The technique of robotic assisted laparoscopic surgery in gynaecology, its introduction into the clinical routine of a gynaecological department and the analysis of the perioperative courses - a German experience

Uterus hastalıklarında robot yardımlı laparoskopik jinekolojik cerrahi tekniği; bir jinekoloji departmanının klinik rutinine girişi ve perioperatif sürecin analizi - bir Alman deneyimi

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Abstract

Objective: Robotic assisted surgery is an advancement on conventional laparoscopy. The first and single FDA-approved device is the daVinci™ system, which provides means to overcome the limitations of conventional laparoscopy. In Germany the use of the robotic system in gynaecology is at the threshold of a promising development. There is a wide spectrum of indications, such as simple and radical hysterectomies, including pelvic and paraaortic lymph node dissection. The introduction of the robotic system into the clinical routine is demonstrated.

Material and Methods: Robotic assisted laparoscopic interventions have been performed in the reporting hospital since April 2008. In the course of treatment of 172 cases, an increasing rise of complexity of surgical procedure has been achieved. The daVinci™ system is well adaptable in clinical routine. Hitherto, the clinical outcome has been favourable, higher-grade specific complications occurred very rarely. The short time advantages are a decrease of postoperative length of stay, a reduction of postinterventional need of analgetics and an overall accelerated period of recovery has been demonstrated compared to conventional abdominal procedures. It also shows that a drastic decrease of open conventional abdominal procedures concerning uterine pathologies appeared in the reporting department.

Results: Perioperative advantages of robotic assisted laparoscopic interventions are, above all, the decrease of morbidity (concerning blood loss, need of analgetics, length of stay, etc.). Surgical advantages are the more complex applicability, improved precision, dexterity and vision (3D), a greater autonomy of the surgeon, a smaller learning curve and an increase of preparation consistent with the anatomical structures. In contrast, disadvantages concern an initial greater time investment, the potentially different management of complications, the limited applicability in multiquadrant surgery and the difficulty regarding cost coverage respective to recovery.

Conclusions: In conclusion, robotic assisted minimal invasive surgery has an enormous potential in gynaecology; by simplifying the essential surgical procedure. The advantages of this technique will be approachability for a majority of gynaecological patients. The feasibility of a multitude of gynaecological surgical interventions has already been approved partially in a small number of cases. The upcoming challenge

Özet

Amaç: Robot yardımlı cerrahi konvansiyonel laparoskopinin bir ilerlemesidir. FDA'nın onayladığı ilk ve tek araç daVinci™ sistemidir; bu sistem konvansiyonel laparoskopinin sınırlamalarının aşılmasını sağlamaktadır. Almanya'da robotik cerrahinin jinekolojideki kullanımı başarı vadeden bir gelişmenin eşiğindedir. Geniş bir endikasyon aralığı vardır; basit ve radikal histerektomiler (pelvik ve paraaortik lenf nodlarının diseksiyonunu içeren) gibi. Burada robot sisteminin klinik rutine girişi sunulmaktadır.

Gereç ve Yöntemler: Hastanemizde Nisan 2008'den bu yana robot yardımlı laparoskopik girişimler yapılmaktadır. 172 olguluk bir seride kompleksitesi giderek artan cerrahi işlemler başarıyla tamamlanmıştır. daVinci™ sistemi klinik rutine iyi adapte edilebilmektedir. Şu ana kadar istenir klinik sonuçlar elde edilmiştir ve yüksek dereceli özgün komplikasyonlar çok ender görülmüştür. Konvansiyonel abdominal işlemlerle kıyaslandığında, kısa sürede ortaya çıkan avantajlar olarak ameliyat sonrası yatış süresinde kısalma, işlem sonrası analjezik gereksinmesinde azalma ve toplam olarak bakıldığında daha hızlı bir toparlanma gösterilebilmiştir. Raporlayan departmanda görülen uterus patolojileriyle ilgili açık konvansiyonel abdominal işlemlerde belirgin bir azalma da görülmüştür.

Bulgular: Robot yardımlı laparoskopik girişimin perioperatif en büyük avantajı morbiditenin azalmasıdır (kan kaybı, analjezik gereksinimi, yatış süresi vb.). Cerrahi avantajları, daha kompleks olgularda uygulanabilirlik, kesinlik, beceriklilik ve üç boyutlu görüşte iyileşme, cerraha daha büyük bir otonomi sağlama, öğrenme kolaylığı ve anatomik yapılara uygun yaklaşımlarda artıştır. Buna karşın, dezavantajları başlangıçta daha fazla zaman harcanması, komplikasyonların potansiyel olarak farklı tedavi edilmesi, birden çok kadranı ilgilendiren girişimlerde sınırlı uygulanabilirlik ve maliyetin yeterince karşılanamaması ile alakalı sorunlar.

Sonuçlar: Sonuç olarak, robot yardımlı minimal invaziv cerrahi jinekolojide büyük bir potansiyele sahiptir. Temel cerrahi işlemlerin basitleşmesiyle bu yöntemin avantajları jinekolojik hastaların büyük bir çoğunluğunca ulaşılabilir olacaktır. Birçok jinekolojik cerrahi girişimin fizibilitesi şu ana kadar kısmen az sayıda olguda onaylanmıştır. Şu anki

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now is to verify the short and long term advantages of robotic surgery in prospective trials, especially concerning gynaecological oncology.
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hedef robot yardımlı cerrahinin kısa ve uzun süreli avantajlarının özellikle jinekolojik onkolojiyle ilgili prospektif çalışmalarda doğrulanmasıdır.
(J Turkish-German Gynecol Assoc 2011; 12: 97-103)
Anahtar kelimeler: Robotik cerrahi, jinekoloji, daVinci tekniği, onkolojik jinekoloji
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Introduction

The robotic assisted surgery represents an advancement of the traditional laparoscopic technique and has to be subsumed under the minimally invasive procedures. The exclusively available and FDA-approved device is the daVinci™ system by Intuitive Surgical (Sunnyvale, CA) which is widely used in divers surgical disciplines, mainly in urology, and in numerous countries, particularly in the United States. The system provides the perspective to overcome the limitations of conventional laparascopy, i. e. 2D-view, rigidity of the instruments, restricted dexterity, precision and control, rapid physical fatique of the surgeon, etc. (2, 6, 17, 24, 29, 39, 43, 45, 56). In Germany the use of the robotic system in gynaecological care is only at the beginning of a promising development. The spectrum of indications includes simple hysterectomies, above all in patients with uterine fibroids, with history of several previous abdominal operations, salpingoophorectomy in larger adnexal masses, interventions in extensive endometriosis, sacrocolpopexies, myomectomies (1, 47, 61), tubal reanastomosis and mainly the modified radical and radical hysterectomies (10, 20-22, 33, 41, 48, 49, 51, 53) in early stages of endometrial (16, 25, 26, 28, 31, 32, 36, 37, 50, 58-69) and cervical cancer (12, 42, 65), especially nerve sparing radical hysterectomy, including pelvic and paraaortic, respectively upper paraaortic lymph node dissection, but also with less frequency trachelectomy, parametranectomy (3, 11, 14, 52, 54, 55), interventions in early ovarian cancer (30, 40), pelvic exenteration (15, 35), colposuspension and the lateral colpopexy via transperitoneal approach (19, 63, 64), interventions in uterine malformations, and others (23). Many of these indications for robotic assisted surgery are validated only in a small number of cases respectively in small randomized trials (12). Concerning non-oncological and oncological gynaecological treatment increasing patient data is published showing the superiority of the daVinci™ technique compared with conventional laparoscopy.

Technique and method

The daVinci™ system consists of three components. 1. The surgeon console, which is located several meters distant to the operating table; the robotic arms, the camera and the energy source by means of stereoscopic sight, hand manipulators and pedals individually adjusted to the surgeon are controlled by him from the surgeon console. 2. The InSite Vision® system, which allows the generation of a 3D sight by using a 12 mm wide angled endoscope containing two 5 mm cameras. 3. The so-called "patient-side cart" with the robotic arms and the attached trocars with the fixed special instruments (EndoWrist® instruments). This results in tremor elimination, graduated grasps, more degrees of freedom in the flexibility of the surgical instruments and a tremendous improvement of the surgical field vision by stereoscopic sight and the attainable magnification (Fig. 1). Some limitations such as the prolongated preparation time (positioning, setup, docking manoeuvre, etc.), the restricted haptic perception, the reduced tactility as well as the barrier in the multiquadrant surgery have to be considered (2, 6, 17, 29, 39, 43, 45, 56).
Since April 2008 robotic assisted laparoscopic gynaecological interventions with the daVinci™ system have been performed in the reporting institution (18). The implementation of this technique has been encouraged by favourable institutional conditions (availability of the daVinci™ system, specially trained OR staff). Subsequent to a two-day lab training (IRCAD [Research Institute against Digestive Cancer], Strasbourg, France) the first robotic surgical procedures took place, whereas initially only benign gynaecological disorders has been chosen in terms of exercising, basically simple total and supracervical hysterectomies with and without salpingoophorectomy (Fig. 2). In the further course an increasing rise of complexity of the surgical procedures has been carried out (increasing uterine weight, multiple myomectomies (Fig. 3, 4), applications of the system in patients with multiple previous abdominal operations); a continuing expansion of the spectrum of indication is done, i. e. radical hysterectomies (Fig. 5) with and without pelvic and paraaortic lymph node dissection (Fig. 6), treatment of extensive endometriosis, sacrocolpopexy (Fig. 7), lateral colpopexy via a transperitoneal approach. It should not be remissed that only patients have been selected which would have undergone an open abdominal operation otherwise, or patients requiring

Figure 1. Components of the daVinci™ system: A. patient side cart, B. surgical console, C. stereoscopic endoscope, D. stereoscopic viewer of the console, E. robotic camera arm, F. degrees of freedom of the EndoWrist™ instruments (source: Intuitive Surgical, Sunnyvale, CA)

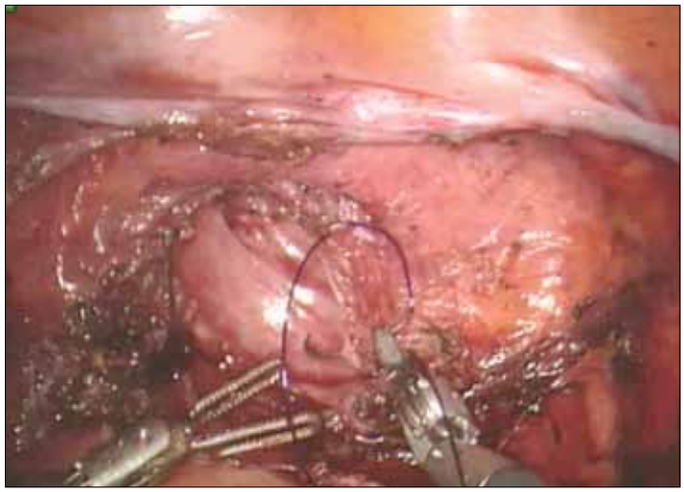

Figure 2. Vaginal cuff closure (after simple hysterectomy)

Figure 3. Myomectomy (large intramural fibroid)

Figure 4. MRI image of a 36 years old, nonparous woman with the desire of having children with multiple fibroids with an overall weight of 800g; all fibroids could be resected; in the postoperative controll an almost normal uterine size has been documented

a protracted traditional laparoscopy with high risk of conversion to laparotomy.

The clinical data of the surgical and postoperative courses from the patients which have been operated with the assistance of the robotic system are registered systematically (data of the patient histories, surgical times, length of time of the console performance, postoperative length of stay, intraoperative and postoperative complications, course of hemoglobin concentration, length of time requiring analgetics, etc.).

Results

So far 172 patients have been undergone robotic assisted surgery with the daVinci™ system (Fig. 8); in 50% of the cases total hysterectomy, in 9.9% supracervical hysterectomy, in 23.8% single or multiple myomectomies, in 11.6% (20 cases) radical hysterectomies with pelvic lymph node dissection +/- paraaortic lymph node dissection, in 3.5% Cervicosacropexies, and 1.1% isolated pelvic lymph node dissections have been performed (Fig. 9). Up to now in these cases it could be demonstrated that the use of the daVinci™ robotic system can be implemented rapidly into the clinical routine of the department after a short period of time of initial training phase. Hitherto, the clinical outcome was favorable, higher-grade specific complications did occur very rare. In one case a partial bowel resection followed secondary because of suspicion of accidental bowel injury undetected in primary surgery (which is in the range of normal bowel complication rate in endoscopic surgery; finally a bowel injury could not be confirmed histopthologically), in 1 case (0.6%) secondary urinoma due to intraoperative right ureter lesion (likely by reason of HF surgery and consecutive thermal injury), in 1.7% (3 cases) bladder injuries occurred, which could be treated by simple double layer suturing intraoperative, in 1 case (0.6%) a lesion of the right external iliacal vein developed during pelvic lymph node dissection (handled with clipping without need for laparotomy), the conversion rate to abdominal laparotomy amounts to date 1.2% (2 cases); in 2.3% (4 cases) transient peripheral neurological disorders such as radial nerve palsy appeared induced by suboptimal patient positioning; subsequent to optimizing the patient positioning no further neurological disorders have been observed (Table 1). As short time advantages of the robotic assisted surgical procedure a decrease of postoperative length of stay, a reduction of

Figure 5. Surgical specimen of a 43 years old woman with a stage IB2 cervical cancer; uterine specimen of a type C radical hysterectomy with bilateral salpingo-oophorectomy (dorsal view)

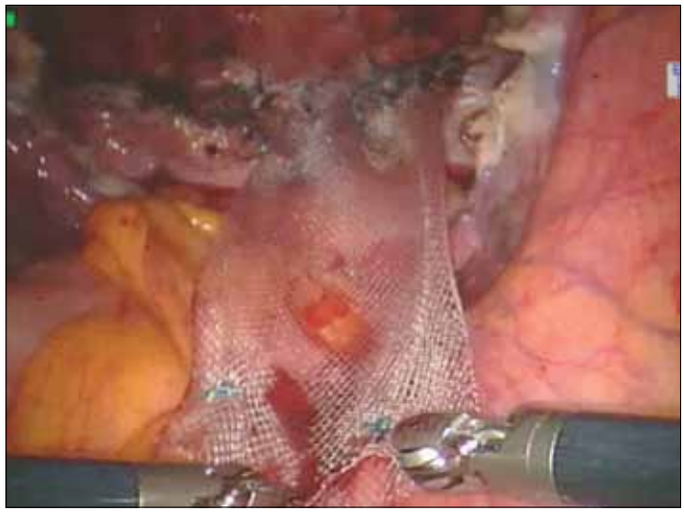

Figure 7. Cervicosacropexy (the mesh is sutured at the cervix and will now fixed at the promontorium)

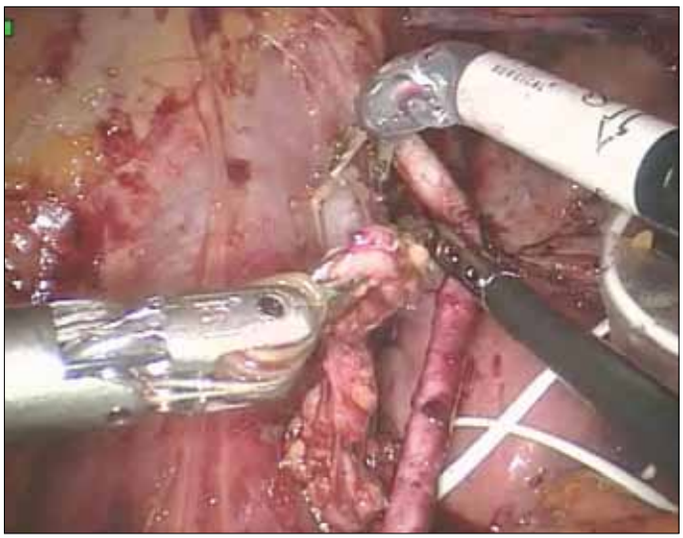

Figure 6. Pelvic lymph node dissection (left external iliacal vein)

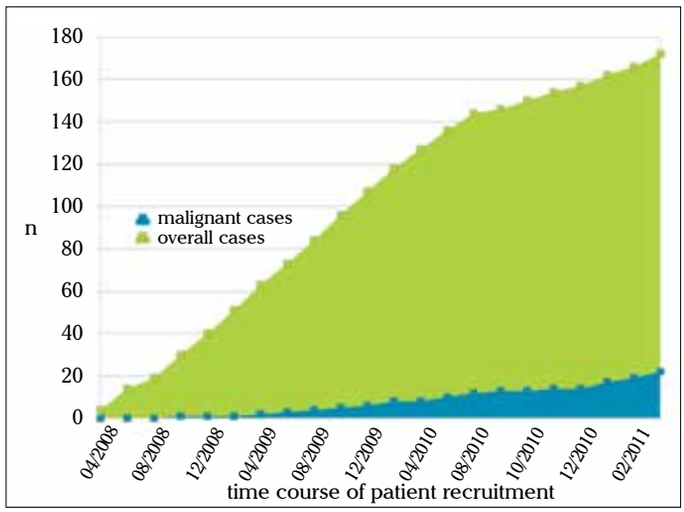

Figure 8. Time course of patient recruitment (April 2008-March 2011)

postinterventional need of analgetics and an overall quickened period of recovery could be demonstrated compared to conventional surgical procedures. As well it shows that a drastic descent of open conventional abdominal procedures concerning uterine pathologies appeared in the reporting department of the municipal hospital (Fig. 10). Furthermore the recruitment of robotic cases decelerates by reason of exclusive selection of more complex cases (such as radical hysterectomies and complex myomectomies [Fig. 8 and 11]), showing that robotic surgery advocates inversely traditional laparoscopy by making the surgeons more confident with minimal invasive procedures even in more complicated cases.

Discussion

In the field of gynaecological surgery and gynaecological oncology elderly and aged patients are frequently affected; this cohort of patients shows commonly an associated relevant comorbidity such as cardiovascular disease and metabolic syndrome. Therefore continuous efforts to reduce surgical morbidity and mortality are necessary, so to improve overall surgical outcome (7-10). On the other hand there is also a great number of young women in the reproductive age who needs gynaecological interventions such as myomectomy or complex surgical restoration in case of extended endometriosis; in this group the preservation of the physical integrity (i. e. less scars) and a quick convalescence respectively a maximal abbreviation of absence in professional and recreational life due to illness have not to be underestimated. From the employment of the daVinci™ robotic system immediate benefits such as reduced intraoperative blood loss respectively transfusion rate, reduced percentage of intraoperative and postoperative complications, shorter OR times, less postoperative need for analgetic medication and shorter duration of hospital stay would be expected,

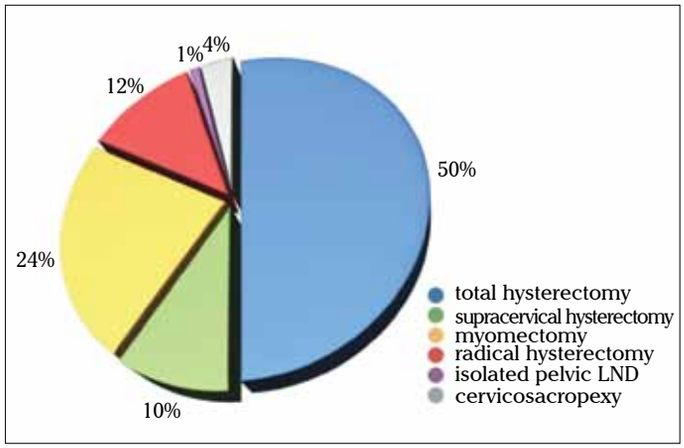

Figure 9. Spectrum of performed cases

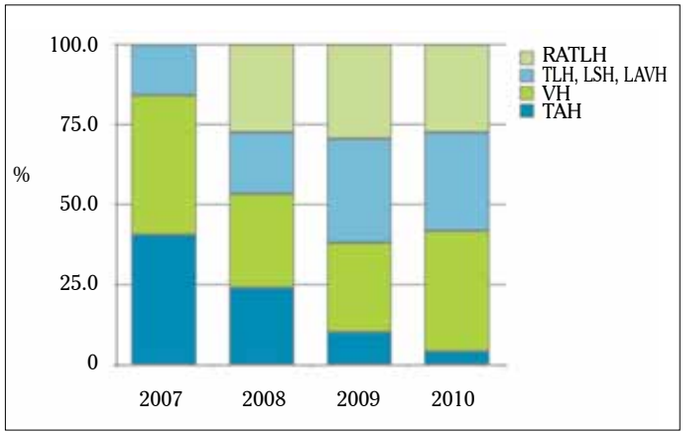

Figure 10. Shifting of the surgical approach in benign hysterectomy from 2007-2010; excluding hysterectomy for pelvic organ prolapse; shows a drastic descent of open abdominal hysterectomies, intraduction of the daVinci™ system in 2008 (RATLH=robot assisted total laparoscopic hysterectomy, TLH=total laparoscopic hysterectomy, LSH=laparoscopic supracervical hysterectomy, LAVH=laparoscopic assisted vaginal hysterectomy, VH=vaginal hysterectomy, TAH=total abdominal hysterectomy

all with the objective to decrease morbidity and subsequently the long-term costs of public health efforts (1, 2, 6, 17, 27, 29, 43, 45, 56).

Surgical advantages are the more complex applicability of minimal invasive procedures, the distinct improved precision, dexterity and surgical sight guaranteed by stereoscopic view, resulting in a diminished prostration, a better adaptation to obese patients, a smaller learning curve due to a natural surgical feeling, a greater autonomy towards difficult controllable factors (e. g. camera guidance), an increase of preparation true to the anatomical structures, and finally the expected and from the mentioned factors resulting enlargement of the possible applications, which is only limited predictable at present.

In contrast, disadvantages concern at least initially a greater time investment, a potentially different management of complications, even in relation to major hemorrhage in the surgical field, the limited applicability in the multiquadrant surgery, the

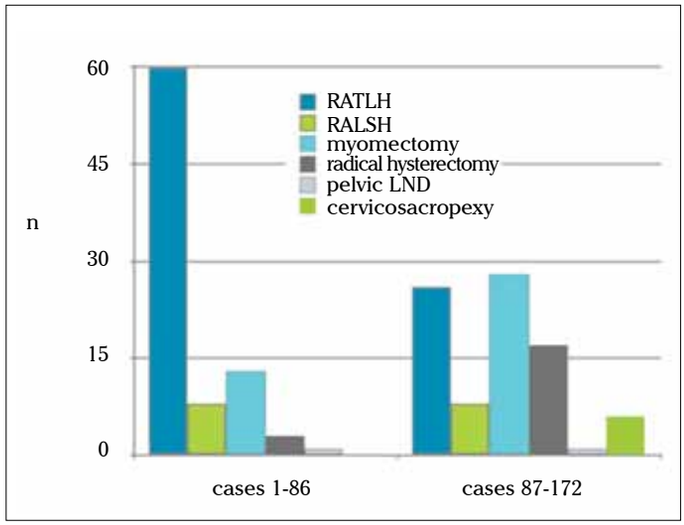

Figure 11. Change of diversity of cases; shows the trend to more complex cases (RATLH=robot assisted total laparoscopic hysterectomy, RALSH=robot assisted laparoscopic supracervical hysterectomy, LND=lymph node dissection)

Table 1. Intra and postoperative complications

Type of complication	n	%
Conversion to laparotomy	2	1.2
Bladder injury[1] with intraoperative treatment	3	1.7
Injury of the right external iliacal vein	1	0.6
Transient peripheral neurological disorders	4	2.3
Suspicion of accidental bowel injury (not confirmed)	1	0.6
Pelveoperitonitis with re-laparoscopy	1	0.6
Thermal injury of the right ureter with following urinoma[2]	1	0.6
Intraoperative Transfusion	1	0.6
Vaginal cuff dehiscence	0	0
Postoperative hemorrhage	0	0

[1]: No bladder lesion in the area of the trigonum, [2]: Conservative treatment with DJ splint and drainage of the urinoma

indispensable reliability of the program support on the part of the hospital administration and management, and the not expected amelioration regarding cost coverage respectively recovery (1, 5, 27, 31, 57).

Conclusion

The establishment of the daVinci™ surgical system for robotic assisted laparoscopy in the field of gynaecology means ultimately the participation in the next generation of minimal invasive surgical procedures as a consequence of the medical and technological progress. Because of this, numerous advances will be started as a sequel of approvement of endoscopic techniques.

The robotic assisted minimal invasive surgery has the potential to revolutionize the existing standards of the gynaecological surgical procedures, especially the oncological interventions, both by a largely elimination of postoperative morbidity and by preservation of the radicality and principles of oncological surgery (4, 5, 7-9, 13, 27, 34, 38, 44, 46). Concurrently by simplification of the essential surgical procedure these advantages will be approachable by the majority of oncologic-gynaecological patients (9). Even nerve-sparing surgical procedures in extended radical hysterectomies for what particularly the robotic assisted surgery has the potential have a promising perspective. A number of pending questions has to be answered, e. g. the insurance of the advantages of the robotic system by means of prospective controlled and randomized trials both regarding short-term parameters such as postoperative morbidity and amelioration of oncological outcome in long-term follow-up [12] and improved quality of life by reduced prolonged or chronic surgery associated morbidity, and arising costs (1, 5, 27, 31, 57). The feasibility of a multitude of gynaecological surgical interventions has been already approved partially in a small number of cases. The upcoming challenge now is to verify the short and long term advantages of robotic surgery in prospective trials, especially concerning gynaecological oncology. Otherwise, due to a broad adoption of robot-assisted surgery in industrial nations the willingness to disclaim the advantages and the comfort of robotic surgery in order to have an adequate number of control cases could be minor.

Conflict of interest

No conflict of interest was declared by the authors.

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