Routes, advantages and disadvantages of robotic para-aortic lymphadenectomy: a review

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Abstract

Introduction
The objective of this article is to review the published scientific literature about para-aortic lymphadenectomy and robotics to date and to summarise findings of this advanced computer-enhanced laparoscopic technique.

Materials and Methods
Relevant sources were identified by a search of PUBMED until January 2014 using the key words 'robot' lymphadenectomy' and 'gynaecology'. We reviewed the robotic approaches published, each with their differences and potential.

Results
There is good evidence that robotic surgery facilitates laparoscopic surgery, with equivalent if not better operative time and comparable surgical outcomes.

Conclusion
It seems that in the hands of experienced laparoscopic surgeons, final outcomes are at least as good as without the use of the robot.

Introduction
The development of robotic technology has facilitated the application of minimally invasive techniques. Since Food and Drug Administration approved the use of surgical robot Da Vinci (Intuitive Surgical, Sunnyvale, CA, USA) there is an increasing number of procedures performed by robotic route. The various advantages of robotic surgery over laparoscopy include the acquisition of 3D images, wristed movement of instruments in the surgical field increasing from 4 to 7 degrees of movement, down-scaling of movements, and ease of left-hand use. In the beginning, it made minimal invasive surgery possible in many centres where the laparoscopic expertise was more limited. Nevertheless, it is in the more complex and longer procedures needing great precision or making many sutures where these advantages are best manifested. Although robotics pose many benefits, it should not be forgotten that, in addition to the high cost, it also has some disadvantages, and there is not a single gynaecological laparoscopic procedure that any well-trained laparoscopist would perform without robotics.

In gynaecology, para-aortic lymphadenectomy is required for surgical staging of endometrial, epithelial and non-epithelial ovarian cancer and tubal cancer, aiding in the selection of patients who will benefit from additional treatments. In the case of advanced cervical cancer the presence of LN metastasis in the upper abdomen is an indication of the expansion of the radiotherapy field. Another indication of extra-peritoneal para-aortic lymphadenectomy is the monitoring of chemotherapy in early stage non-seminomatous germ cell tumours of the testes.

In this article, we review controversies and different approaches of para-aortic lymphadenectomy performed by robotics.

Materials and Methods
A Pubmed search has been performed using the terms: (‘robotics’ [MeSH Terms] OR ‘robotics’ [All Fields] OR ‘robotic’ [All Fields]) AND (‘lymph node excision’ [MeSH Terms] OR ‘lymph’ [All Fields] AND ‘node’ [All Fields] AND ‘excision’ [All Fields]) OR ‘lymph node excision’ [All Fields] OR ‘lymphadenectomy’ [All Fields]) AND (‘gynaecology’ [All Fields] OR ‘gynaecology’ [MeSH Terms] OR ‘gynaecology’ [All Fields]). Publications in languages other than English or Spanish have been discarded. Ninety-nine related publications were found, from which the 35 most important/relevant papers were reviewed. A search for (‘aorta’ [MeSH Terms] OR ‘aorta’ [All Fields] OR ‘aortic’ [All Fields]) AND (‘lymph node excision’ [MeSH Terms] OR ‘lymph’ [All Fields] AND ‘node’ [All Fields] AND ‘excision’ [All Fields]) OR ‘lymph node excision’ [All Fields] OR ‘lymphadenectomy’ [All Fields]) AND (‘robotics’ [MeSH Terms] OR ‘robotics’ [All Fields] AND (‘gynaecology’ [All Fields] OR ‘gynaecology’ [MeSH Terms] OR ‘gynaecology’ [All Fields]) was also done.

Results
Twenty-nine publications were found, out of which 24 were selected to be reviewed. Appropriate case reports, case series, retrospective studies, prospective trials and review articles as well as references cited in the publications have been reviewed. The purpose of this review is not to perform a meta-analysis of all the studies to date, but to expose the different techniques, state of art, advantages and disadvantages of different approaches.

Discussion
First robotic staging procedures were reported in seven patients in 2005 by Reynolds et al., concluding that the integration of robot-assisted...
technology in the performance of laparoscopic staging of gynaecologic malignancies was feasible, and could overcome the surgical limitations of conventional laparoscopy. Since then, several routes and comparisons have been published.

**Robotic transperitoneal techniques**

Different techniques have been described for robotic transperitoneal lymphadenectomy. When this procedure is performed alone, a single docking and position of the patient is enough, but when this procedure is combined with other procedures it can be a problem, because one of the limitations of the robot is the impossibility to access the entire abdominal quadrants with the same docking procedure.

In gynaecology, for pelvic surgery, the standard robotic setup is docking the robot between the legs or oblique to the patient’s side. To access the upper part of the abdomen and perform a para-aortic lymphadenectomy, a relocation of the robotic column is needed for the dissection of lymph nodes above the inferior mesenteric artery (IMA).

The possibilities described are the double docking with the robotic column to the head of the patient, a transperitoneal left lateral approach or a single docking procedure.

Transperitoneal robotic approach is usually made with the double docking and table rotation when used in conjunction with robotic pelvic surgery. A good coordination with anaesthesiologist and nursing is required. Additional trocar sites are needed. Aortic lymphadenectomy can be performed adequately and safely with the robotic column at the patient’s head (Video 1).

Boggess et al. proposes single docking as the best approach and has demonstrated that it is possible to perform the dissection until renal vein with a higher trocar disposition. The benefit of this approach is that complete surgery can be performed with no redocking and relocation of the robotic column. Trocar for optics is located 10 cm above umbilicus. Complete description of location of robotic trocars is well published. High port placement may be a problem in regard to access of the pelvis, especially in some patients who have a long distance between the xiphoid and the symphysis pubis. The longest instruments of the last Da Vinci Si model help reaching well to the pelvis; turning 90° optics at the level of cava vein facilitate dissection of aorto-caval nodes.

In our experience, the wristed robotic instrumentation makes it easier for the excision of inter aorto-cave nodes and left latero-aortic nodes in transperitoneal para-aortic lymphadenectomy (Videos 2 and 3).

**Robotic extraperitoneal lymphadenectomy**

There are few papers published about extraperitoneal para-aortic lymphadenectomy by robotics; the description of the technique in two female cadavers and consequently in one alive cervical cancer patient, five cases in advanced cervical cancer until IMA and six cases, including male patients, until renal vein. Larger series have been published by the group of Vall D’Hebron with 17 patients and by ourselves in 13 patients (Table 1). The number of nodes obtained by this route is similar or even higher when robotics are used instead of classical laparoscopy. Díaz-Feijoo published higher number of nodes on the extraperitoneal route via robotics, comparing it with a retrospective series of this group by classical laparoscopy (17 vs. 14, P < 0.05), with decreased blood loss (90 vs. 20 mL, P < 0.05) without differences on postoperative complications.

<table>
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<tr>
<th>Author</th>
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<th>Level of dissection</th>
<th>Cancer</th>
<th>Nodes removed</th>
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<tbody>
<tr>
<td>Magrina et al.</td>
<td>1*</td>
<td>Renal vein</td>
<td>Cervical cancer</td>
<td>5*</td>
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<tr>
<td>Vergote et al.</td>
<td>5</td>
<td>IMA</td>
<td>Advanced cervical cancer</td>
<td>9,2 (7–12)</td>
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<tr>
<td>Narducci et al.</td>
<td>6</td>
<td>Renal vein</td>
<td>Non-seminomatous male cancer, cervical</td>
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<td>Gorostidi et al.</td>
<td>13</td>
<td>Renal vein</td>
<td>Advanced cervical, endometrial and ovarian</td>
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<td>Diaz-Feijoo et al.</td>
<td>17</td>
<td>Renal vein</td>
<td>Advanced cervical cancer</td>
<td>17 (10–31)</td>
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*Two cadavers and one cervical cancer alive patient, with selected (not systematically) lymphadenectomy.

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Access in such constrained surgical field can be challenging (Video 4), but once used to the technique, the surgery is basically the same as with laparoscopy.

**Transperitoneal vs. extraperitoneal route**

Some papers suggest the number of nodes excised on extraperitoneal route is higher, due to better visualisation and excision of the left aortic side. Some authors such as Mariani et al., in Mayo clinic, believe that this area, especially above IMA is the most important area of the para-aortic lymphadenectomy in endometrial cancer, and it is a very important location of aortic metastasis in cervical cancer as well. A publication comparing classical laparoscopy, extraperitoneal para-aortic lymphadenectomy, classical transperitoneal lymphadenectomy and robotic transperitoneal lymphadenectomy concludes that the number of nodes is higher in the extraperitoneal route. Other papers conclude that the number of nodes is similar in the transperitoneal route.

Transperitoneal route has a high number of conversions to laparotomy, about 8% approximately, which could be decreased with the use of the extraperitoneal route.

Extraperitoneal para-aortic laparoscopic lymphadenectomy is preferable to reduce the risk of adhesions, reproduced in animal models, and prior to chemoradiation treatments, thus not fully demonstrated, the risk of complications due to adhesions and radiotherapy seems to be lower. It is a complex, but easy learning procedure and can be easily performed by trained surgeons, and it is the best approach for obese patients where the transperitoneal approach can be more difficult or impossible, and it does not need Trendelemburg, many times not well tolerated by patients with comorbidity conditions.

Our group preferred starting the staging procedure with the extraperitoneal para-aortic approach whenever possible. The transperitoneal route is only performed when the decision is made after pelvic surgery, making an extraperitoneal approach impossible, or in the few cases where a conversion from extraperitoneal to transperitoneal is needed due to an unresolved peritoneal hole.

### Robotics vs. laparoscopy complete staging

Laparoscopic pelvic and para-aortic lymph node staging is widely used in patients with endometrial, cervical and ovarian cancer, and the use of robotics has been described in all of them.

An extended pelvic and para-aortic lymphadenectomy can be reliably and safely performed robotically in the management of gynaecological malignancies. The robotic system aids in performing a very precise dissection.

Comparisons of complete surgical staging in endometrial cancer by robotics with laparoscopy (including bilateral salpingo oophorectomy and total hysterectomy, pelvic and para-aortic lymphadenectomy) have been published, with similar peri- and postoperative results. Even though a lower number of urinary complications, shorter hospital stay, more surgical time, lower number of conversions and less blood loss, without any difference in number of transfusions, nodes obtained, reoperations and readmissions between both groups, suggesting less number of complications in the robotic group.

Omectomy in our experience is more laborious if only the monopolar and bipolar robotic instrumentations are used. It is much quicker and easier introducing an advanced sealing and cutting device through assistant port. Our group has published some of the advantages and disadvantages encountered by robotics (Table 2).

### Single-port para-aortic lymphadenectomy

Para-aortic lymphadenectomy was first described by single-site surgery by the group of Cleveland, directed by Escobar et al. The technique has been performed mainly by extraperitoneal route, as well as transperitoneal route, using step Trendelemburg and left flank...
Conclusion
Robotic-assisted aortic lymphadenectomy is a safe and feasible procedure in the hands of properly trained surgeons. The development of robotic technology has facilitated the application of minimally invasive techniques for the treatment of gynaecological cancer. The skills could be acquired in a shorter time but also by a large number of laparotomy surgeons who encountered difficulties with conventional laparoscopy. Although patient advantages and surgical results are similar or slightly improved with robotics, there are multiple advantages for the surgeons.

Abbreviation list
IMA, IMA, inferior mesenteric artery.

References
Review

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