Laparoscopic hepatectomy: indications and results from 18 resectable cases

Hepatectomia laparoscópica: indicações e resultados em 18 casos ressecados

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ABSTRACT

Objective: To evaluate the early and late results from laparoscopic hepatectomy procedures at a tertiary hospital in Brasília (DF), Brazil. **Methods:** The authors report on a series of 18 patients (11 women) who underwent laparoscopic hepatectomy performed by a single surgical team at Santa Lúcia Hospital, in Brasília, between June 2007 and December 2010. Age ranged from 21 to 71 years (median = 43 years). There were eleven women and seven men. Nine patients had benign diseases and nine had malignant lesions. The lesion diameter ranged from 1.8 to 12 cm (mean: 4.96 cm). **Results:** Six major hepatectomy procedures and 12 minor hepatectomy procedures were performed. The mean duration of the operation was 205 minutes (range: 90 to 360 minutes). The mean intraoperative blood loss was 300 mL (range: 100 to 1,500 mL). Two patients received a transfusion (11%). There was one conversion to open surgery. There was no death and no patient underwent reoperation. The postoperative morbidity rate was 11% (n = 2). One patient presented with a minor complication (lobar pneumonia) while other presented with two major complications (intraoperative bleeding and incisional hernia). The median length of hospital stay was 4 days (range: 2 to 11 days). The median time to return to normal activities was 13 days (range: 7 to 40 days). **Conclusion:** Laparoscopic hepatectomy is a safe surgical approach for treating both benign and malignant hepatic lesions. This small series showed no mortality, low morbidity and good cosmetic results.

Keywords: Laparoscopy; Hepatectomy; Liver neoplasms/surgery; Neoplasm metastasis

RESUMO

Objetivo: Avaliar os resultados precoces e tardios das hepatectomias laparoscópicas realizadas em um hospital terciário, em Brasília (DF). **Métodos:** Os autores relatam uma série de 18 pacientes (11 mulheres) submetidos à hepatectomia laparoscópica, realizada por uma única equipe cirúrgica do Hospital Santa Lúcia, em Brasília, entre Junho de 2007 e Dezembro de 2010. A idade variou de 21 a 71 anos com mediana de 43 anos. Havia onze mulheres e sete homens. Nove casos apresentavam lesão benigna e nove, lesão maligna. O diâmetro da lesão variou de 1,8 a 12 cm (média: 4,96 cm). **Resultados:** Seis hepatectomias maiores e 12 hepatectomias menores foram realizadas. O tempo cirúrgico médio foi de 205 minutos (variação de 90 a 360 minutos). A média de sangramento intraoperatório foi de 300 mL (variação de 100 a 1.500 mL). Dois pacientes foram transfundidos. Houve uma conversão para cirurgia aberta. Não houve óbitos e nenhum paciente foi reoperado. A morbidade pós-operatória foi de 11% (n = 2). Um indivíduo apresentou uma complicação menor (pneumonia lobar), e outro teve duas complicações maiores (sangramento intraoperatório e hérnia incisional). A duração mediana de internação foi de 4 dias (variação de 2 a 11 dias). O tempo mediano de retorno às atividades diárias foi de 13 dias (variação de 7 a 40 dias). **Conclusão:** A hepatectomia laparoscópica é um método cirúrgico seguro para tratamento de lesões hepáticas benignas e malignas. Nesta pequena série, não houve óbitos, a taxa de morbidade foi baixa, e o resultado estético foi bom.

Descritores: Laparoscopia; Hepatectomia; Neoplasias hepáticas/cirurgia; Metástase neoplásica

INTRODUCTION

Laparoscopic hepatectomy (LH) was first described in 1992 by Gagner et al.[1] and it remains an appealing concept: major surgery with a potential for bleeding, carried out using a minimally invasive approach. Azagra et al.[2] performed the first anatomical laparoscopy, which consisted of a successful left lateral sectionectomy (LLS) or sectorectomy (segments II-III) in a patient with hepatic adenoma (HA) of segments II and III. LH was the last bastion to fall to laparoscopic surgery (LS) because of a combination of the anatomical complexity of this surgical approach and the lack of surgeons with experience in both laparoscopy and hepatic surgery. In

general lines, LH offers several advantages over an open surgery. The main advantages are less postoperative pain, early mobilization, lower incidence of ileus, earlier resumption of oral intake, and shorter hospital stay. Initially, minor hepatectomy for superficial lesions was performed with great confidence. With advances in laparoscopic instruments and parenchymal transection devices, together with greater experience of complex laparoscopic hepatobiliary resections, the use of both right and left major laparoscopic hepatic resections has grown[1-27].

Over recent years, LH has been performed with unfortunate morbidity but with low mortality in reference centers[3-7,15-17]. Recently a few authors have taken the view that LH should be the preferred approach towards both benign and malignant hepatic lesions[3-5,16,17]. Even difficult-to-reach lesions in the right hepatic lobe may be resectable by means of a safe and satisfactory laparoscopic approach, with low conversion rates and morbidity[7,16,20,22,27]. Thus, the laparoscopic approach has begun a new era in minimally invasive hepatobiliary surgery.

On the other hand, except for a few studies, most papers have reported on limited numbers of patients. Nevertheless, it has been established that for selected patients, and when performed by a team with expertise in both hepatic and advanced laparoscopic surgery, LH is safe and produces results identical to those from open operations[4,5,16,17,23]. In Brazil, although there have only been a few anecdotal case reports[19,20,25,26] and few small series have been reported[21-23,27], Machado et al.[23] showed that LH was efficacious, with good results regarding colorectal metastasis (CRM).

OBJECTIVE

The aim of the present study was to describe both the short- and long-term results of LH used to treat benign and malignant liver disease, performed by a single surgical team in a private reference hospital in Brasília (DF), Brazil.

METHODS

Between June 2007 and December 2010, 18 consecutive LHs were performed at the Hospital Santa Lúcia, Brasilia. All resections were performed by a single surgical team. Nine LH procedures were performed to treat benign hepatic lesions, and nine for malignant lesions. The indications for laparoscopic resection of benign liver tumors were preoperative diagnosis of HA with 5 cm of diameter or more or cystadenoma; uncertain diagnosis on imaging or biopsy; and presence of symptoms. The laparoscopic approach was chosen because of the size and location of the lesions. Large tumors, tumors close to

major vascular structures, and tumors located in central positions were excluded from this sample.

Liver resections were defined in accordance with the International Hepato-Pancreato-Biliary Association (IHPBA) terminology, derived from the Couinaud classification. Subsequently, major hepatectomy was defined as the resection of three or more segments. Ultrasonography, computed tomography and magnetic resonance imaging were performed on all patients. For malignant lesions, PET-scans were also performed. Tumor markers CEA, AFP, and Ca 19.9 were assayed in all cases.

The surgical technique for laparoscopic hepatic resection was determined case by case, in accordance with previously described technical principles[6,7,18,20-23,27]. In general, the procedures were performed with carbon dioxide pressure control over the pneumoperitoneum, with a positive pressure of 12 mmHg. A 30-degree laparoscope was used with four or five port sites (Figure 1) depending on the case, and in accordance with the surgeon's preference and site of the lesion. Liver transection (Figure 2) was always performed using Ligasure (10 mm size, Valleylab, Boulder, USA). Small vascular or biliary ducts were sealed using the Ligasure, while major structures were sealed using metal clips. Portal pedicles and hepatic veins were divided using a linear stapler (Endogia, 30 or 45 mm, vascular type), in accordance with Gumbs et al.[13].

Figure 1. Portal position – left hemi-hepatectomy for non-colorectal metastases in left hepatic lobe
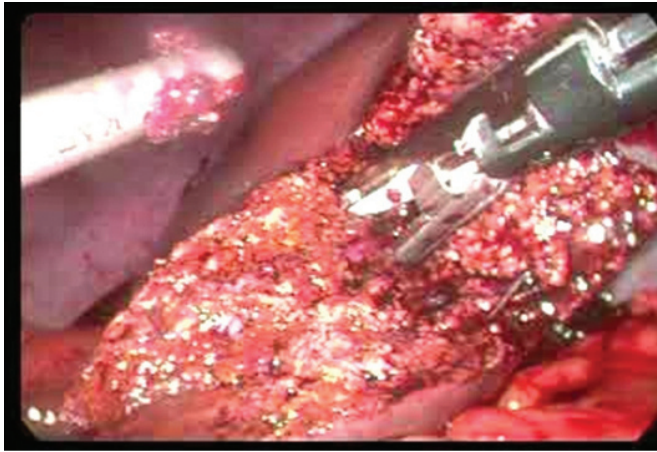
Figure 2. Transection of hepatic parenchyma with Ligasure 10 mm – right hemi-hepatectomy

Except for two cases in which the patients presented with an abdominal incision due to prior open surgery (one case of right subcostal and one case of median laparotomy, according to Figure 1), the surgical specimen was resected by means of a Pfannenstiel incision. The surgical specimen was placed into a plastic bag or glove. Abdominal drainage was generally not performed. When necessary, suction drains were used (in three cases).

Demographic characteristics of 18 patients and lesion etiology are shown in chart 1. There were 11 women and seven men. The mean age was 43 years (range: 21 to 71 years). Five patients (30%) were younger than 40 years. The lesion was solitary in nine patients (50%), while six patients presented two (35%) or more lesions (15%). Right-side lesions were predominant, with ten cases, while the left lobe was involved in eight cases. The etiology of the hepatic lesions was as follows: adenoma (n = 3), metastasis (n = 7), hepatocarcinoma (HCC) (n = 2), nodular focal hyperplasia (NFH) (n = 2), hepatic abscess (n = 2), hemangioma (n = 1) and biliary cystadenoma (n = 1). The main symptoms were pain (n = 8), palpable mass (n = 6), discomfort (n = 5) and early satiety (n = 4). The lesion diameter ranged from 1.8 to 12 cm (mean: 4.96 cm).

Preoperative radiological investigations showed that 15 patients presented with a solid liver tumor (80%), and three patients had cystic lesions (20%). Eight out of 17 patients underwent tumor biopsy (percutaneously in 6 cases, laparoscopically before starting liver resection in 1 case, and laparoscopically in 1 case). In this series, tumor biopsy allowed us to obtain a certain diagnosis in four cases (50%, i.e., in four out of eight biopsies).

In ten patients, the surgical indication was malignant or premalignant disease. There were two cases of HCC, two of non-colorectal non-neuroendocrine metastases (NCNEM), five of colorectal metastases (CRM), and one of hepatic cystadenoma. In the other eight patients with benign disease, the most common indications were presence of symptoms, HA (diameter > 5 cm), uncertain preoperative diagnosis, or failure of percutaneous treatment of hepatic abscess.

Among the benign solid tumors, typical preoperative features of HA and hemangioma were found in all patients (n = 4). All presented with symptoms, such as pain and discomfort. One case presented with multiple adenomatosis with three lesions: this patient reported having made abusive use of anabolic steroids. Histological

Chart 1. Demographic characteristics and etiology of lesions

Case	Gender	Age	Etiology	Number	Diameter of the largest lesion (cm)	Site - Hepatic segment(s)	ASA
1	Male	71	Hepatic pyogenic abscess	1	10	II/III/IV	2
2	Female	68	Hepatic pyogenic abscess	3	5	II/III/VI	2
3	Female	63	Hepatic cystadenoma	1	12	VI/VII/VIII	1
4	Female	21	Hepatic adenoma	3	3	VI/VII	1
5	Female	38	Hepatic adenoma	1	5	VI	1
6	Female	23	Hepatic adenoma	1	5	VI/VII	1
7	Male	58	Focal nodular hyperplasia	1	6	II/III/III	1
8	Male	63	Hepatocellular carcinoma	1	3	VI/VII	2
9	Male	61	Colorectal metastasis	2	3.5	II/III/IV	1
10	Female	30	Focal nodular hyperplasia	1	8	V	1
11	Female	32	Non colorectal metastasis	2	3	II/III	1
12	Female	43	Non-colorectal metastasis	3	3	VI/VII	1
13	Male	63	Hepatocellular carcinoma	1	3	V	2
14	Female	43	Colorectal metastasis	3	4	V/VI/VII	1
15	Female	54	Colorectal metastasis	2	3	II/III	1
16	Male	50	Colorectal metastasis	3	3	II/III	2
17	Female	53	Colorectal metastasis	1	4	VI/VII	1
18	Male	45	Hepatic hemangioma	1	10	II/III/IV	1

ASA: American Society of Anesthesiologists.

examination confirmed the preoperative diagnosis in all these patients. Neither of the cases of NFH was diagnosed preoperatively, since both cases presented with atypical radiological findings. The indication for liver resection in these patients was an uncertain diagnosis (differential with HCC) in one case, and right upper quadrant pain due to a bulky hanging tumor located in the V hepatic segment in the other case. Both cases of hepatic abscess had previously been unsuccessfully treated by means of percutaneous drainage. Subsequently, LH was performed because both lesions had central locations within the hepatic lobe, with partial destruction of the parenchyma.

RESULTS

The laparoscopic procedure was completed in 17 patients (94%). One patient who presented with a giant hemangioma (10 cm) underwent open conversion due to massive intraoperative bleeding. The types and details of the hepatectomy procedures are shown in chart 2 and chart 3. They included 6 major hepatectomy procedures (Figure 3) and 12 minor hepatectomy procedures (Figure 4). Two patients required postoperative blood transfusions. Three patients underwent surgical drainage of the liver bed using suction drains. The drains were taken out on the 4th or 5th postoperative days. There was no case of gas embolism in this series.

Chart 2. Types of hepatectomy performed

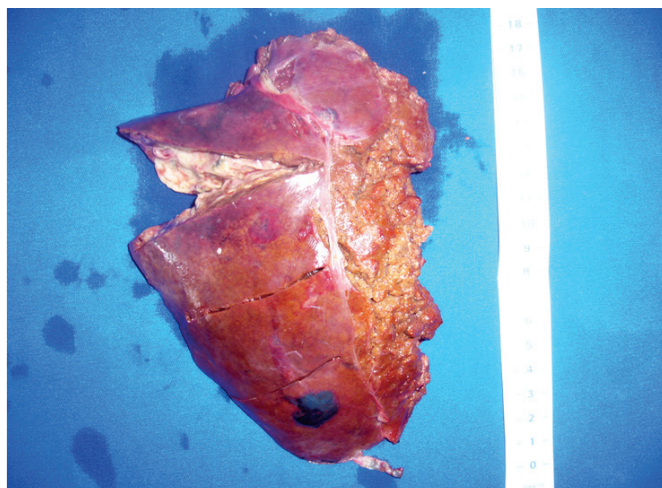| Type of resection	Number of patients
Right hemi-hepatectomy	2
Left hemi-hepatectomy	4
Bisegmentectomy of segments II+III	4
Bisegmentectomy of segments VI +VII	5
Monosegmentectomy of segment V	2
Monosegmentectomy of segment VI	1
Total	18

Figure 3. Surgical specimen – left hemi-hepatectomy (segments II-III-IV) from giant multiseptated abscess in left lobe

Figure 4. Surgical specimen – left hepatic lobectomy (bisegmentectomy II-III) from metastases

The mean duration of the operation was 205 minutes. For the initial cases (n = 5), the mean duration of the operation was greater than in the subsequent operations (257 *versus* 197 minutes). However, most of the major hepatectomy procedures (80%) were performed in the latter cases. There was no mortality in this series. Postoperative complications occurred in two patients who underwent one right hemi-hepatectomy and one left hemi-hepatectomy (11%) (Chart 3). One patient presented infectious left lobar pneumonia that was treated with antibiotics. Other patient who experienced intraoperative bleeding and underwent open conversion finally presented with an incisional hernia (90th postoperative day). There was no biliary leakage or hepatic insufficiency. There was no case of reoperation in this series. Oral intake was resumed on the first postoperative day in all except one patient who underwent open conversion. The median hospital stay was 4 days (range: 2 to 11 days). All the patients except one used low doses of common analgesics, such as dipirone, during their postoperative course (1 or 2 days). One patient used narcotic analgesia during the postoperative period. The median time taken for the patients to return to their normal activities was 13 days (range: 7 to 40 days). Characteristics of the postoperative period are shown in table 1.

The mean follow-up time in this series was 14 months (median: 15 months; range: 1 to 27 months). All the symptomatic patients achieved complete symptom relief.

Chart 3. Surgical features

Feature	Number of patients
Vascular clamping	1 (18)
Intraoperative blood loss, mL, mean (range)	300 (100-1500)
Transfusions received	2 (18)
Duration of surgery, min, mean (range)	240 (90-360)
Mean weight of specimen, g, mean (range)	285 (57-1040)

Table 1. Postoperative course

Variables	Number of patients
Morbidity	2 (11%)
Reoperation	0 (0%)
Specific liver resection complications*	1 (5.5%)
Nonspecific complications	1 (5.5%) – Lobar pneumonia
Mortality	0 (0%)
Hospital stay, days, median (range)	4 (2-11)
Return to normal activities, days, median (range)	13 (7-30)
Oral intake (hours)	
6	10 (52%)
12	4 (23%)
24	3 (17%)
> 24	1 (7%)

*Intraoperative bleeding.

Among the cancer patients, there was no recurrence. All of them experience good quality of life.

DISCUSSION

LH is a progression in the continuing evolution of minimally invasive surgery (MIS), in general, and laparoscopic liver surgery, in particular. Advances in expertise related to laparoscopic procedures, ongoing technological advances in laparoscopic devices, and increased patient awareness of availability of these techniques have created evolving interest in applications of these techniques in LH[16].

The surgical skills required for LH have evolved in parallel with the adaptation of laparoscopic techniques to this procedure. Hilar dissection, biliary or vascular repair, mobilization of the liver, and transection of the parenchyma are more technically demanding and potentially more dangerous than other previously reported laparoscopic procedures. Anatomical hemi-hepatectomy requires a clear understanding of general liver anatomy, experience in advanced hepatobiliary surgery and, the ability to dissect major vascular and biliary structures using a laparoscopic approach[10,14,16,21,23].

Despite the various obstacles and challenges, LH shows great advantages over open hepatectomy. The major advantages of LH are those of all laparoscopic surgical procedures. LH causes less tissue damage, and this has been associated with lower levels of postoperative pain, fewer peritoneal adhesions, shorter hospital stay, and an earlier return to daily activity[3,4,7,11]. Additionally, two recently published case-control studies[16,17] and one cohort study[5] showed that LH provided lower blood loss, reduced morbidity, fewer operative complications overall and, specifically with regard to malignant disease, no significant difference either in tumor recurrence or in long-term survival[15-17,29,30]. Furthermore, the cosmetic advantages are excellent when LH is performed. It is particularly important when performed to treat benign disease[3,14,24]. Earlier resumption of oral intake is also a great advantage, considering that hepatectomy is a major surgical procedure. For these reasons, the laparoscopic approach should be taken into account, both for benign and for malignant liver disease management[4,5,8,12,16,17,23].

According to some authors[3,11,14,17,23], the use of the laparoscopic route should not modify or broaden the indications for either benign or malignant liver disease. The same principles applied to open hepatic surgery must be respected. Therefore, especially for benign disease, it should be reserved for symptomatic lesions, specific complications, or even uncertain diagnoses (differential with primary or metastatic neoplasms). In particular, for HA, because of the high risk of rupture and malignant degeneration, patients should be offered more liberal surgical resections[14].

Despite the initial skepticism about the use of LH to treat malignant neoplasms, currently it is frequently performed since it is a safe and efficient procedure. Some authors[4,11,15-17] took the view that LH is as safe as conventional open hepatectomy.

For left lesions, some authors considered LH to be the initial approach in reference centers, performed by surgeons with high levels of expertise[3-5,15,17]. Campos et al.[4] recently published a single series of left laparoscopic resections in which the clear advantages of the laparoscopic approach were observed. More recently, in a cohort study that compared laparoscopy and open LLS, Carswell et al.[5] observed that laparoscopy was superior because of the lower need for postoperative opiate analgesia and shorter postoperative hospital stay. In the present study, it was noted that opiates were used and, specifically regarding the LLS procedures, none of the patients presented complications on the third postoperative day. It was also observed in the present series that the results were similar, without postoperative opiate administration, for all except one patient who underwent open conversion (left hemi-hepatectomy for a giant hemangioma). Specifically regarding left resections, only one patient experienced a complication (intraoperative bleeding and incisional hernia).

In a series of 78 patients, Zhang et al.[24] observed totally successful laparoscopic liver resections with no conversion to open procedures, and only four patients received transfusions. In the present series, there was one perioperative complication (intraoperative bleeding), and only two patients received transfusions (in a case of major right hepatectomy due to a large cystadenoma of 12 cm in diameter and one case of left hemi-hepatectomy due to a giant hemangioma).

Although the rate of conversion to open surgery has ranged from 0 to 15%[14,23], it depends on the type of resection, experience of the team, and volume of the lesion. The present open conversion rate is similar to that found in literature.

Although the initial experiences of right liver resection were technically demanding, some authors[5,16,21,22,27] have taken the view that the laparoscopic approach should be the preferred choice, even for posterior right lesions (segments VI-VII). In the present series, despite the fact that the sample was small, there were more cases of right resections, including two cases of formal right hepatectomy, five cases of posterior right sectionectomy (SVI-VII), two cases of segmentectomy of segment V, and one case of segmentectomy of segment VI. The major advantage of LH for resecting posterior right lesions is that it avoids the large open incision that is generally necessary to access posterior pedicles[7,27], although right-side hepatic resections not only are technically more difficult, but also produce higher conversion rates than left resections[11,16,19,23]. LH for right lesions can be considered feasible and safe, as Cho et al.[7] have shown in a recent study. For the posterior right sectionectomy (PRS) in the present series, an intra-hepatic approach was preferred, as already described in Brazil by Machado et al.[22]. This technique was previously published by the authors of the present article[27]. This is safe and minimizes the intraoperative bleeding: in the present series, none of the five patients who underwent PRS received any transfusions and the intraoperative bleeding was minimal.

In one of the largest series, with 300 minimally invasive liver resections (MILR) that were compared with open procedures (among which there were 64 cases of right hepatectomy and 8 cases of extended right hepatectomy), Koffron et al.[16] observed that the laparoscopic approach was superior to the open technique. The advantages were the duration of the operation (99 *versus* 182 minutes), blood loss (102 *versus* 325 mL), transfusion requirement (2 out of 300 cases *versus* 8 out of 100 cases), length of hospital stay (1.9 *versus* 5.4 days), overall operative complications (9.3 *versus* 22%), and local malignant recurrence (2 *versus* 3%). These authors concluded that the outcomes from MILR compared favorably with those of the standard open operation. In a previously published study by the present author[29] on a single series of cases of open hepatectomy (OH) due to metastasis (n = 30 cases), in which almost all of the patients were operated by the senior author (Costa SRP), the overall mortality was 3% while the morbidity rate was 46%. The reoperation rate was 16%, and 44% of the patients received transfusions. The median blood loss was 800 mL. Although it was difficult to compare the outcomes between the laparoscopic series and a contemporaneous open series, given the higher proportion of major hepatic resections (66 *versus* 35%) and greater severity of metastatic disease (age, nutritional state, and associated diseases) in the open series, and without any specific statistical test to compare these samples, the laparoscopic series had some advantages. Respectively, there was less mortality (0 *versus* 3%), morbidity (46 *versus* 11%), transfusions (44 *versus* 11%), blood loss (300 *versus* 800 mL), and reoperation (0 *versus* 16%).

In Brazil, a few authors[18-23,25-27] published studies on LH. Machado et al.[21] observed both low morbidity and zero mortality in LH procedures performed due to CRM, and their results were similar to the present series. This has also been observed in more recent studies, in which mortality was generally zero while general morbidity ranged from 0 to 10%[3,4,16,17,21,27]. However, with regard to right resections, the morbidity is proportionally higher than in left resections, as described by Koffron et al.[16], which suggests that right lesions might be more difficult to treat. Cho et al.[7] observed an overall morbidity rate of 28% when considering only the right liver resections. In the present series, there was no reoperation, thus differing from what some authors have previously reported[23]. However, major hepatectomy only accounted for 30% (n = 6) of the present series, which may have contributed towards the low morbidity rate in this series[7].

To date, with regard to malignant disease, studies suggested that there is no difference between LH and OH in relation to port-site metastasis, free margins, local-systemic recurrence, or even survival rates[11,12,16,17,21,29,30]. However, there have only been a few match-controlled studies, with no ideal level of evidence. Historical series have shown no difference between LH and OH performed on malignant disease.

Nevertheless, such findings should be viewed with caution, and new studies need to be conducted in order to answer these unresolved questions.

CONCLUSION

LH is a safe surgical approach towards focal hepatic lesions consisting of either benign or malignant disease. In the small series presented here, both zero mortality and low morbidity were associated with a good cosmetic result.

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