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Resection or Enucleation for Liver Hemangioma

Research Article

E. Nikolaev[1]*, N. Nikolov[1], D. Kostov[1], N. Vladov[2], I. Takorov[3], V. Mutafchiiski[4], M. Valcheva[1], I. Mircheva[5]

[1]*Clinic of Surgery of MMA, Varna at the Military Medical Academy, Sofia*
[2]*Clinic of Liver - Pancreatic Surgery and Transplantology MMA, Sofia*
[3]*Clinic of Abdominal Surgery, Military Medical Academy, Sofia*
[4]*Clinic of Endoscopic Surgery, Military Medical Academy, Sofia*
[5]*Faculty of Public health, Medical University, Varna*

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***Corresponding author:** E. Nikolaev, Clinic of Surgery of MMA, Varna at the Military Medical Academy, Sofia

Key words: hepatic hemangioma, anatomical resection, atypical resection, enucleation, enucleoresection

Abstract

Introduction: Hemangiomas are the most common benign tumors of the liver. There are two main methods for surgical treatment of hepatic hemangiomas: liver resections of different sizes and enucleation. To date, there is no consensus on the surgical treatment of benign liver tumors, including hemangiomas.

Objective: To make a comparative analysis of the results obtained in the surgical treatment of LH, focusing on the two main methods of resection and enucleation.

Materials and methods: For the period 2006 - 2018, 101 patients with LH were operated on in the surgery clinics of the Military Medical Academy, and 111 tumors were removed. 84 resections and 27 enucleations were performed. The influence of the operative procedure on the operative factors: blood loss, operative time, postoperative period and complications, as well as the influence of the size and localization on the choice of operative procedure are analyzed.

Results: 84 resections (63 anatomical and 21 atypical) and 27 enucleations (18 ideal and 9 enucleorections) were performed. Of all 111 interventions, 63 (56.8%) were on tumors located deep in the liver parenchyma, and 48 (43.2%) were on tumors located superficially. Resections of superficial hemangiomas are 22 (19.8%). Resections of deep hemangiomas were 62 (55.9%). Of all 27 enucleations, 26 (18%) were on superficial hemangiomas. Only one enucleation of a deep single hemangioma was performed. The average operating time for resections was 188,438 minutes, and 169,524 minutes for enucleations. In resections the average blood loss is 180,938 ml, and in enucleations is 145,238 ml. The postoperative stay during resections is 6.59 days on average, and during enucleations it is 5.1 days. There are postoperative complications in 13 (16.2%) resections and 1 (4.8%) enucleations. Surgical complications were 9 (11.2%) in resections and 1 (4.8%) in enucleations.

Discussion: Resection is performed on a deep tumor and enucleation is performed on a superficial tumor. The chance to perform resection in a single deep hemangioma is 56 times higher than to perform enucleation ($p < 0.001$). No statistical difference was found in terms of blood loss and operative time between resection and enucleation in the group we studied. A statistically significant relationship was found between postoperative stay and the type of intervention. In resections, the postoperative stay was longer by an average of 1.5 days ($p = 0.018$). No statistically significant relationship was found between the choice of resection or enucleation and the complications that occurred, including surgical complications.

Conclusion: The adequate differentiated approach in each individual patient with hepatic hemangioma is the most direct way to his successful treatment. Knowledge of the factors that increase the frequency of postoperative complications determines the choice of surgical procedure.

Introduction

Hemangiomas are the most common benign tumors of the liver. Despite the proven benign nature of the process, the presence of hemangiomas is associated with a risk of rupture and acute bleeding. When the process is localized in the area of the porta hepatis and when its elements are involved in the process, it is possible to develop a thromboembolism of the trunk of the pulmonary artery or its branches. A violation is possible in the portal circulation, even with a small hemangioma. The treatment strategy for LH is controversial and is closely related to the size, location, symptoms and concomitant diseases of the patient. There are two main methods for surgical treatment of hepatic hemangiomas: liver resections and enucleation. To date, there is no consensus on the surgical treatment of benign liver tumors, including hemangiomas. In accordance with the classification of Brisbane 2000y the degree of resection is divided into right trisectonectomy, left trisectonectomy, right hepatectomy, left hepatectomy, bisegmentectomy (including left lateral sectionectomy and right posterior sectionectomy), segmentectomy, non-anatomical [atypical] resection and enucleation [1]. The degree of resection is related to the size of the resected hemangioma. In anatomical resections, together with the hemangioma, a functionally healthy liver parenchyma is removed by its vascular-secretory device. Anatomical liver resection for hepatic hemangiomas is indicated for large tumors, single or multiple, located in 2, 3 or more adjacent segments of a lobe, located deep intraparenchymal [2]. Atypical resection does not comply with vascular-secretory autonomy and segmental boundaries. It occurs in smaller tumors, marginal and superficial [3]. It is successfully used in multiple localization of non-adjacent segments [4]. Enucleation is based on the fact that as the hemangioma grows, it compresses the surrounding liver tissue and a fibrous pseudocapsule forms around the hemangioma, made up of compressed liver cells and connective tissue. Between the fibrous pseudocapsule and the surrounding normal parenchyma, a vascular space is formed - "plan de clevage", where the enucleation itself takes place [5]. Here, the vascular and biliary structures that enter and exit the hemangioma are very well objectified and can be adequately treated. Enucleation is a procedure applicable to both peripheral and centrally located tumors in the risk mesosector. However, especially in centrally located hemangiomas, enucleation should be performed under vascular control [6].

Objective

To make a comparative analysis of the results obtained in the surgical treatment of LH, focusing on the two main methods of resection and enucleation.

Materials and methods

The study included 101 patients with cavernous hemangiomas radically operated in the Clinics of Surgery of the Military Medical Academy for the period 2006 - 2018. Of these, 52 were operated in the Clinic of Surgery at MMA, Varna, 43 were operated in the Clinic of Liver - Pancreatic Surgery and Transplantation MMA, Sofia, 4 were operated on in the Clinic of Endoscopic Surgery MMA, Sofia and 2 in the Clinic of Abdominal Surgery, Sofia.

Patients treated at the Surgery Clinic of MMA, Varna were followed prospectively (n = 52) and the rest (n = 49) retrospectively.

Gender: 37% men (n = 37), 63% women (n = 64), mean age 54. 101 LH patients were operated on and 111 tumors were removed. 84 resections and 27 enucleations were performed.

The type and volume of the operation is determined by the size, number, location, relationship of the tumor to the vascular and biliary structures of the liver, intraparenchymal spread, functional state of the parenchyma, as well as the patient's current condition and the presence of concomitant diseases. During the resection, the hemangioma is removed together with part of the surrounding healthy parenchyma, with the aim of minimizing its volume. In case of enucleation, the preparation is carried out in the so-called "Plan de clevage" (the vascular space between the normal parenchyma and the pseudocapsule of the hemangioma). In this area, the afferent vessels of the hemangioma are very clearly visualized, dissected and clamped. We call this enucleation ideal. In some cases, due to a disturbance in the blood supply to a peripheral subsegment or a loss of orientation about the fibrous capsule in depth, the resection line has to pass through a healthy liver parenchyma - enucleoresection. The terminology used for anatomical liver resection is consistent with the Brisbane 2000 system. Anatomical resections range from monosegentectomy to triseconectomy (Table 1).

Results

111 surgical interventions were performed due to the presence of more than one lesion in 10 patients. Of these, 84 resections and 27 enucleations, the total number of patients operated laparoscopically was 30 (30%)

Table 1: Distribution of the types of liver operations among the studied group

Volume of liver surgery	Patients (n = 101) Operations (n = 111)
Monosegmentectomy	6
Right posterior sectiononectomy	3
Left lateral sectiononectomy	35
Bisegmentectomy Sg5 / Sg6	2
Right hepatectomy	8
Right trisectionectomy	2
Left hepatectomy	5
Extended right hepatectomy	2
Large atypical resections ≥ 3 adjacent Sg	3
Atypical resections central ≤ 2 adjacent Sg	3
Small atypical resections ≤ 2 adjacent Sg	15
Enucleation / enucleoresection of central Sg	12
Enucleation / enucleoresection anterior Sg	10
Enucleation / enucleoresection posterior Sg	5

(Figure 1). The largest number is n = 35 of the left lateral sectionectomies, 16% of large anatomical liver resections, 19% of atypical resections. In 20% of the cohort, the lesion involves at least 3 or more adjacent liver segments. In 27%, the hemangioma was located near large arteries. In 30 of the patients, synchronous surgery was performed for another disease in the abdominal cavity, and in 17% of them (n = 5) the liver was a target organ. The operative factors we analyzed are: type of operative method - resection (anatomical or atypical) and enucleation (ideal or enucleoresection) performed by laparoscopic or conventional access, presence and type of vascular control, presence or absence of associated resections, presence or absence of synchronous operations, degree of blood loss, intensity of blood transfusions, duration of the operation, presence and severity of complications (surgical or general medical) and their grading according to the classification of Dindo - Clavien, length of hospital stay, postoperative survival and self – esteem (Table 2).

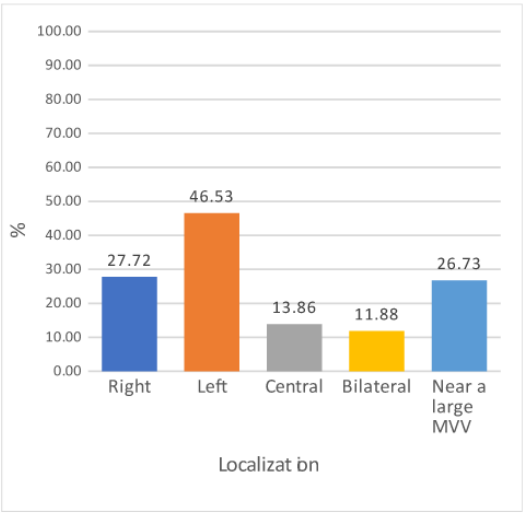

Figure 1: Localization of the tumor formation

In about half of the patients (47 or 46.53%) the hemangiomas were on the left and 28 (27.72%) of the hemangiomas were on the right. Hemangiomas are located in the central sector in 14 (13.86%) patients, in 12 (11.88%), hemangiomas or hemangiomas occupy more than one part of the liver or bilaterally, and in 27 (26.73%) of patients, hemangioma lie near a large main venous vessel (MVV) (Figure 1).

Table 2: Characteristics of operational factors

Indicator	total number of patients (n=101)	No synchronous operations (n=71)	With synchronous operations (n = 30)
Type of operation resection enucleation	80(80%) 21(20%)	56(55,5%) 15(14,8%)	24(23,7%) 6(6%)
Type of operation open laparoscopic	71(70%) 30(30%)	45(44,6%) 26(25, 7%)	26(25, 7%) 4(4%)
Pringle Yes No	35(35%) 66(65%)	26(25,7%) 45(44,6%)	9(8,9%) 21(20,7%)
Intraoperative blood loss (ml)	173,5	158,6	208,6
Operating time (min)	184,5	117,5	215,3
Postoperative period (days)	6,28	5,9	7,17
Complications (Dindo – Clavien) I – II degree. III – IV degree.	12 6	7 3	5 3
AST on day 3	74,7	82,1	57,2
ALT on day 3	91,8	100,3	71,7
INR on day 3	1,1	1,11	1,12
Bilirubin on day 3	13,06	13,4	11,8
Hemoglobin on day 3	119	120	116
Lactat - postoperative.	1,95	1,97	1,88

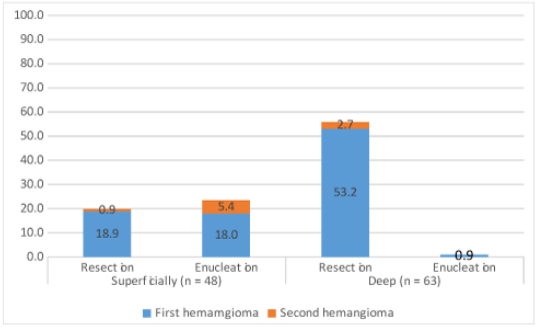

Figure 2: Segmental location and intraparenchymal location of tumors n = 111 (depth and surface)

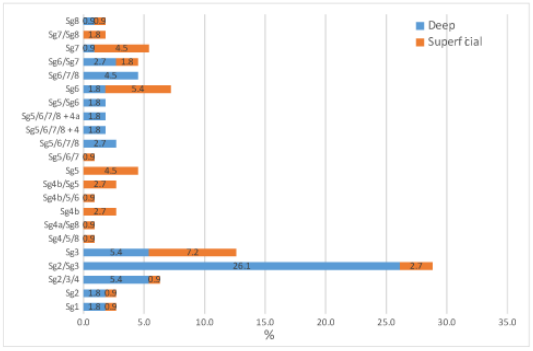

Figure 3: Percentage distribution of types of operations depending on the intraparenchymal location

Depending on the location of the tumor (deep or superficial), the tumors are located in different segments. It is noteworthy that hemangiomas with left localization in a larger percentage are deeply located, while those in the mesosector are superficial. (Figure 2)

Of all 111 interventions, 63 (56.8%) were on tumors located deep in the liver parenchyma, and 48 (43.2%) were on tumors located superficially. Resections of superficial hemangiomas are 22 (19.8%). Resections of deep hemangiomas were 62 (55.9%). Of all 27 enucleations, 26 (18%) were superficial hemangiomas. Only one enucleation of a deeply located single hemangioma was performed (Figure 3).

Table 3: Distribution of tumor size in categories and by type of operation (resection or enucleation)

Intervention	Size - 1 hemangioma			Size - 2 hemangioma		Total
	4 - 9 sm.	10 - 20 sm.	> 20 sm.	4 - 9 sm.	10 - 20 sm.	
Resection	36	34	10	5	2	87
Enucleation	13	7	1	2	1	24
Total	49	41	11	7	3	111

• Influence of size on the choice of surgical intervention (resection or enucleation)

No statistically significant difference was found between tumor size (in categories) and resections and enucleations for both the first hemangioma (X2 = 2.239; p = 0.327) and the second hemangioma (X2 = 0.023; p = 0.88) (Table 3).

We used logistic regression to determine the influence of tumor location and size on the choice of surgical intervention. The size of the tumor together with the localization do not affect the choice of surgical intervention (open, laparoscopic, resection, enucleation). Of the types of localization, only central localization influences the choice of operative intervention. The chance of choosing enucleation in central tumor localization is 9 times higher than in bilateral (Wald X2 = 5.299; OR = 9; p = 0.021; 95% CI = 1.386 - 58.443).

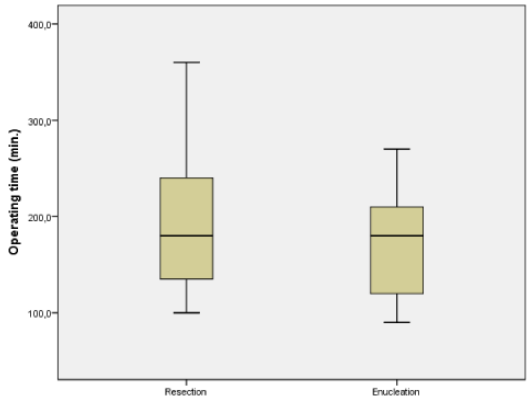

Figure 4: Surgical time and type of intervention (resection / enucleation)

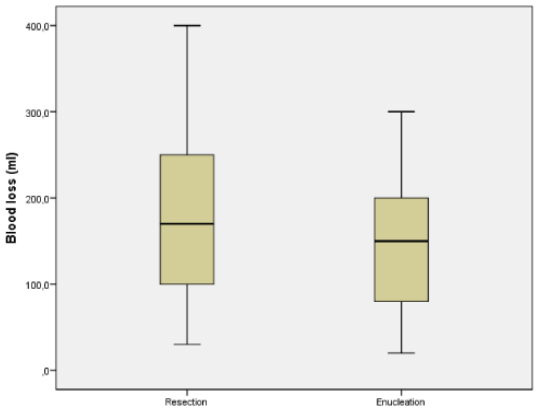

Figure 5: Blood loss in ml during resection and enucleation

• Operative time and resection / enucleation

In resections, the operating time ranged from 100 to 360 minutes, with a mean time of 188.438 minutes (SD = 63.413). For enucleations, the operating time ranged from 90 to 270 minutes, with a mean time of 169,524 minutes (SD = 55,810) (Figure 4).

• Blood loss and resection / enucleation

In resections, blood loss ranged from 30 to 400 ml, with a mean blood loss of 180,938 ml (SD = 90,432). In enucleations, blood loss ranged from 20 to 300 ml, with a mean blood loss of 145.238 ml (SD = 80.970) (Figure 5).

• Postoperative period and resection / enucleation

The postoperative stay during resections varies from 3 to 14 days, with an average stay of 6.59 days; (SD = 2,085). The postoperative stay in enucleations varies from 2 to 9 days, with an average stay of 5.1 days; (SD = 1,895). A statistically significant relationship was found between postoperative stay and the type of intervention (resection or enucleation). In resections, the postoperative stay was longer by an average of 1.5 days (t = 2.414; DF = 99; p = 0.018).

There are postoperative complications in 13 (16.2%) resections and 1 (4.8%) enucleations. Surgical complications were 9 (11.2%) in resections and 1 (4.8%) in enucleations. No statistically significant association was found between the choice of resection or enucleation and complications, including surgical complications.

Discussion

In the last decade, enucleation has risen and is approaching, and even ahead of resections in frequency [7]. According to some authors, enucleation is applicable in 40–80% of cases [8]. The biggest advantages of the method, according to others, are the preservation of a functionally healthy liver parenchyma and scanty intraoperative bleeding [5]. When choosing an operative volume in patients with hepatic hemangiomas with relative indications for surgical treatment, it is important to weigh the benefits and risks of it and to consider the benign nature of the process.

The decision about the type of surgical procedure is made based on the size and location of the hepatic hemangioma, its relationship to the main vascular and biliary structures and the residual volume of the liver parenchyma, often depending on the personal preferences and experience of the surgeon [9]. Avoiding unnecessary loss of a healthy liver parenchyma is one of the basic principles that should be considered when choosing a surgical procedure [10]. The size and location of the lesion influence the decision whether to perform segmental resection or enucleation.

In larger lesions, enucleation would be a more difficult intervention, leading to greater blood loss, and resection is the preferred choice in this case [11]. Due to the small volume of the left hepatic lobe, hemangiomas are more likely to occupy the entire volume, and resection will sacrifice only a small portion of the unaffected liver tissue. This explains the higher frequency of patients with left localization who have undergone resection [12]. This was confirmed in our study - the largest (n = 35; 34.6%) is the number of left lateral sectionectomies.

Some authors advocate liver resection [13], while others recommend enucleation [14]. Comparative studies between liver resection and hemangioma enucleation have reported that enucleation is associated with less intraoperative bleeding, shorter operative times, lower morbidity, and shorter hospital stays [15]. These comparative studies have several limitations: the average size of reported lesions is rarely> 10 cm; the size of the study population in these studies was small and the influence of hemangioma location on the selection of surgical technique was not analyzed individually. In another study, 47 of 86 (54.7%) hepatic hemangiomas were treated with enucleation, stating that the operative time, time and frequency of hepatic vascular occlusion, blood loss, complications and postoperative hospital stay did not differ between hepatic resection and enucleation, regardless of localization (left or right hemiliver) [16]. This has been confirmed by other authors [17].Therefore, in order to minimize the removal of a normal liver parenchyma, liver resection is a useful alternative surgical procedure. For giant hepatic hemangiomas occupying the middle and lateral areas of the affected area, little normal liver parenchyma remains. In this situation, anatomical liver resection will not lead to excessive removal of a healthy liver parenchyma. In addition, if it is not possible to maintain the normal liver parenchyma located around the hepatic hemangioma, for example in deep localized or multiple liver hemangiomas located next to each other, the preferred technique is also liver resection. In the case of anterior and superficial lesions, enucleation is the indicated treatment, while large lesions that occupy most of the left or right lobe are treated with liver resection. Therefore, left or right hepatectomy is usually used to

treat a hemangioma that occupies almost the entire lobe, while tumors that occupy a small portion of one or more lobes are removed by enucleation or atypical resection. In addition to size, location should also be considered in the surgical treatment of patients with hepatic hemangiomas and may be one of the considerations for the choice of surgical procedure [12].

In our group of patients, a statistically significant relationship was found between the location (superficial or deep) of the tumor and the performance of resection or enucleation. Resection is performed on a deep tumor, and enucleation is performed on a superficial tumor. The chance of performing resection in a single deep hemangioma is 56 times higher than in enucleation ($p < 0.001$). Of all 84 resections, 21 (25%) atypical resections of one hemangioma were performed in superficial hemangiomas, and one (1.2%) anatomical resection was performed in a patient with more than one hemangioma. In deep hemangiomas, 59 (70.2%) anatomical resections of a single hemangioma and three (3.6%) were performed in patients with more than one hemangioma. In resections of a single hemangioma, a statistically significant relationship was found between tumor location and type of resection. Anatomical resection was performed in deep hemangiomas, and atypical resection was performed in superficial hemangiomas ($p < 0.000$). A total of 27 enucleations were performed, of which 18 (66.7%) were ideal and 8 (29.6%) were enucleoresections; 26 (96.3%) have superficial hemangiomas and one (3.7%) has deep hemangiomas. A statistically significant relationship was found between tumor location and type of enucleation in a single hemangioma. In superficial tumors, ideal enucleation is applied ($p < 0.000$).

Although the result is not statistically significant, out of 84 resections, 43 were on the left and 24 were on the right. In patients with left localization, which are most numerous in the study group (47 or 46%), 43 resections and 6 enucleations were performed. Of all the operations, the largest number of left lateral sectionectomies is 35. Out of 55 tumors larger than 10 cm, 46 underwent resection, while only 9 tumors larger than 10 cm underwent enucleation. No statistical difference was found in terms of blood loss and operative time between resection and enucleation in the group we studied. A statistically significant relationship was found between postoperative stay and the type of intervention. In resections, the postoperative stay was longer by an average of 1.5 days ($p = 0.018$). No statistically significant relationship was found between the choice of resection or enucleation and the complications that occurred, including surgical complications.

Conclusion

Adequate differentiated approach in each individual patient with hepatic hemangioma is the most direct way to his successful treatment. Knowledge of the factors that increase the frequency of postoperative complications determines the choice of surgical procedure. Surgical removal of hepatic hemangiomas can be performed safely in large hospitals. The main limitations of our study were the nonrandomized selection of patients and the retrospective nature of the study of approximately half of the patients. We cannot rule out deviations in the choice. The types of surgical procedures were selected according to the surgeon's preferences and this choice was influenced by the characteristics of the lesion and the experience of the surgeons. Second, we simply compared the short-term postoperative outcome of the two main techniques studied, resection and enucleation, and long-term follow-up should be performed to fully analyze the feasibility of the two methods. However, further studies with more patients and longer follow - ups are needed to compare the safety and efficacy of the two techniques. Third, this study was conducted in one institution and the results obtained may not be comparable to those in other centers. On the other hand, single-center studies have the advantage of reducing possible differences in the indications for surgical treatment and the surgical technique used. Further external confirmation is needed that our findings will be applicable to other surgical teams.

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