients in our research with those in the studies of Zoghlami-Rintelen's and Duperier's, we found that our sample size was somewhat larger (92 vs. 67, 48), and the levels of preoperative platelet counts were different; (2) In our study, we reported that 11 patients relapsed within 1 year after LS, especially within 3 months ($n = 7$), so maybe POM 3 is a critical point for long-term response to LS, with the result that platelet counts on POM 3 could be used as a predictor. However, this conclusion should be confirmed by large samples, multi-center clinical trials, and evidence-based medicine. Although we could not make decision before LS, a high platelet count on POM 3 does suggest a long-term response and could be used to inspire confidence in the patients.

It was reported that the 30-day mortality rate after LS was 0.2 % [8], and in our study, only one patient (0.6 %), who was excluded from long-term follow-up died of overwhelming postsplenectomy infection (OPSI) after LS on POD 5, which is the major long-term complication with the incidence <1 % in adults [33]. In the present study, no fatal infections except common colds were observed in some patients during the long-term follow-up. Even so, the life-threatening complication should be taken into serious consideration. All febrile illnesses must be carefully evaluated, and intravenous antibiotics should be put into use if any systemic illness with fever of 38 °C or higher exists until bacterial sepsis can be excluded [7]. Vascular complications can not be ignored, either. It was reported that venous thromboembolism (VT) occurred in up to 10 % of patients with hematologic diseases after splenectomy [12, 34]. With the help of Doppler ultrasound or CT scan, asymptomatic cases will be detected, and the incidence of portal vein thrombosis will reach as high as 37 % [35, 36]. Six patients with asymptomatic portal of splenic thrombosis were detected in our study with thrombus disappearing 3 months after surgery.

In summary, although our study was nonrandomized, retrospective, the follow-up time is not long enough, and no preoperative predictive factors were determined; our results give the opinion that LS is associated with encouraging long-term response for patients with chronic ITP, the dynamic surveillance of platelet counts after surgery is of importance, and platelet counts on POM 3 can be used as a predictor of long-term hematological outcome. Although it is not correlated with long-term outcome based on our study, age should be considered when selecting patients. We suggest that the future research should focus on biological or immunological markers that can objectively, exactly, and easily predict the long-term results of LS for patients with chronic ITP.

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Conflict of interest No competing financial interests exist

References

1. McMillan R. Chronic idiopathic thrombocytopenic purpura. N Engl J Med. 1981;304:1135–47.
2. Cines DB, Blanchette VS. Immune thrombocytopenic purpura. N Engl J Med. 2002;346:995–1008.
3. McMillan R. The pathogenesis of chronic immune thrombocytopenic purpura. Semin Hematol. 2007;44:S3–11.
4. Bethell FH, Meyers MC, Miller S, Bullock WH. Effects of ACTH and cortisone on idiopathic thrombocytopenic purpura. Trans Assoc Am Phys. 1951;64:199–203.
5. Provan D, Stasi R, Newland AC, Blanchette VS, Bolton-Maggs P, Bussel JB, et al. International consensus report on the investigation and management of primary immune thrombocytopenia. Blood. 2010;115:168–86.
6. Neunert C, Lim W, Crowther M, Cohen A, Solberg L Jr, Crowther MA. The American Society of Hematology 2011 evidence-based practice guideline for immune thrombocytopenia. Blood. 2011;117:4190–207.
7. Cines DB, Bussel JB. How I treat idiopathic thrombocytopenic purpura (ITP). Blood. 2005;106:2244–51.
8. Kojouri K, Vesely SK, Terrell DR, George JN. Splenectomy for adult patients with idiopathic thrombocytopenic purpura: a systematic review to assess long-term platelet count responses, prediction of response, and surgical complications. Blood. 2004;104:2623–34.
9. Delaitre B, Maignien B. Splenectomy by the laparoscopic approach. Report of a case. Presse Med. 1991;20:2263.
10. Friedman RL, Fallas MJ, Carroll BJ, Hiatt JR, Phillips EH. Laparoscopic splenectomy for ITP. The gold standard. Surg Endosc. 1996;10:991–5.
11. Wu Z, Zhou J, Pankaj P, Peng B. Laparoscopic splenectomy for immune thrombocytopenia (ITP) patients with platelet counts lower than 1 × 109/L. Int J Hematol. 2011;94:533–8.
12. Cordera F, Long KH, Nagorney DM, McMurtry EK, Schleck C, Ilstrup D, et al. Open versus laparoscopic splenectomy for idiopathic thrombocytopenic purpura: clinical and economic analysis. Surgery. 2003;134:45–52.
13. Cai YQ, Zhou J, Chen XD, Wang YC, Wu Z, Peng B. Laparoscopic splenectomy is an effective and safe intervention for hypersplenism secondary to liver cirrhosis. Surg Endosc. 2011;25:3791–7.
14. George JN, el-Harake MA, Raskob GE. Chronic idiopathic thrombocytopenic purpura. N Engl J Med. 1994;331:1207–11.
15. Mazzucconi MG, Fazi P, Bernasconi S, De Rossi G, Leone G, Gugliotta L, et al. Therapy with high-dose dexamethasone (HD-DXM) in previously untreated patients affected by idiopathic thrombocytopenic purpura: a GIMEMA experience. Blood. 2007;109:1401–7.
16. Cheng Y, Wong RS, Soo YO, Chui CH, Lau FY, Chan NP, et al. Initial treatment of immune thrombocytopenic purpura with high-dose dexamethasone. N Engl J Med. 2003;349:831–6.
17. Radaelli F, Faccini P, Goldaniga M, Guggiari E, Pozzoli E, Maiolo AT, et al. Factors predicting response to splenectomy in adult patients with idiopathic thrombocytopenic purpura. Haematologica. 2000;85:1040–4.
18. Shojaiefard A, Mousavi SA, Faghihi SH, Abdollahzade S. Prediction of response to splenectomy in patients with idiopathic thrombocytopenic purpura. World J Surg. 2008;32:488–93.
19. Duperier T, Brody F, Felsher J, Walsh RM, Rosen M, Ponsky J. Predictive factors for successful laparoscopic splenectomy in patients with immune thrombocytopenic purpura. Arch Surg. 2004;139:61–6 (discussion 66).
20. Fabris F, Tassan T, Ramon R, Carraro G, Randi ML, Luzzatto G, et al. Age as the major predictive factor of long-term response to splenectomy in immune thrombocytopenic purpura. Br J Haematol. 2001;112:637–40.
21. Cooper N, Stasi R, Cunningham-Rundles S, Feuerstein MA, Leonard JP, Amadori S, et al. The efficacy and safety of B-cell depletion with anti-CD20 monoclonal antibody in adults with chronic immune thrombocytopenic purpura. Br J Haematol. 2004;125:232–9.
22. Bussel JB, Kuter DJ, George JN, McMillan R, Aledort LM, Conklin GT, et al. AMG 531, a thrombopoiesis-stimulating protein, for chronic ITP. N Engl J Med. 2006;355:1672–81.
23. Bussel JB, Cheng G, Saleh MN, Psaila B, Kovaleva L, Meddeb B, et al. Eltrombopag for the treatment of chronic idiopathic thrombocytopenic purpura. N Engl J Med. 2007;357:2237–47.
24. Ghanima W, Godeau B, Cines DB, Bussel JB. How I treat immune thrombocytopenia: the choice between splenectomy or a medical therapy as a second-line treatment. Blood. 2012;120:960–9.
25. Mikhael J, Northridge K, Lindquist K, Kessler C, Deuson R, Danese M. Short-term and long-term failure of laparoscopic splenectomy in adult immune thrombocytopenic purpura patients: a systematic review. Am J Hematol. 2009;84:743–8.
26. Zoghlami-Rintelen C, Weltermann A, Bittermann C, Kyrle PA, Pabinger I, Lechner K, et al. Efficacy and safety of splenectomy in adult chronic immune thrombocytopenia. Ann Hematol. 2003;82:290–4.
27. Katkhouda N, Grant SW, Mavor E, Friedlander MH, Lord RV, Achanta K, et al. Predictors of response after laparoscopic splenectomy for immune thrombocytopenic purpura. Surg Endosc. 2001;15:484–8.
28. Tsereteli Z, Smith CD, Branum GD, Galloway JR, Amerson RJ, Chakaraborty H, et al. Are the favorable outcomes of splenectomy predictable inpatients with idiopathic thrombocytopenic purpura (ITP)? Surg Endosc. 2001;15:1386–9.
29. Balague C, Vela S, Targarona EM, Gich IJ, Muniz E, D'Ambra A, et al. Predictive factors for successful laparoscopic splenectomy in immune thrombocytopenic purpura: study of clinical and laboratory data. Surg Endosc. 2006;20:1208–13.
30. Kumar S, Diehn FE, Gertz MA, Tefferi A. Splenectomy for immune thrombocytopenic purpura: long-term results and treatment of postsplenectomy relapses. Ann Hematol. 2002;81:312–9.
31. Bourgeois E, Caulier MT, Delarozee C, Brouillard M, Bauters F, Fenaux P. Long-term follow-up of chronic autoimmune thrombocytopenic purpura refractory to splenectomy: a prospective analysis. Br J Haematol. 2003;120:1079–88.
32. Akwari OE, Itani KM, Coleman RE, Rosse WF. Splenectomy for primary and recurrent immune thrombocytopenic purpura (ITP). Current criteria for patient selection and results. Ann Surg. 1987;206:529–41.
33. Lortan JE. Management of asplenic patients. Br J Haematol. 1993;84:566–9.
34. Mohamed SY, Abdel-Nabi I, Inam A, Bakr M, El Tayeb K, Saleh AJ, et al. Systemic thromboembolic complications after laparoscopic splenectomy for idiopathic thrombocytopenic purpura in comparison to open surgery in the absence of anticoagulant prophylaxis. Hematol Oncol Stem Cell Ther. 2010;3:71–7.
35. Thomsen RW, Schoonen WM, Farkas DK, Riis A, Fryzek JP, Sorensen HT. Risk of venous thromboembolism in splenectomized patients compared with the general population and appendectomized patients: a 10-year nationwide cohort study. J Thromb Haemost. 2010;8:1413–6.
36. van't Riet M, Burger JW, van Muiswinkel JM, Kazemier G, Schipperus, Bonjer HJ. Diagnosis and treatment of portal vein thrombosis following splenectomy. Br J Surg. 2000;87:1229–33.