

Robotic-assisted Atypical Segments 2-3 Hepatectomy for Hemangioma Using the Versius CMR System

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Rezumat

Hepatectomie atipică de segmente 2-3 prin abord asistat robotic utilizând platforma Versius CMR

Prezentăm cazul unei paciente în vârstă de 41 de ani diagnosticată cu un hemangiom hepatic de segmente 2-3 pentru care s-a practicat o hepatectomie atipică utilizând platforma robotică Versius. Majoritatea centrelor din lume efectuează chirurgie hepatică utilizând platforma DaVinci, datele privind chirurgia hepatică cu sisteme robotice diferite fiind limitate. Demonstrăm siguranța și fezabilitatea sistemului Versius în efectuarea unei hepatectomii atipice utilizând instrumente robotice conventionale (pensa bipolară Maryland și foarfecă monopolară) și considerăm că acest sistem poate fi utilizat și în rezecții hepatice cu grad mai ridicat de complexitate.

Cuvinte cheie: resecție hepatică robotică, Versius CMR, hemangiom hepatic

Abstract

We present the case of a 41-year-old female patient diagnosed with a liver hemangioma located in the left lobe - segments 2-3. We performed an atypical liver resection of the segments 2-3 using the Versius robotic system. To the best of our knowledge, the majority of centers perform liver surgery using the DaVinci system, while data regarding liver surgery with other robotic platforms are scarce. We demonstrate the safety and feasibility of the Versius system in performing a crush-clamping technique for liver transection using the Maryland bipolar forceps and the monopolar curved scissors.

Keywords: robotic liver resection, Versius CMR, liver hemangioma

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Introduction

Robotic systems are relatively new tools for performing minimally invasive liver surgery. Despite of the high costs that are a barrier to widespread adoption, the number of reports regarding robotic liver surgery is constantly increasing. The robotic approach is being used in many types of liver resections, from minor hepatectomies to complex liver resections for benign and malignant disease and liver transplantation (1-5). There is a high heterogeneity of the surgical techniques, especially regarding the parenchymal transection, so a standardized protocol is difficult to impose. This variability increases as new robotic systems develop and become accessible (6). To the best of our knowledge, the majority of the centers perform liver surgery using the DaVinci system (7).

We present a robotic atypical liver resection of the segments 2-3 with the Versius system, using the bipolar Maryland clump-crash technique and monopolar scissors for parenchyma transection. No other device was used for parenchyma transection. We demonstrate the feasibility of the Versius system and its instruments and the potential for its use in more complex liver surgeries. This is the first report of liver surgery performed with the Versius system in the Romanian literature. The first robotic assisted left lateral segmentectomy with the DaVinci system in Romania was performed and published in 2008 by Popescu et al (8).

Case Report

A 41-year-old female patient was investigated for abdominal discomfort. On clinical examination, a right upper quadrant abdominal mass was palpated. Upper and lower GI endoscopy were normal. An MRI was performed and revealed an 82/93/72 mm well defined mass in contact with liver segments 5 and 6 (*Fig. 1*) but without right hemiliver parenchyma invasion.

A robotic approach was decided using the Versius system. On laparoscopic exploration, a large segment 2-3 hemangioma was identified that was prolapsed to the right side in the Morrison space with mass effect on the right colonic flexure and duodenum. The left liver lobe and the tumor were repositioned in the left upper quadrant (*Fig. 2*) and the Versius bedside units were positioned for segments 2-3 atypical liver resection (*Fig. 3*). From a technical standpoint, a wide rhombus configuration was used with the 4th arm coming down from the upper left quadrant for expo-

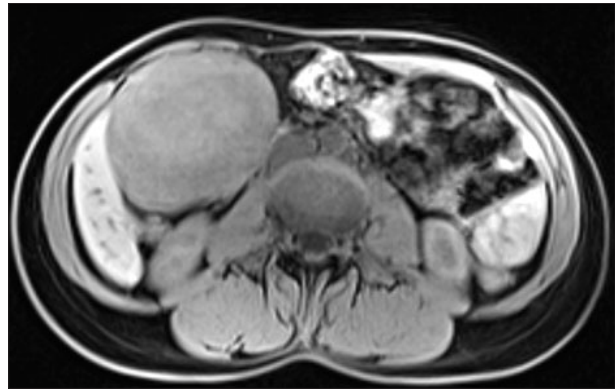


Figure 1. MRI T1 viba showing a well-defined/encapsulated lesion in the space of Morrison in contact with the right liver

sure, a Maryland bipolar for the left hand and monopolar scissors for the right hand. The bedside surgeon's port (12 mm for suction, irrigation and clips) was placed inferiorly as shown in *Fig. 3*.

The transection line was marked with the monopolar scissors. The parenchyma was transected using a bipolar Maryland crush-clamp technique and monopolar scissors; a segment 3 hepatic vein was encountered and clipped after dissection (*Fig. 4*). The Valleylab Force Triad Energy Platform was used, the bipolar in standard mode at 50 and the monopolar scissors 50 for pure cut and 40 for blend mode. The operative specimen was extracted in an endobag through a 5 cm Pfannenstiel incision.

The final pathological report confirmed a liver hemangioma. Total console time was 3 hours and 40 minutes (*Fig. 5*). Estimated blood loss was 100 ml. One drain was left in place and removed on POD 3. An ultrasound was performed and revealed no abdominal collections. The patient was discharged on POD 4.

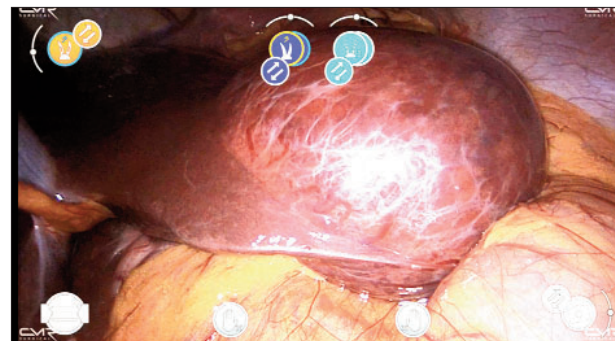


Figure 2. Intraoperative appearance: segments 2-3 liver hemangioma

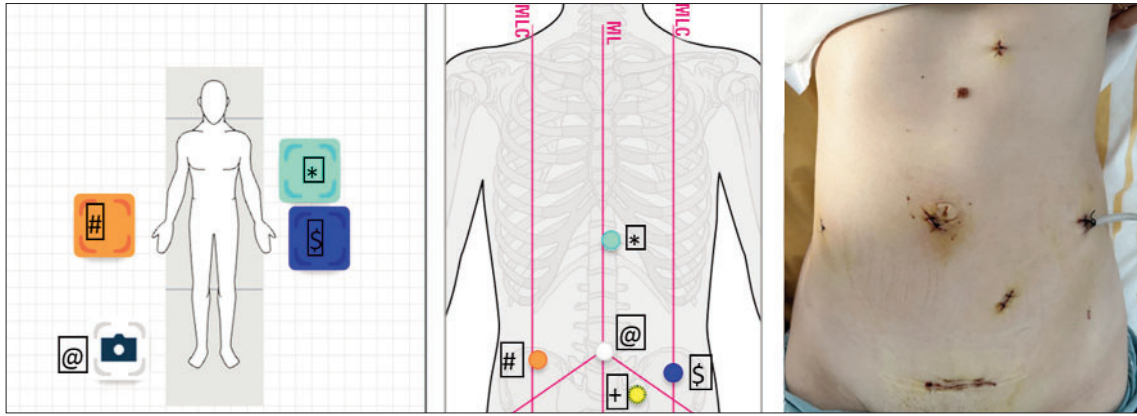


Figure 3. white arm (@) – vizualization unit, 300 down endoscope 11 mm port; orange arm (#): instrument bedside unit with Maryland bipolar 5 mm port; blue arm (\$): instrument bedside unit with monopolar curved scissors 5 mm port; cyan arm (*): instrument bedside unit with fenestrated grasper; yellow port (+): assistant port 12 mm

Discussion

Robotic liver surgery is a valuable alternative to laparoscopic liver surgery because of the benefits offered by the robotic platforms, consisting of improved 3D magnification view, instrument articulation, tremor filtration and motion scaling, ease of suturing, and better overall ergonomics (9). Although the robotic approach to liver resection may include a shorter learning curve, robotic platforms remain limited by the paucity of parenchyma transection devices, the lack of haptic feedback, and the added time associated with docking and instrument change and cleaning (10). Since the first robotic liver resection published in 2003 by Giulianotti et al. (11), the first randomized control trial comparing laparoscopic liver resection and robotic liver resection was published in 2024 by Birgin et al. (12) and revealed similar outcomes in terms of quality of life and perioperative outcomes.

In our case, the initial robotic setup and the preoperative planning was made for a right upper quadrant tumor, as was seen and described by the MRI examination. The laparoscopic exploration revealed a large left lobe hemangioma that was “prolapsed” to the right side, in the space of Morrison, without any adhesion syndrome. After restoring the normal anatomy, the Versius setup plan modification was easily performed as only the visualization unit had to be moved from the left side to the right side of the patient.

Trocar position is extremely important in order to minimize the arm clash situations. The Versius system with its independent bedside units offers flexibility and ergonomics for trocar placement without the constraint of a linear port insertion. In our relatively small patient, the 4th arm used for retraction could be easily placed inside the working cone, sometimes difficult to do with other monolithic platforms. Lancellotti et al. published in

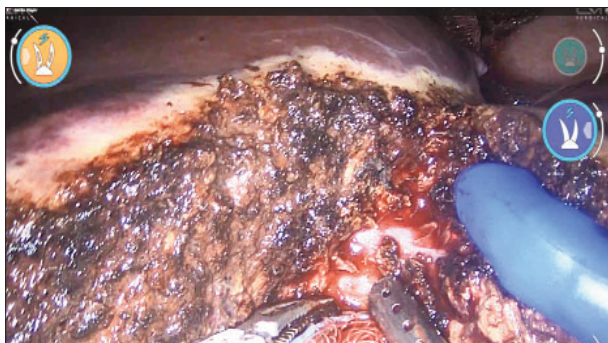


Figure 4. Intraoperative appearance: dissection of segment 3 hepatic vein

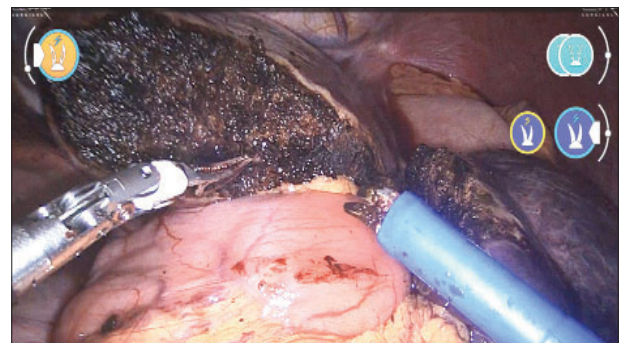


Figure 5. Intraoperative appearance: final appearance after resection

December 2024 their initial experience of robotic distal pancreatectomy using the Versius platform and pointed out that the flexibility in arm positioning can result in incorrect setting that may lead to arm clashes or suboptimal instrument movement (13).

Bleeding control during hepatic transection is of utmost importance, because perioperative blood transfusion is a risk factor associated with poor outcome after liver resection (14). High quality preoperative imaging and reconstructions, good anatomy knowledge, and the use of intraoperative ultrasound are the prerequisites of low postoperative morbidity and mortality and improved long term outcomes. The modern liver surgeon must be familiarized with different parenchyma transection techniques and devices and use them according to the patient's particular liver quality, parenchyma consistency, and resection type (15).

While robotic platforms introduce several innovative features, the available instruments for parenchyma transection are limited (16). Navines-Lopes et al. (17) summarized three modalities for performing the robotic parenchyma transection: robotic assisted: when the bedside surgeon transects the liver parenchyma with a specific laparoscopic tool like the laparoscopic cavitron ultrasonic surgical aspirator; totally robotic: using advanced robotic tools like the Vessel Sealer, Harmonic Scalpel or SynchroSeal; real robotic: no special laparoscopic tool or robotic advanced tool are used, only bipolar Maryland forceps, bipolar fenestrated forceps, monopolar curved scissors, monopolar hook or spatula (17). Whatever the techniques or the approach used, we consider that both surgeons (console and bedside) should have experience in open and laparoscopic liver surgery, especially during the first robotic cases.

Since the introduction of the clump-crush technique for parenchyma transection in the 1970, many different transection devices have been developed and marketed both for open surgery and laparoscopic surgery (18). A meta-analysis published in 2009 comparing the clamp-crush technique and other parenchyma transection devices revealed no difference between overall morbidity, biliary leakage, transfusion rates, and mortality. (18) None of the identified studies demonstrated a clinically important benefit of alternative transection methods in terms of blood loss, parenchymal injury, transection time, and hospital stay. (18) However, the authors mention that for donor hepatectomy and complex central liver resection more accurate tools might be better.

(18). The staple transection technique does not reduce intraoperative blood loss in elective liver surgery compared with the clump-crushing technique (19).

The clamp-crush technique can be safely used in robotic parenchymal transection. We recommend CMR to introduce in training or virtual training phase more tasks reproducing this technique. One of the disadvantages of this technique is that the coagulated liver tissue sticks to the forceps when the energy is applied making it inefficient for further use, regarding the hemostasis. The multiple withdrawing and insertion of the instrument for cleaning leads to an increased operative time, as in our case. To address this issue Kajiwara et al. introduced the saline-linked bipolar clamp crush method preventing and limiting the formation of coagulated and necrotic liver tissue on the bipolar forceps (20).

Using the standard instruments of the robotic platform Navines-Lopez et al. described the microfracture-coagulation technique for robotic liver parenchymal transection (17). In this technique, despite being based on the use of bipolar and monopolar energy, the progress in transection is mainly cold, through small microfracture steps; the authors state that it allows precise and fine dissection of the critical structures so that they can be identified, sutured or clipped.

Sambommatsu et al. described the 'burn and push' robotic technique for liver parenchymal transection. In this technique, the liver parenchyma was transected using mainly the monopolar curved scissors in the right hand; after coagulation, the liver parenchyma is separated by a slight lateral push to the right with the monopolar scissors while the Maryland bipolar forceps in the left hand provides appropriate counter traction to the left side of the transection plane; the newly exposed transection plane is coagulated and the motion is repeated every few millimeters; small vessels are controlled with the Maryland bipolar forceps (21).

Palucci et al. published in December 2024 a comprehensive overview on the robotic liver parenchymal transection techniques and emphasized the importance of standardization and importance of a solid background in open liver surgery before approaching robotic surgery (22). No single parenchymal transection technique has been proven superior (22).

Robotic liver surgery is still in its development stages. A robotic liver program should be implemented in a stepwise manner. High procedural costs are a major problem especially for public

hospitals, but they may be justified in centers with high volume in liver surgery.

Conclusion

As more robotic platforms become available, standardization of robotic complex surgeries is challenging. Guidelines need to address and include all robotic platforms and instruments, but this will happen as more worldwide experience is gained. We safely performed a robotic liver resection with the Versius system and demonstrated the safety and feasibility of the liver parenchymal transection using conventional robotic instruments in a crush-clamp technique fashion. We believe that this system may be used for more complex liver surgeries especially if other advanced energy devices will be added in its armamentarium.

Author's Contributions

AM was the console surgeon and performed the writing of the manuscript and the video editing; CG was the bedside surgeon and together with LC performed the literature research; FG was the preceptor and performed the critical review of the manuscript; DD was the anesthesiologist; NB and NC: conceptualization and critical review of the draft.

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Conflict of Interest

The authors declare no conflict of interest; no financial support was provided for the writing of this article and video.

Ethics of Approval

This study was approved by the Ethics Committee of Sfânta Maria Clinical Hospital.

References

1. Broering DC, Raptis DA, Elsheikh Y. Pioneering fully robotic donor hepatectomy

- and robotic recipient liver graft implantation - a new horizon in liver transplantation. *Int J Surg.* 2024;110(3):1333-6.
2. Mutillo EM, Chiarella LL, Ratti F, Magistri P, Belli A, Berardi G, et al. Is robotic liver resection feasible in patients with lesions in close proximity to major vessels? A propensity score matching analysis. *HPB (Oxford).* 2025;27(1):21-28.
3. Liu R, Abu Hilal M, Wakabayashi G, Han HS, Palanivelu C, Boggi U, et al. International experts consensus guidelines on robotic liver resection in 2023. *World J Gastroenterol.* 2023;29(32):4815-30.
4. Chen PD, Wu CY, Hu RH, Ho CM, Lee PH, Lai HS, et al. Robotic liver donor right hepatectomy: A pure, minimally invasive approach. *Liver Transpl.* 2016;22(11):1509-18.
5. Broering D, Sturdevant ML, Zidan A. Robotic donor hepatectomy: A major breakthrough in living donor liver transplantation. *Am J Transplant.* 2022;22(1):14-23.
6. Marchegiani F, Siragusa L, Zadoroznyj A, Laterza V, Mangana O, Schena CA, et al. New Robotic Platforms in General Surgery: What's the Current Clinical Scenario? *Medicina.* 2023;59(7):1264.
7. Pilz da Cunha G, Lips DJ, Ahmad J, Kvarnström N, Aldrighetti L, D'Hondt M, et al. A European expert consensus surgical technique description for robotic hepatectomy. *Hepatobiliary Surg Nutr.* 2024;13(6):991-1006.
8. Vasile S, Sgarbură O, Tomulescu V, Popescu I. The robotic-assisted left lateral hepatic segmentectomy: the next step. *Chirurgia (Bucur).* 2008;103(4):401-5.
9. Görgec B, Zwart M, Nota CL, Bijlstra OD, Bosscha K, de Boer MT, et al. Implementation and Outcome of Robotic Liver Surgery in the Netherlands. *Ann Surg.* 2023;277(6):e1269-77.
10. Ayabe RI, Azimuddin A, Tran Cao HS. Robot-assisted liver resection: the real benefit so far. *Langenbecks Arch Surg.* 2022;407(5):1779-87.
11. Giulianotti PC, Coratti A, Angelini M, Sbrana F, Cecconi S, Balestracci T, et al. Robotics in general surgery: personal experience in a large community hospital. *Arch Surg.* 2003;138(7):777-84.
12. Birgin E, Heibel M, Heijens S, Rasbach E, Reissfelder C, Téoule P, et al. Robotic versus laparoscopic hepatectomy for liver malignancies (ROC'N'ROLL): a single-centre, randomised, controlled, single-blinded clinical trial. *The Lancet Regional Health - Europe.* 2024;43:100972.
13. Lancellotti F, Iqbal A, Barrie J, Stathakis P, Satyadas T, Deshpande R, et al. Robotic distal pancreatectomy: Initial experience with the Versius robotic surgical system. Stage 2a IDEAL prospective case series. *Clinical Surgical Oncology.* 2024;3(4):100063.
14. Kooby DA, Stockman J, Ben-Porat L, Gonen M, Jarnagin WR, Dematteo RP, et al. Influence of Transfusions on Perioperative and Long-Term Outcome in Patients Following Hepatic Resection for Colorectal Metastases. *Ann Surg.* 2003;237(6):860-70.
15. Poon RTP. Current techniques of liver transection. *HPB (Oxford).* 2007;9(3):166-73.
16. Landry J, Jain AJ, Tzeng CW, Newhook TE, Ikoma N, Chun YS, et al. Robotic Hepatic Parenchymal Transection Techniques: A Choice Between Imperfect Tools. *Ann Surg Oncol.* Epub 2024 Oct 16.
17. Navinés-López J, Pardo Aranda F, Cremades Pérez M, Espin Álvarez F, Zárate Pinedo A, Cugat Andorrà E. Microfracture-coagulation for the real robotic liver parenchymal transection. *J Robot Surg.* 2024;18(1):101.
18. Rahbari NN, Koch M, Schmidt T, Motschall E, Bruckner T, Weidmann K, et al. Meta-Analysis of the Clamp-Crushing Technique for Transection of the Parenchyma in Elective Hepatic Resection: Back to Where We Started? *Ann Surg Oncol.* 2009;16(3):630-9.
19. Rahbari NN, Elbers H, Koch M, Vogler P, Striebel F, Bruckner T, et al. Randomized clinical trial of stapler versus clamp-crushing transection in elective liver resection. *Br J Surg.* 2014;101(3):200-7.
20. Kajiwara M, Fujikawa T, Naito S, Sasaki T, Nakashima R, Hasegawa S. Non-Stick Liver Parenchymal Transection With Saline-Linked Bipolar Clamp-Crush Technique in Robotic Liver Resection. *Cureus.* 2023;15(3):e36401.
21. Sambommatsu Y, Lee SD, Imai D, Savsani K, Khan AA, Sharma A, et al. 'Burn and Push' technique: A novel robotic liver parenchymal transection technique. *Int J Med Robot.* 2024;20(2):e2631.
22. Palucci M, Giannone F, Del Angel-Millán G, Alagia M, Del Basso C, Lodin M, et al. Robotic liver parenchymal transection techniques: a comprehensive overview and classification. *J Robotic Surg.* 2024;19(1):36.