Accepted: 3 January 2023

DOI: 10.1111/1471-0528.17408

BJOG An International Journal of Obstetrics and Gynaecology

COMMENTARY

Open radical hysterectomy: The new standard of care in early-stage cervical cancer

Pedro T. Ramirez[1] | **Rene Pareja**[2,3] | **David Viveros-Carreño**[2,4] | **Michael Frumovitz**[1]

[1]Department of Gynecologic Oncology & Reproductive Medicine, The University of Texas MD Anderson Cancer Center, Houston, Texas, USA

[2]Department of Gynecologic Oncology, Instituto Nacional de Cancerología, Bogotá, Colombia

[3]Department of Gynecologic Oncology, Astorga Clínica de Oncología, Medellín, Colombia

[4]Department of Gynecologic Oncology, Clínica Universitaria Colombia and Centro de tratamiento e investigación sobre el cáncer Luis Carlos Sarmiento Angulo, Bogotá, Colombia

Correspondence
Pedro T. Ramirez, Department of Gynecologic Oncology & Reproductive Medicine, The University of Texas MD Anderson Cancer Center, Houston, TX 77030, USA.
Email: peramire@mdanderson.org

1 | LAPAROSCOPIC APPROACH TO CARCINOMA OF THE CERVIX TRIAL RESULTS

1.1 | Oncologic outcomes

The Laparoscopic Approach to Carcinoma of the Cervix (LACC) trial is a prospective randomised trial comparing open versus minimally invasive radical hysterectomy in patients with early-stage cervical cancer.[1] The trial included patients with International Federation of Gynaecology and Obstetrics (FIGO) 2009 stage IA1 (lymphovascular space invasion), IA2 or IB1 cervical cancer and histologic subtypes such as squamous-cell carcinoma, adenocarcinoma or adenosquamous carcinoma. Its primary aim was to evaluate disease-free survival at 4.5 years, with noninferiority claimed if the lower boundary of the two-sided 95% confidence interval of the between-group difference was greater than −7.2 percentage points. A total of 319 patients were assigned to minimally invasive surgery and 312 patients were assigned to open surgery. Most patients (91.9%) had stage IB disease. Of the patients who were assigned to and underwent minimally invasive surgery, 84.4% underwent laparoscopy and 15.6% underwent robot-assisted surgery. The two groups were similar in histologic subtypes, the rate of lymphovascular invasion, parametrial and lymph-node involvement rates, tumour size, tumour grade and the rate of adjuvant therapy. The trial was prematurely closed as a recommendation of the data and safety monitoring committee, as the minimally invasive surgical intervention was associated with higher death rates.

The rate of disease-free survival at 4.5 years was 86.0% with minimally invasive surgery and 96.5% with open surgery. Minimally invasive surgery was associated with a lower rate of disease-free survival than open surgery (3-year rate, 91.2% vs 97.1%, HR 3.74, 95% CI 1.63–8.58). This difference remained even after adjustment for age, body mass index, stage of disease, lymphovascular invasion, lymph node involvement and Eastern Cooperative Oncology Group (ECOG) performance status score. In addition, minimally invasive surgery was also associated with a lower overall survival rate (3-year rate, 93.8% vs 99.0%, HR 6.00; 95% CI 1.77–20.30). It was also associated with a higher rate of death from cervical cancer (3-year rate, 4.4% vs 0.6%, HR 6.56, 95% CI 1.48–29.00), and a higher rate of locoregional recurrence (3-year rate of locoregional recurrence-free survival, 94.3% vs 98.3%, HR 4.26, 95% CI 1.44–12.60).

In summary, minimally invasive radical hysterectomy in patients with cervical cancer was associated with a higher rate of recurrence and a lower rate of disease-free survival than the open approach.

After the publication of the LACC trial, a population-based study showed that the use of minimally invasive surgery decreased after the publication of the trial results.[2] The odds of minimally invasive surgery before the publication of the trial results were 59% lower than the odds of minimally invasive surgery before the publication of the trial results (OR 0.41, 95% CI 0.29–0.59, $p < 0.001$).

1.2 | Adverse events

Subsequent data were published on the comparison of complication rates between the open and minimally invasive surgery in the LACC trial.[3] In that study, the mean duration of surgery was 216 minutes (range 75–441 minutes)

for minimally invasive surgery and 187 minutes (range 61–425 minutes) for open surgery. The mean estimated blood loss was 101 ml (range 10–1500 ml) for minimally invasive surgery and 209 ml (range 10–2200 ml) for open surgery ($p < 0.001$). Intraoperative and/or postoperative blood transfusions were administered to ten of 279 patients (3.6%) in the minimally invasive surgery group and to 20 of 257 patients (7.8%) in the open surgery group ($p = 0.03$). Hospital stay was 3 days (range 0–72 days) for minimally invasive surgery and 5 days (range 1–69 days) for open surgery. The mean estimated blood loss was 91 ml (range 10–500 ml) for robotic surgery and 103 ml (range 0–1500 ml) for laparoscopic surgery. The mean length of surgery was 288 minutes (range 140–441 minutes) for robotic surgery and 205 minutes (range 75–420 minutes) for laparoscopic surgery. The median length of hospital stay was 2 days (range 0–34 days) for robotic surgery and 4 days (range 0–72 days) for laparoscopic surgery.

The incidence of intraoperative and postoperative adverse events associated with minimally invasive versus open radical hysterectomy for early-stage cervical cancer was similar. The incidence of intraoperative adverse events of grade 2 or higher was 12% in the minimally invasive group versus 10% in the open surgery group ($p = 0.45$). Intraoperative adverse events occurred in 10% of patients (4/41) in the robotic surgery group and in 13% of patients (30/238) in the laparoscopic surgery group. The overall incidence of postoperative adverse events of grades greater than 2 was 54% in the minimally invasive group versus 48% in the open surgery group ($p = 0.14$). Of note, four of 279 patients (1.4%) in the minimally invasive surgery group and 16 of 257 patients (6%) in the open surgery group had wound complications ($p = 0.004$). Eleven of 279 patients (4%) in the minimally invasive surgery group and two of 257 patients (0.8%) in the open surgery group had vaginal vault complications ($p = 0.01$). The authors concluded that the overall incidences of intraoperative and postoperative adverse events did not differ between minimally invasive and open radical hysterectomy for early cervical cancer.

1.3 | Quality of life

Subsequently, the comparison of quality of life (QoL) between open surgery and minimally invasive radical hysterectomy in the LACC trial was published.[4] Eligible patients completed validated QoL and symptom assessments (SF-12, FACT-Cx, EQ-5D and MDASI) before surgery, at 1 and 6 weeks after surgery, and at 3 and 6 months after surgery (FACT-Cx was completed at 54 months after surgery). In that study, 79% of patients completed at least one baseline and one follow-up QoL survey. At baseline, no differences in the mean FACT-Cx total score were identified between the open surgery (129.3, SD 18.8) and minimally invasive surgery groups (129.8, SD 19.8). No differences in mean FACT-Cx total scores were identified between the groups at 6 weeks after surgery (128.7, SD 19.9, in the open surgery group vs 130.0, SD 19.8, in the minimally invasive surgery group) or at 3 months after surgery (132.0, SD 21.7, vs 133.0, SD 22.1).

The authors concluded that as recurrence rates are higher and disease-free survival is lower for minimally invasive radical hysterectomy than for open surgery, and postoperative quality of life is similar between the treatment groups, gynaecological oncologists should recommend open radical hysterectomy for patients with early-stage cervical cancer.

2 | OVERVIEW OF PUBLISHED LITERATURE ON ONCOLOGIC OUTCOMES

In an effort to determine whether the findings of high-quality observational studies are consistent with the results of a randomised clinical trial, Nitecki et al.[5] performed a systematic review and meta-analysis of high-quality studies only. Study quality was assessed with the Newcastle–Ottawa scale and included studies with scores of at least seven points that controlled for confounding by tumour size or stage. A total of 49 studies were identified, of which 15 were included in the meta-analysis. Of 9499 patients who underwent radical hysterectomy, 49% ($n = 4684$) underwent minimally invasive surgery; of these, 57% ($n = 2675$) had robot-assisted laparoscopy. There were 530 recurrences and 451 deaths reported. The pooled hazard of recurrence or death was 71% higher among patients who underwent minimally invasive radical hysterectomy, compared with patients who underwent open surgery (HR 1.71, 95% CI 1.36–2.15, $p < 0.001$), and the hazard of death was 56% higher (HR 1.56, 95% CI 1.16–2.11, $p = 0.004$). The authors concluded that among patients undergoing radical hysterectomy for early-stage cervical cancer, minimally invasive radical hysterectomy was associated with an elevated risk of recurrence and death compared with open surgery.

A recent European, multicentre, retrospective, observational cohort study evaluated disease-free survival in patients with FIGO 2009 stage IB1 cervical cancer undergoing open surgery versus minimally invasive radical hysterectomy.[6] Data were obtained from 1272 patients that underwent a radical hysterectomy by open or minimally invasive surgery for stage IB1 cervical cancer (FIGO 2009) from January 2013 to December 2014. The primary end point compared disease-free survival at 4.5 years in both groups. Secondary end points compared overall survival among groups and the impact of the use of a uterine manipulator and protective closure of the colpotomy over the tumour in the minimally invasive surgery group.

In that study, the authors found that the risk of recurrence for patients who underwent minimally invasive surgery was twice as high as that in the open surgery group (HR 2.07, 95% CI 1.35–3.15, $p = 0.001$). Similarly, the risk of death was 2.42 times higher than in the open surgery group (HR 2.45, 95% CI 1.30–4.60, $p = 0.005$). Interestingly, patients who underwent minimally invasive surgery using a uterine manipulator had a 2.76 times higher hazard of relapse (HR 2.76,

95% CI 1.75–4.33, $p < 0.001$), and those without the use of a uterine manipulator had similar disease-free survival to those in the open surgery group (HR 1.58, 95% CI 0.79–3.15, $p = 0.20$). Moreover, patients that underwent minimally invasive surgery with protective vaginal closure had similar rates of relapse to those who underwent open surgery (HR 0.63, 95% CI 0.15–2.59, $p < 0.52$). The authors concluded that minimally invasive surgery in cervical cancer increased the risk of relapse and death compared with open surgery. In addition, the authors added that avoiding the uterine manipulator and using manoeuvres to avoid tumour spread at the time of colpotomy in minimally invasive surgery was associated with similar outcomes to open surgery. However, it should be noted that the study was not designed to evaluate these two factors; thus, these findings are hypothesis-generating only.

3 | FACTORS IMPACTING ONCOLOGIC OUTCOMES

3.1 | Vaginal protective manoeuvre

One of the potential hypotheses for the increased recurrence rates in minimally invasive radical hysterectomy has been the suggestion that in this approach there may be a higher rate of tumour spillage. This could result from several factors, including: exposure of exophytic tumours to the intra-abdominal and pelvic cavity in the setting of gross disease; the use of a uterine manipulator and mobilisation of the tumour on its axis in the cervix when performing the colpotomy;[7] or exposure of the tumour to CO_2 gas from the pneumoperitoneum, thus potentially leading to higher rates of implantation along the surfaces of the peritoneum.[8]

To avoid exposure of the tumour and to protect the tumour from spilling into the abdominal and pelvic cavity, some have proposed the concept of the 'vaginal protective maneuver'.[8] In this approach, a vaginal cuff is created and closed with a continuous suture. This is then grasped with serrated clamps to open the cul-de-sac and vesicovaginal space. The parametrial resection is then performed vaginally, with the final extraction of the specimen once laparoscopic steps have been completed intra-abdominally, as routinely performed for a radical hysterectomy.

In a recent retrospective study by Kohler and colleagues,[9] the investigators gathered information on 1952 patients with FIGO 2009 stages IA1 (lymphovascular space invasion) to IIA1 or IB1 who had undergone radical hysterectomy through a combined transvaginal laparoscopic approach without the use of a uterine manipulator. After a median follow-up of 99 months (range 1–288 months), the investigators found that the 3-, 4.5- and 10-year disease-free survival rates were 96.8%, 95.8% and 93.1%, respectively, and the equivalent overall survival rates were 98.5%, 97.8% and 95.8%. Thus concluding that with this vaginal protective manoeuvre the oncologic outcomes were favourable. Of note, there were several limitations in that study, including the fact that the rate of lymph node positivity was only 3%, as the authors routinely abandoned the radical hysterectomy in patients proven to have positive lymph nodes on frozen section. In addition, given the retrospective nature of the study there were no details on which patients were selected to undergo, or not, a vaginal protective manoeuvre. Lastly, there are no data available demonstrating that this approach has been evaluated in a prospective fashion and with results that are consistent with the retrospective data.

In another retrospective publication by Chiva et al.,[6] known as the SUCCOR (Surgery in Cervical Cancer, Observational, Retrospective) study, the investigators evaluated disease-free survival in patients with FIGO 2009 stage IB1 cervical cancer undergoing open versus minimally invasive surgery. The results showed that minimally invasive surgery increased the risk of relapse and death compared with open surgery. As a secondary objective, the authors evaluated the impact of a protective closure of the colpotomy over the tumour in the minimally invasive group, and found that avoiding the uterine manipulator and using manoeuvres to avoid tumour spread, the minimally invasive approach was associated with similar outcomes to those of open surgery.

It should be noted that before adopting this approach, gynaecologic oncologists must be cognizant of the fact that such an approach has not been tested in a prospective manner against the open surgical approach, which is the current standard.[10–14] In addition, there is limited information on the learning curve, complications, readmissions or reoperations when performing the vaginal protective manoeuvre. Lastly, there is no information as to who the ideal patients for this approach are, and so this approach should remain investigational when performed in conjunction with minimally invasive surgery.

3.2 | Cervical conisation

Recent data have explored cervical conisation as a prognostic indicator of oncologic outcomes. This is based on the hypothesis that generally patients who undergo cervical biopsy alone have a worse oncologic outcome, compared with patients who undergo a diagnostic conisation. A retrospective study by Casarin et al.[15] compared open versus minimally invasive radical hysterectomy in patients with early cervical cancer. The authors found that recurrence rates in patients who underwent preoperative conisation were 1.1%, versus 16.1% for those who only had a preoperative cervical biopsy. In addition, the 5-year disease-free survival was higher for those who underwent a preoperative conisation (vs cervical biopsy).

Another retrospective, multi-institutional registry study from Europe, known as the SUCCOUR CONE study, evaluated the role of conisation as a protective factor for patients undergoing radical hysterectomy, regardless of surgical approach.[16] From the propensity matching score, the investigators found that the risk of relapse was reduced by 65% and the risk of death was reduced by 75% in patients who underwent a prior conisation. Similarly, in another multi-institutional

study from Latin America, Odetto et al.[17] found that prior conisation was associated with a significantly lower risk of recurrence: 4.9% versus 16.2% ($p = 0.001$). The investigators also evaluated patients who underwent conisation and had no residual tumour on the preoperative assessment before radical hysterectomy. In these patients, the recurrence rate was 1.4% in the open group versus 2.9% in the minimally invasive group ($p = 0.48$). In addition, they found no recurrences in patients with no residual tumour on their final pathology.

It should be highlighted that there should be caution in interpreting this data. There are many factors to consider when evaluating conisation and oncologic outcomes. First, it should be noted that all studies evaluating this question are retrospective, thus leaving a gap in our knowledge of the indications for conisation versus no conisation, the results of imaging studies prior to conisation, the association with histologic subtype and the tumour grades. Second, knowing that there are worse outcomes for minimally invasive surgery there may be an influential factor on outcome based on surgical approach, as this is often not clearly defined or appropriately allocated into subgroups for adequate statistical analysis. Third, one obvious fact is that when comparing oncologic outcomes for patients who underwent a cervical conisation, versus patients that only had a cervical biopsy, one needs to realise that, by definition, patients who undergo a conisation are typically patients who have a microscopic tumour, and thus the conisation allows for information on depth of invasion and lymphovascular invasion, as well as grade. Conversely, patients who undergo biopsy alone are generally patients who have gross tumours, who we know have a worse prognosis than those with microscopic disease. Therefore, the favourable outcomes of conisation are not directly related to having undergone conisation but rather to the fact that conisation is used for a much more favourable patient and tumour profile. Lastly, one should be reminded that conisation is not indicated in the setting of a visible or gross lesion on the cervix, and as such these data presented here regarding conisation prior to radical hysterectomy should not be cause for a change in practice or an indication for conisation.

3.3 | Tumour size

Tumour size remains one of the most important predictors of outcomes in patients with early cervical cancer. In the LACC trial, the authors did not evaluate outcomes stratified by tumour size (<2 cm vs. ≥2 cm in diameter) because the study was not powered to detect a difference between these groups.[1] There have been several retrospective studies that have demonstrated that the minimally invasive approach in patients with tumours of <2 cm in diameter is worse than open radical hysterectomy. A retrospective study conducted by Uppal et al.[18] compared open versus minimally invasive radical hysterectomy in 815 patients with early cervical cancer. The authors found that patients undergoing minimally invasive radical hysterectomy had inferior disease-free survival. Interestingly, after propensity score matching, the recurrence rate was 4.4% for open surgery and 11.5% for minimally invasive surgery ($p = 0.019$ in patients with tumours of ≤2 cm in diameter). Another retrospective study from Asia performed by Chen et al.[19] evaluated oncologic outcomes for open versus minimally invasive surgery, specifically in cervical cancer patients with tumours of ≤2 cm in diameter. The results showed that patients in the laparoscopic group had a significantly worse 5-year disease-free survival rate than patients in the open group (90.4% vs 97.5%, $p = 0.02$).

To capture a large patient population, and thus gather more robust data, Nasioudis et al.[20] evaluated a total of 2046 patients with tumours of ≤2 cm in diameter: 1195 (58.4%) and 851 (41.6%) patients had minimally invasive surgery and open radical hysterectomy, respectively. After controlling for age, history of another tumour, type of insurance, lymph node metastases, tumour histology, tumour size and receipt of radiotherapy, patients who underwent minimally invasive surgery had worse survival (HR 1.72, 95% CI 1.05–2.82). Another recent meta-analysis compared open versus minimally invasive radical hysterectomy in patients with tumours of ≤2 cm in diameter.[21] This study compiled data from ten studies encompassing 4935 patients. After controlling for confounding factors, minimally invasive surgery was associated with worse progression-free survival rates than laparotomy.

4 | CONTINUING CLINICAL TRIALS

There are currently three continuing trials comparing open versus minimally invasive radical hysterectomy. The first of these is the RACC (Robot-assisted Approach to Cervical Cancer) trial,[22] which aims to investigate the oncologic safety of robot-assisted surgery for early-stage cervical cancer, compared with laparotomy. This is a multi-institutional, open-label randomised controlled trial. The primary end point is recurrence-free survival at 5 years. The study aims to recruit a total of 768 patients. It is anticipated that the trial will complete accrual in 2027. The second trial is from China, led by Chao and colleagues,[23] and aims to compare either robotic-assisted surgery or laparoscopy versus open radical hysterectomy. The study intends to recruit 1448 patients from 28 centres in China, and the primary objective is 5-year disease-free survival. The third trial is from the USA and is titled the ROCC (Robotic versus Open Radical Hysterectomy for Cervical Cancer) trial.[24] In this study, the investigators will randomise patients to either robotic-assisted radical hysterectomy or open radical hysterectomy. The goal for accrual is 840 patients with a primary objective of evaluating 3-year disease free survival. The anticipated completion date is 2029.

5 | CONCLUSION

The results of the LACC trial have led to a change in the standard of care, with all guidelines, including those from the European Society of Gynaecological Oncology (ESGO),

the European Society for Medical Oncology (ESMO), FIGO, the National Comprehensive Cancer Network (NCCN) and the National Institute for Health and Care Excellence (NICE), now recommending the open approach when performing radical hysterectomy for early cervical cancer. A number of questions remain unanswered regarding the aetiology of the inferior outcomes with minimally invasive surgery. Similarly, further research is encouraged to determine the impacts of tumour size, the vaginal protective manoeuvre and previous conisation on oncologic outcomes. Currently, there are three continuing trials exploring oncologic outcomes based on a surgical approach when performing radical hysterectomy.

AUTHOR CONTRIBUTIONS

PTR: conception, writing and editing. RP: writing and editing. DVC: writing and editing. MF: writing and editing.

CONFLICT OF INTEREST STATEMENT

None declared. Completed disclosure of interests form available to view online as supporting information.

REFERENCES

1. Ramirez PT, Frumovitz M, Pareja R, Lopez A, Vieira M, Ribeiro R, et al. Minimally invasive versus abdominal radical hysterectomy for cervical cancer. N Engl J Med. 2018;379(20):1895–904.
2. Lewicki PJ, Basourakos SP, Qiu Y, Hu JC, Sheyn D, Hijaz A, et al. Effect of a randomized, controlled trial on surgery for cervical cancer. N Engl J Med. 2021;384(17):1669–71.
3. Obermair A, Asher R, Pareja R, Frumovitz M, Lopez A, Moretti-Marques R, et al. Incidence of adverse events in minimally invasive vs open radical hysterectomy in early cervical cancer: results of a randomized controlled trial. Am J Obstet Gynecol. 2020;222(3):249.e1–10.
4. Frumovitz M, Obermair A, Coleman RL, Pareja R, Lopez A, Ribero R, et al. Quality of life in patients with cervical cancer after open versus minimally invasive radical hysterectomy (LACC): a secondary outcome of a multicentre, randomised, open-label, phase 3, non-inferiority trial. Lancet Oncol. 2020;21(6):851–60.
5. Nitecki R, Ramirez PT, Frumovitz M, Krause KJ, Tergas AI, Wright JD, et al. Survival after minimally invasive vs open radical hysterectomy for early-stage cervical cancer: a systematic review and meta-analysis. JAMA Oncol. 2020;6(7):1019–27.
6. Chiva L, Zanagnolo V, Querleu D, Martin-Calvo N, Arévalo-Serrano J, Căpîlna ME, et al. SUCCOR study: an international European cohort observational study comparing minimally invasive surgery versus open abdominal radical hysterectomy in patients with stage IB1 cervical cancer. Int J Gynecol Cancer. 2020;30(9):1269–77.
7. Kong TW, Chang SJ, Piao X, Paek J, Lee Y, Lee EJ, et al. Patterns of recurrence and survival after abdominal versus laparoscopic/robotic radical hysterectomy in patients with early cervical cancer. J Obstet Gynaecol Res. 2016;42(1):77–86.
8. Volz J, Köster S, Spacek Z, Paweletz N. The influence of pneumoperitoneum used in laparoscopic surgery on an intraabdominal tumor growth. Cancer. 1999;86(5):770–4.
9. Kohler C, Hertel H, Herrmann J, Marnitz S, Mallmann P, Favero G, et al. Laparoscopic radical hysterectomy with transvaginal closure of vaginal cuff - a multicenter analysis. Int J Gynecol Cancer. 2019;29(5):845–50.
10. NCCN, National Comprehensive Cancer Network. Cervical cancer (version 1.2022). [cited 2022 Oct 17]. Available from: https://www.nccn.org/professionals/physician_gls/pdf/cervical.pdf
11. Committee FGO. FIGO statement on minimally invasive surgery in cervical cancer. Int J Gynaecol Obstet. 2020;149(3):264.
12. Querleu D, Cibula D, Concin N, Fagotti A, Ferrero A, Fotopoulou C, et al. Laparoscopic radical hysterectomy: a European Society of Gynaecological Oncology (ESGO) statement. Int J Gynecol Cancer. 2020;30:15.
13. ESMO Guidelines Committee. eUpdate – Cervical cancer treatment recommendations. 2020 [cited 2022 Oct 17]. Available from: https://www.esmo.org/guidelines/guidelines-by-topic/gynaecological-cancers/cervical-cancer/eupdate-cervical-cancer-treatment-recommendations
14. NICE. Minimally invasive radical hysterectomy for early stage cervical cancer: Interventional procedures guidance [IPG686]. 2021 [cited 2022 Oct 18]. Available from: https://www.nice.org.uk/guidance/ipg686
15. Casarin J, Bogani G, Papadia A, Ditto A, Pinelli C, Garzon S, et al. Preoperative conization and risk of recurrence in patients undergoing laparoscopic radical hysterectomy for early stage cervical cancer: a multicenter study. J Minim Invasive Gynecol. 2021;28(1):117–23.
16. Chacon E, Manzour N, Zanagnolo V, Querleu D, Núñez-Córdoba JM, Martin-Calvo N, et al. SUCCOR cone study: conization before radical hysterectomy. Int J Gynecol Cancer. 2022;32(2):117–24.
17. Odetto D, Puga MC, Saadi J, Noll F, Perrotta M. Minimally invasive radical hysterectomy: an analysis of oncologic outcomes from hospital Italiano (Argentina). Int J Gynecol Cancer. 2019;29(5):863–8.
18. Uppal S, Gehrig PA, Peng K, Bixel KL, Matsuo K, Vetter MH, et al. Recurrence rates in patients with cervical cancer treated with abdominal versus minimally invasive radical hysterectomy: a multi-institutional retrospective review study. J Clin Oncol. 2020;38(10):1030–40.
19. Chen X, Zhao N, Ye P, Chen J, Nan X, Zhao H, et al. Comparison of laparoscopic and open radical hysterectomy in cervical cancer patients with tumor size ≤2 cm. Int J Gynecol Cancer. 2020;30(5):564–71.
20. Nasioudis D, Albright BB, Haggerty AF, Ko EM, Kim SH, Morgan MA, et al. Survival following minimally invasive radical hysterectomy for patients with cervical carcinoma and tumor size ≤2 cm. Am J Obstet Gynecol. 2021;224(3):317–8.e2.
21. Nasioudis D, Albright BB, Ko EM, Haggerty AF, Giuntoli RL II, Kim SH, et al. Oncologic outcomes of minimally invasive versus open radical hysterectomy for early stage cervical carcinoma and tumor size <2 cm: a systematic review and meta-analysis. Int J Gynecol Cancer. 2021;31(7):983–90.
22. Falconer H, Palsdottir K, Stalberg K, Dahm-Kähler P, Ottander U, Lundin ES, et al. Robot-assisted approach to cervical cancer (RACC): an international multi-center, open-label randomized controlled trial. Int J Gynecol Cancer. 2019;29(6):1072–6.
23. Chao X, Li L, Wu M, Ma S, Tan X, Zhong S, et al. Efficacy of different surgical approaches in the clinical and survival outcomes of patients with early-stage cervical cancer: protocol of a phase III multicentre randomised controlled trial in China. BMJ Open. 2019;9(7):e029055.
24. A trial of robotic versus open hysterectomy surgery in cervix cancer (ROCC). [cited 2022 Oct 18]. Available from: https://clinicaltrials.gov/ct2/show/NCT04831580

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.