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TOPIC PAPER

Nurse-led coordinated surgical care pathways for cost optimization of robotic-assisted partial nephrectomy: medico-economic analysis of the UroCCR-25 AMBU-REIN study

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Abstract

Purpose Robot-assisted partial nephrectomy (RAPN) reduces morbidity, enabling development of Enhanced Recovery After Surgery (ERAS) and day-case protocols. Additional financial costs limit its integration into clinical practice. We evaluated the medico-economic impact of RAPN using a nurse-led coordinated pathway of care (NLC-RAPN).

Methods All tumor RAPNs performed in 2017 were prospectively included in nurse-led protocols: NP-RAAC (ERAS) or Ambu-Rein (day case). Clinico-biological and pathological data were prospectively collected within the French Research Network for Kidney Cancer database (NCT03293563). Estimated costs were compared to "average" patients at the national level operated by open partial nephrectomy (OPN) or RAPN, using data from the 2017 French hospital discharge database and the national cost scale.

Results The NLC-RAPN cohort ($n=151$) included 27 (18%) outpatients and the average hospital length of stay (LOS) was 2.4 days. In the national control cohorts for OPN ($n=2475$) and RAPN ($n=3529$), the average LOS were 8.0 and 5.2 days, respectively. The mean incomes per group were €7607 for NLC-RAPN, €9813 for OPN, and €8215 for RAPN. The mean daily cost of stay was €659 for NLC-RAPN, €838 for OPN, and €725 for RAPN. The overall cost for NLC-RAPN was €6594, €8733 for OPN, and €8763 for RAPN. The best operational margin was obtained for day-case NLC-RAPN (€1967).

Conclusion Combining RAPN with nurse-led coordinated pathways of care led to a shorter hospital stay and reduced costs versus OPN. This may facilitate the economic sustainability of robotic assistance for hospitals where the extra cost is not covered by the healthcare system.

Keywords Cost analysis · Kidney cancer · Robot-assisted partial nephrectomy · Urology · Medico-economics

Introduction

Partial nephrectomy (PN) for cancer management has a triple objective: oncologic, functional, and control of postoperative morbidity. Robot-assisted surgery, which allows three-dimensional (3D) views and pluri-articulated instruments, may increase precision and thus provide a safe, minimally-invasive alternative for the treatment of kidney tumors. Similar oncologic benefits have been reported for robot-assisted and open surgery (the reference technique) [1], with at least equal or superior patient benefits [2]. The use of robot-assisted surgery has demonstrated advantages such as reduced transfusion rates, postoperative complications, and length of stay (LOS) [3–5].

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Despite the lack of full reimbursement by French health insurance (which reimburses robot-assisted surgery at the same cost as pure laparoscopy or laparotomy), robot-assisted PN (RAPN) is widespread within France; in 2017, the split in all surgical approaches was 41% for robot-assisted laparoscopy, 19% for pure laparoscopy, and 41% for open surgery (Programme de Médicalisation des Systèmes d'Information (PMSI) data) [6]. However, investment related to the robotic platform, associated service fees, and consumables have led to the question of affordability and cost-effectiveness of this therapeutic option.

Our hypothesis is that combining robot-assisted surgery with Enhanced Recovery After Surgery (ERAS) or day-case protocols, with a dedicated nurse to coordinate the pathways [7, 8], may increase the cost-effectiveness of RAPN. Some medico-economic evaluations of robot-assisted surgery for radical prostatectomy, cystectomy, or outside of urology have already been reported [9–12]. To our knowledge, no comparative evaluation of costs according to surgical approaches and type of treatment pathway have been published for PN.

Thus, we aimed to evaluate the incomes and costs associated with RAPN from the perspective of our experience and the French healthcare system. Secondary objectives were to compare the costs to those for open surgery in PN (OPN) at the national level, and to assess the potential benefits of a treatment pathway in minimizing the costs of RAPN.

Methods

Within the French Research Network for Kidney Cancer (UroCCR) (Clinical trials: NCT03293563), along with labeling from the French ministry of Health (Direction Générale de l'Offre de Soins) and the National Cancer Institute as a pilot center developing outpatient surgery in kidney cancer, we have led an observational monocentric prospective study: Ambu-Rein [13]. In addition to the authorization to collect data with informed consent for UroCCR project (CNIL DR-2013–206), specific reuse in the Ambu-Rein protocol benefited from another data protection declaration (CNIL 2063345). This medico-economic analysis for 2017 was performed at the department of urology in the Academic Hospital of Bordeaux (CHU) and after consolidation of the French National System of Health Data (SNDS) for that year, thus starting in autumn 2019.

Study population

RAPN cohort with nurse-led coordinated treatment care pathway (NLC-RAPN)

In our hospital, robot-assisted surgery has been the only surgical approach for PN since 2017. The ERAS protocol (NP-RAAC) was implemented in 2015, followed by the outpatient protocol in 2016 (Ambu-Rein) [7, 8]. Both are nurse-led coordinated pathways comprising in-hospital and at-home periods of coordination using face-to-face visits and phone calls, from preoperative day – 30 to postoperative day + 30 (Fig. 1). Patient inclusion was prospective during the study period, and included adults undergoing RAPN through the NP-RAAC and Ambu-Rein protocols.

Nationwide control OPN and RAPN cohorts (for economic evaluation)

The mean data for OPN and RAPN across France in 2017 were issued from the French administrative database SNDS (Système National des Données de Santé) and used to identify the necessary indicators to estimate the related incomes and costs associated with this technique.

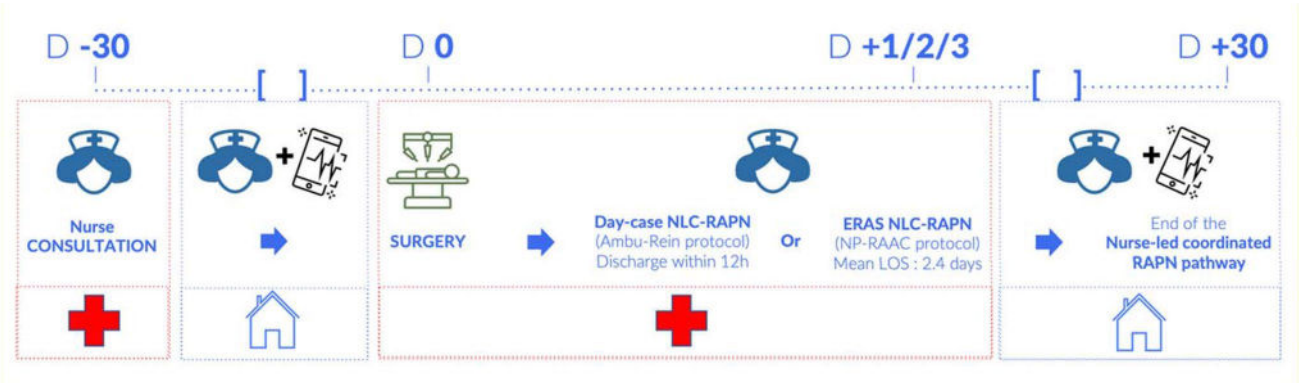

Fig. 1 60-day, nurse-led coordinated RAPN pathway. *Ambu-Rein* the day-case protocol for RAPN, *ERAS* enhanced recovery after surgery protocol, *LOS* length of stay, *NLC-RAPN* nurse-led coordinated robot-assisted partial nephrectomy, *NP-RAAC* the ERAS protocol.

Data sourcing

Clinico-biological descriptive data from the NLC-RAPN cohort (NP-RAAC and Ambu-Rein protocols) were extracted from the French clinico-biologic multidisciplinary and prospective database on renal cancer (UroCCR). In France, the level of reimbursement of surgical care by the national health insurance depends on patients categorization according to the type of surgery defined as "Groupe Homogène de Malades" (GHM) and the complexity of the case (severity). The mean LOS and relative proportion per GHM according to severity (levels 1–4) among the NLC-RAPN and nationwide control groups were extracted from the PMSI database (part of the SNDS). Costs associated with these surgical procedures were estimated using the national cost scale for 2017 [14, 15], as well as analytic accounting data from the hospital for specific costs. Income identification.

For our analysis, we considered the diagnosis group GHM 11C02 "Surgery on kidneys, ureters or major bladder surgery for cancer". The rate associated with the GHM (the "groupe homogène de séjours" (GHS); i.e., an income for the hospital) [15] includes four severity levels [14], and can be increased if patients stay in resuscitation, intensive care, or continuous care units. RAPN, which does not have a specific GHS, is given the same income/reimbursement as the corresponding surgery procedure using conventional laparoscopy. In addition to the GHS, the hospital receives supplements per days spent in intensive care. Patient study data allowed us to calculate a mean supplement that could be added to the mean GHS for the income. Additional details can be found in online resource 1. For the national control groups, the calculation of the average GHS and the supplement was based on the proportion of patients according to severity level at the national level in 2017 (PMSI database).

Cost identification

We identified several items that could impact the cost of surgery: LOS, operating room (OR) time (i.e., before, during, and after surgery), medical devices, surgical complications, laparoconversions, and transfusions. Further details for these costs can be found in online resource 1.

Length of stay

The standard daily cost of stay (issued from hospital analytical accounting) represents the stay in a conventional surgery ward or outpatient unit for patients of severity levels 1 and 2. The mean cost of stay (not including intensive care) was obtained by multiplying the daily cost of stay by the LOS for each surgical approach and treatment pathway, i.e., nationwide OPN or RAPN, hospitalized NLC-RAPN (NP-RAAC) and outpatient NLC-RAPN (Ambu-Rein). Extra costs were added if patients stayed in intensive care, including resuscitation, intensive care, and continuous care. Since the mean LOS includes the stay in a surgery ward and intensive care, the mean cost of intensive care stay was obtained as follows: intensive care LOS × (intensive care cost of stay–conventional surgery ward cost of stay).

Operating room

Surgery duration for the two surgical approaches were calculated according to the practices of our center [13]. For RAPN, we used the mean surgery duration for 2017, when we were beyond our learning curve [12]. For OPN, to ensure comparable surgery duration from an expert team with high volume, we used the surgery duration from our hospital in 2010, before the start of the robotic program. To assess all OR costs, full occupation was considered, i.e., preoperative time + surgery time + postoperative time. The OR costs were calculated as follows: OR duration (min) × OR cost per min [16].

Medical devices

Medical devices used for each surgical approach were listed according to surveys in our OR, then costed according to prices provided by the hospital pharmacy. Single-use medical devices and reusable devices were considered. The cost per procedure using reusable devices was established by dividing the cost per instrument by the number of recommended uses by the manufacturer. Sterilization costs were not estimated. Unit prices for the robotic system (consumables and platform) are detailed in online resource 1.

Surgical complications

Surgical complications usually increase the severity level for patients from GHM level 1–2 to 3–4, increase the LOS and, in some cases, require additional treatment. In 85% of cases, GHM 3 and 4 are linked with a major surgery complication [17]. The remaining 15% can be explained by preexisting comorbidities and/or a longer LOS than the GHM cap. The calculation for the extra cost associated with surgical complications can be summarized as follows: % level 3–4 patients × (LOS 3–4 –LOS 1–2) × (daily cost of stay in surgery ward) × 1.5.

Laparoconversions

Converting a minimally-invasive procedure to open surgery results in an increased LOS and extra costs. This extra conversion cost for RAPN was estimated as follows: (LOS

OPN–LOS RAPN) × (daily cost of stay) × RAPN conversion rate.

Transfusions

The transfusion costs were obtained by multiplying the cost of a blood unit by the transfusion rate [18].

Statistical analysis

Quantitative variables are reported as median (range) or mean (± standard deviation) values. Qualitative variables are described by the number and frequency of observations for each of the outcomes. Pairwise cost comparisons were performed using the non-parametric Mann–Whitney two-sample test. Analyses were carried out using Stata software, version 13.0 (StataCorp, College Station, Texas, USA).

Results

Patient characteristics

In 2017, 151 NLC-RAPN were performed at our center, including 124 (82%) patients hospitalized in a surgery ward (NP-RAAC protocol) and 27 (18%) treated as outpatients (Ambu-Rein protocol). During this time in France, 2475 patients were treated with OPN and 3529 with RAPN. The main patient characteristics of the NLC-RAPN cohort are described in Table 1, while the number of patients and mean LOS according to surgical approach and GHM level of severity are outlined in Table 2.

Incomes

In the OPN group, the mean income (€9813) was 19.4% higher than in the RAPN group (€8215) and 29% higher than in the NLC-RAPN group (€7607). Detailed calculations are presented in the online resource 2.

Cost calculations

Cost of stay and additional costs following complications

In the OPN group, the mean LOS was 8 days, including 1.37 days in resuscitation unit, 0.42 days in intensive care unit and 0.35 days in continuous care unit. In the NLC-RAPN group, the mean LOS was 2.4 days, including 0.04 days in the continuous care unit. There were no stays in the intensive care or resuscitation units. The additional cost of stay following complications (patients with severity levels 3–4) was higher in the OPN group (€1072) than the NLC-RAPN group (€195). Consequently, the mean cost of stay was €838 per day for OPN, €725 for RAPN, and €659 per day for NLC-RAPN. Complete data for the three groups are presented in Table 3.

Other costs

The mean OR times were 188 min (OPN), 198 min (hospitalized NLC-RAPN, NP-RAAC protocol), and 143 min (outpatient NLC-RAPN, Ambu-Rein protocol). The mean corresponding costs were €2030 (OPN), €2138 (hospitalized NLC-RAPN), and €1550 (outpatient NLC-RAPN). Medical device costs were considered null for OPN and €1572 for RAPN, while transfusion costs were €22 for OPN and €15 for RAPN. There was one conversion to open surgery in the NLC-RAPN group (0.7%), entailing an additional cost per patient of €24. Detailed data per group are presented in Fig. 2, which shows a 0.3% cost increase for RAPN and a 24.5% cost decrease for NLC-RAPN compared to OPN.

Operational margins per surgical approach and treatment pathway

The overall cost for NLC-RAPN was €6594 compared to €8733 for OPN and €8763 for RAPN (Table 4). The income and cost parameters for each surgical approach are also illustrated in Table 4, and show comparable operational margins for OPN (€1080) and NLC-RAPN (€1013). Outpatient NLC-RAPN (Ambu-Rein) generated a greater margin (+ €1967) versus hospitalized NLC-RAPN (NP-RAAC) (+ €692).

Discussion

Robotic-assisted laparoscopic techniques allow less invasive and traumatizing surgeries for PN, with a reduced LOS, less postoperative pain, and fewer complications compared with the same surgery using an open approach [2, 5]. However, mastering the minimally-invasive techniques, even with robotic assistance, requires a long learning curve [19, 20] and the associated operating costs have made its value questionable for many procedures [21]. The cost-effectiveness of robot-assisted surgery still needs to be assessed in France.

Our economic study indicates that LOS is the parameter with the highest impact on RAPN cost-effectiveness. Therefore, a reduction in LOS and low rate of complications can partially or completely compensate for the extra costs of the robotic system. Lowering LOS can be achieved but may require dedicated protocols and surgical care pathways to maintain quality of care and patient satisfaction. We have previously reported that nurse-led coordination may be crucial in the development of day-case RPN without compromising patient satisfaction [8]. While a low mean LOS of 2.4 days for all severity levels of RAPN was achieved in our

Table 1 Demographic characteristics of the prospective NLC-RAPN cohort ($n=151$)

Characteristics	Hospitalized NLC-RAPN (NP-RAAC protocol) ($n=124$)	Outpatient NLC-RAPN (Ambu-Rein protocol) ($n=27$)
Age (years), mean (± SD)	59 ± 14	56 ± 14
Sex male, *n* (%)	88 (71)	17 (63)
No surgical history, *n* (%)	25 (20.2)	7 (26)
No medical history, *n* (%)	28 (22.6)	8 (31)
History of cancer, *n* (%)	24 (19.4)	8 (30)
ASA, *n* (%)		
1	12 (9.7)	9 (33)
2	85 (68.5)	15 (56)
3	27 (21.8)	2 (11)
ECOG, *n* (%)		
0	103 (83.1)	24 (89)
1	16 (12.9)	3 (11)
2	1 (0.8)	0
Symptoms at diagnosis, *n* (%)		
Asymptomatic	108 (87.1)	25 (92.6)
Local signs	13 (10.5)	2 (7.4)
General signs	3 (2.4)	0
Body mass index (kg/m^2), mean (± SD)	28 ± 6.9	27 ± 3.6
Family history of kidney cancer, *n* (%)	4 (3.2)	2 (12)
Single kidney, *n* (%)	2 (1.6)	3 (11)
Clinical tumor staging, *n* (%)		
cT		
1a	54 (43.5)	22 (81.5)
1b	54 (43.5)	5 (18.5)
2a	14 (11.3)	0
2b	2 (1.6)	0
cN		
0	119 (96)	26 (96.3)
1	1 (0.8)	0
X	4 (3.2)	1 (3.7)
Tumor size (cm), mean (± SD), cm	4.4 ± 2,.2	2.9 ± 1,.2
RENAL Score[a], *n* (%)		
Low complexity (4–6)	26 (21)	10 (37)
Moderate complexity (7–9)	65 (52.4)	13 (48.1)
High complexity (10–12)	33 (26.6)	4 (14.9)
PADUA score[b], *n* (%)		
Low complexity (6–7)	22 (17.7)	7 (25.9)
Moderate complexity (8–9)	34 (27.4)	16 (59.3)
High complexity (10–14)	68 (54.9)	4 (14.8)

[a]Kutikov A, Uzzo R (2009) The R.E.N.A.L. nephrometry score: a comprehensive standardized system for quantitating renal tumor size, location and depth. J Urol 182:844–853

[b]Ficarra V, Novara G, Secco S, Macchi V, Porzionato A, De Caro R, Artibani W (2009) Preoperative aspects and dimensions used for an anatomical (PADUA) classification of renal tumours in patients who are candidates for nephron-sparing surgery. Eur Urol 56 (5):786–793

ASA American Society of Anesthesiologists, *ECOG* Eastern Cooperative Oncology Group, *ERAS* Enhanced Recovery After Surgery, *NLC-RAPN* nurse-led coordinated robot-assisted partial nephrectomy, *SD* standard deviation

Table 2 Patients included in the study according to severity level and surgical approach

Level of severity	OPN nationwide ($n=2475$)		RAPN nationwide ($n=3529$)		Nurse-led coordinated RAPN CHU Bordeaux ($n=151$)	
	n (%)	Mean LOS, days	*n* (%)	Mean LOS, days	*n* (%)	Mean LOS, days
1	1110 (45)	6.2	2285 (65)	4.1	117 (77)	1.8
2	917 (37)	7.6	921 (26)	6.0	27 (18)	4.1
GHM 1 + 2	2027 (81)	6.8	3206 (91)	4.7	144 (95)	2.2
3	352 (14)	11.1	272 (8)	8.9	7 (5)	6.7
4	96 (4)	20.6	51 (1)	16.6	0	–
GHM 3 + 4	448 (19)	13.1	323 (9)	10.1	7 (5)	6.7
Total	2475 (100)	8.0	3529 (100)	5.2	151 (100)	2.4

LOS length of hospital stay, *OPN* open partial nephrectomy, *RAPN* robot-assisted partial nephrectomy

Table 3 Calculations for the cost of stay

	Daily cost of reference, €	OPN nationwide ($n=2475$)		RAPN nationwide ($n=3529$)		Nurse-led coordinated RAPN CHU Bordeaux ($n=151$)	
		Mean LOS, days	Mean cost, €	Mean LOS, days	Mean cost, €	Mean LOS, days	Mean cost, €
Urology severity level 1–2	627	6.8	4281	4.7	2920	2.2	1398
Extra cost for Urology severity level 3–4		13.1	1072	10.1	465	6.7	195
Continuous care	991	1.37	498	0.2	194	0.04	14
Intensive care	1387	0.42	318	0.07	95	0	–
Resuscitation	2080	0.35	511	0.05	95	0	–
TOTAL cost of stay (€)			6681		3769		1607
Mean LOS / Average cost of stay per day (€)		8.0	838	5.2	725	2.4	659

LOS length of hospital stay, *OPN* open partial nephrectomy, *RAPN* robot-assisted partial nephrectomy

center in 2017, the French National System of Health Data reported, for the same period, a mean LOS of 5.2 days at a national level. This highlights that robotic assistance alone may not be enough to reach maximal optimization of LOS, and highest benefit may be obtained in combining robot-assisted surgery with patient-centered, nurse-led care coordination. In doing so, RAPN procedures were cost-effective at our center. In view of the recent pandemic experience, where delays for surgery (including oncologic procedures) were increased, practices such as these that offer optimized cost and shorter LOS may gain particular interest. However, the roles of surgeon expertise and surgeon/hospital volumes are important [22]. Indeed, our results were achieved at a high-volume tertiary center with 8 years of experience using the robotic platform. We highlight the fact that many urology departments that use RAPN do not have the same level of experience as our center in running nurse-led coordinated ERAS and day-case care pathways. We suggest that a good cost-effectiveness ratio could be obtained when the surgery team achieves significant experience. Nevertheless, patient-centered, nurse-led, care coordination efficiency can now benefit from the availability of apps and mobile platforms integrated into clinical practice to enhance the quality of postoperative follow-up and ease the implementation of ERAS and day-case surgery.

Although only 18% of our patients were eligible for day surgery, we noticed that the operational margin was largest in the outpatient NLC-RAPN (Ambu-Rein) group. The ERAS protocol alone only partially compensated the extra cost of robot-assisted surgery. Indeed, operational margins were €692 for the NP-RAAC group compared with €1080 for the OPN group. However, a strict organization for patient selection and follow-up is mandatory to safely implement day-case RAPN. This favors a unique coordination between outpatients and in-hospital pathways, with the aim of proposing the most appropriate personalized care to each individual patient, considering their medical history and tumor characteristics.

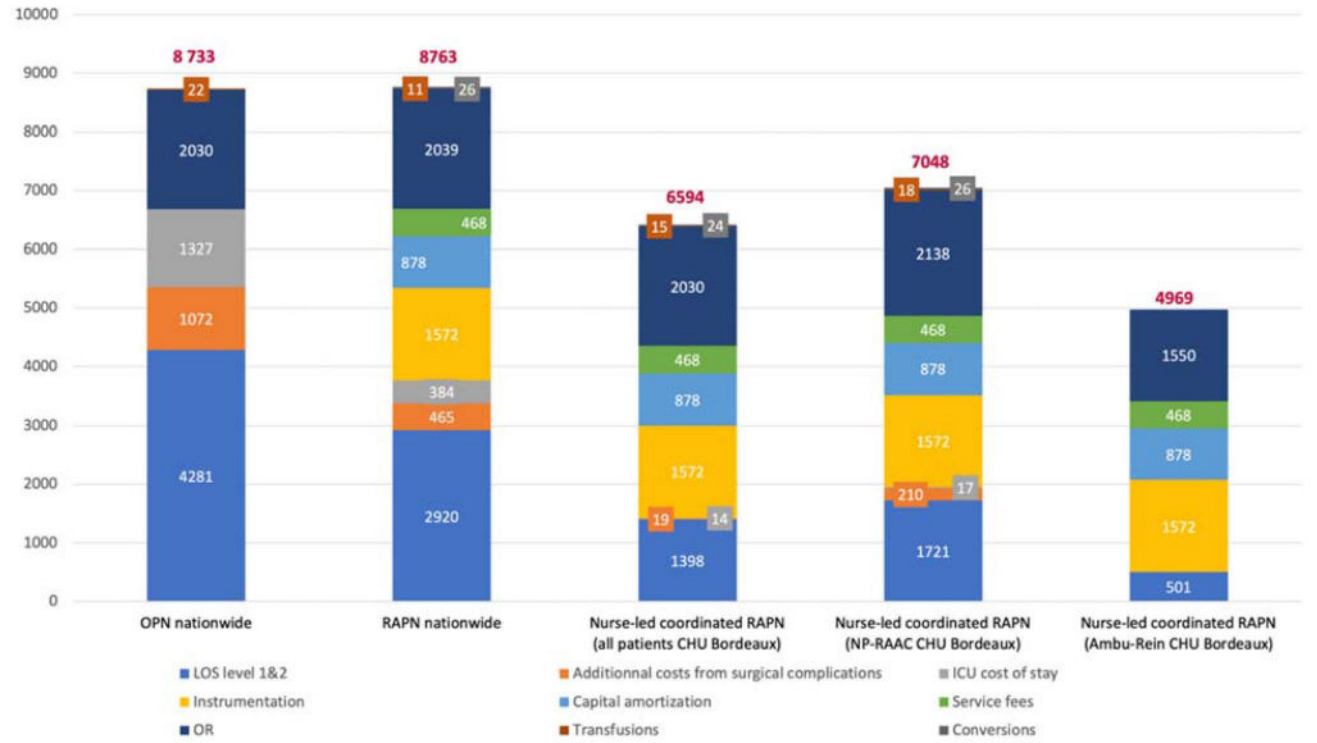

Fig. 2 Costs details regarding surgical approach and treatment pathway. *Ambu-Rein* the day-case protocol for RAPN, *ICU* intensive care unit, *LOS* length of stay, *NP-RAAC* the enhanced recovery after surgery (ERAS) protocol, *OPN* open partial nephrectomy, *OR* operating room, *RAPN* robot-assisted partial nephrectomy

It should be noted that although the cost of NLC-RAPN (€6594) was lower than OPN, hospital incomes are greater for laparotomy (€9813 versus €8215 for RAPN and €7607 for NLC-RAPN). This better cover provided by the French healthcare system may seem totally paradoxical considering the greater patient benefits resulting from a minimally-invasive approach, but also when taking into account the HAS guidelines in favor of day surgery and ERAS [23–25].

Finally, it should be noted that our center had fully amortized the robotic platform in 2016. If the amortization cost is removed (€1891 for hospitalized patients and €2845 for outpatients), the operational margin for RAPN is higher than OPN. However, since most hospitals proposing RAPN amortize their material, we chose to include the amortization cost.

Our study presents several limitations. First of all, incomes and costs are specific to the French healthcare reimbursement rates; other countries may have different reimbursement rates. Furthermore, sterilization costs for reusable medical devices are difficult to estimate and were not included in our study; therefore, the cost calculation may be underestimated. However, we feel that the conclusions of this economic assessment may be extrapolated to other countries, especially where robotic assistance has no specific pricing. Secondly, as robot-assisted surgery was the only surgical approach used in our center in 2017, data from patients treated by laparotomy in the same department could not be used as a comparison. Patients treated in 2017 at our hospital were then compared to those of similar patients treated by OPN at a national level (PMSI 2017). There is a risk of comparing patient populations with differing clinical profiles that cannot be precisely assessed in administrative databases such as PMSI. However, a nationwide representation of RAPN practice and its economic assessment was included in our analysis to counterbalance this limitation. Although we no longer perform OPN, other centers might choose the open approach over robot-assisted surgery in cases of highly complex or bilateral surgery. Therefore, it should be noted that OPN patients might not be comparable to RAPN patients at the national level because they might be harboring particularly complex tumors that require a higher level of care and be more prone to complications. Nevertheless, as a tertiary referral center where there is no selection of surgical approach based on patient or tumor profiles (all of our PN patients are managed using the robotic approach), we consider our NLC-RAPN group to be "all-comers". In addition, ERAS or day-case protocol adaptation is difficult in OPN patients, since minimally-invasive surgery is a key factor of the ERAS approach. Analysis of OPN and RAPN, both following the same nurse-led coordinated pathway, would provide a more accurate comparison but appears

Table 4 Incomes, costs, and operational margin per procedure regarding surgical approach and treatment pathway

	OPN nationwide ($n=2475$)	RAPN nationwide ($n=3529$)	NLC-RAPN (CHU Bordeaux all patients) ($n=151$)	NLC-RAPN (CHU Bordeaux NP-RAAC) ($n=124$)	NLC-RAPN (CHU Bordeaux Ambu-Rein) ($n=27$)
Incomes, €					
Mean GHS	8925	8088	7595	7725	6936
Mean supplement resuscitation/intensive care/continuous care	888	127	13	15	0
TOTAL income, €	9813	8215	7607	7741	6936
Costs, €					
LOS level 1 & 2	4281	2920	1398	1721	501
Additional costs from surgical complications	1072	465	19	210	NA
ICU cost of stay	1327	384	14	17	NA
Instrumentation	0	1572	1572	1572	1572
Capital amortization	0	878	878	878	878
Service fees	0	468	468	468	468
OR	2030	2039	2030	2138	1550
Transfusions	22	11	15	18	0
Conversions	NA	26	24	26	NA
TOTAL costs, €	8733	8763	6594	7048	4969
Margin, €	1080	– 548	1013	692	1967

NP-RAAC Enhanced recovery after surgery protocol for RAPN, Ambu-Rein: day-case protocol for RAPN. *GHS* groupe homogène de séjours, *ICU* intensive care unit, *LOS* length of stay, *NLC-RAPN* nurse-led coordinated RAPN, *OPN* open partial nephrectomy, *OR* operating room, *RAPN* robot-assisted partial nephrectomy

difficult. Finally, our tertiary reference center is not easily comparable to other, less experienced centers; this may limit comparison of our results with the national average in OPN and RAPN, which will not be representative of highly experienced, tertiary reference centers such as ours. However, this does not limit the value of our findings in favor of RAPN cost optimization facilitated by a dedicated care coordination pathway.

Conclusion

When combined with nurse-led coordination of ERAS and outpatient care pathways, the robotic-assisted approach led to a shorter hospital stay with a reduced cost versus OPN. This strategy may facilitate the economic sustainability of robotic assistance for hospitals in countries where the extra cost is not covered by the healthcare system.

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Declarations

Conflict of interest JCB declare to be proctor for Intuitive Surgical.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the research committee CPP Sud-Ouest et Outre-mer (approval DC 2012-108) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Signed informed consent was obtained

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