Human Capital Gains Associated With Robotic Assisted Laparoscopic Pyeloplasty in Children Compared to Open Pyeloplasty

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Purpose: Robotic assisted laparoscopic pyeloplasty is an emerging, minimally invasive alternative to open pyeloplasty in children for ureteropelvic junction obstruction. The procedure is associated with smaller incisions and shorter hospital stays. To our knowledge previous outcome analyses have not included human capital calculations, especially regarding loss of parental workdays. We compared perioperative factors in patients who underwent robotic assisted laparoscopic and open pyeloplasty at a single institution, especially in regard to human capital changes, in an institutional cost analysis.

Materials and Methods: A total of 44 patients 2 years old or older from a single institution underwent robotic assisted (37) or open (7) pyeloplasty from 2008 to 2010. We retrospectively reviewed the charts to collect demographic and perioperative data. The human capital approach was used to calculate parental productivity losses.

Results: Patients who underwent robotic assisted laparoscopic pyeloplasty had a significantly shorter average hospital length of stay (1.6 vs 2.8 days, $p < 0.05$). This correlated with an average savings of lost parental wages of $90.01 and hospitalization expenses of $612.80 per patient when excluding amortized robot costs. However, cost savings were not achieved by varying length of stay when amortized costs were included.

Conclusions: Robotic assisted laparoscopic pyeloplasty in children is associated with human capital gains, eg decreased lost parental wages, and lower hospitalization expenses. Future comparative outcome analyses in children should include financial factors such as human capital loss, which can be especially important for families with young children.

Key Words: kidney, laparoscopy, robotics, costs and cost analysis, cost savings

Abbreviations and Acronyms

LOS = length of stay

OPN = open pyeloplasty

RALP = robotic assisted laparoscopic pyeloplasty

Study received institutional review board approval.

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URETEROPELVIC junction obstruction in children can present with symptoms of intermittent flank pain, flank mass and nausea/vomiting, and it is increasingly being diagnosed after the discovery of prenatal hydronephrosis. With preservation of kidney function as 1 of the primary treatment goals various treatment options are available with OPN considered the gold standard in the pediatric population.

RALP is an emerging, minimally invasive alternative to OPN in children for ureteropelvic junction obstruction treatment that is associated with smaller incisions, shorter hospi-

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tal stay and decreased pain medication requirements.[1–3] The success rates of OPN and RALP appear comparable and usually exceed 95%, which can create difficulties in determining significant objective advantages in outcomes between the 2 modalities.[4]

The economic impact of the pyeloplasty methods should be a major consideration in discussions of these methods. Previously described cost analysis models have helped deliver objective comparisons ranging from operating room costs, capital equipment acquisition and depreciation as well as correlations of clinical outcomes with perioperative expenses.[5,6] A particular area that has been underappreciated in these models is human capital loss, which is usually represented as lost workdays for the parents of pediatric patients. Although these calculations are progressively being included in the national health care financing debate, the human capital loss component directly impacts the pediatric patient and family, and should be strongly considered in future cost analysis projections. Human capital loss is particularly of interest in pediatric care since the illness of a child can result in large nonmedical costs in the form of lost wages and travel time of 1 or each parent. Savings in this area would correlate with decreased hospital LOS as well as with shorter recovery time, and more rapid return to school for the patient and to work for the parents.

We performed a cost analysis of a single institution comparison between OPN and RALP in a pediatric population with a particular emphasis on cost analysis as it relates to human capital. A pediatric population 2 years old or older was selected to compare 2 equivalent groups based on demographic criteria. Presented data provide a snapshot of the financial impact of OPN and robotic pyeloplasty, especially on patients and their families, at a single institution with implications for the overall health care costs of these procedures.

MATERIALS AND METHODS

A total of 44 patients 2 years old or older underwent RALP (15 females and 22 males) or OPN (3 females and 4 males) at a single pediatric hospital between 2008 and 2010. RALP was done on the right and left sides in 26 and 11 patients, and OPN was done on the right and left sides in 5 and 2, respectively.

We performed an institutional review board approved retrospective chart review to compare demographic and perioperative clinical parameters. Cohorts were sampled from the same period and matched for age ($p = 0.251$). Patients younger than 2 years were excluded from data sampling to create an age matched comparison.

We used a simplified version of the previously described financial model by Link et al[6] to predict the direct costs of the procedure and incorporate the indirect expense to patients in the form of human capital costs using the output method (see Appendix).[7] This model also incorporates the cost of depreciation of the surgical robot based on a straight line method using an annual robotic case volume of 100. We determined the amortization schedule at 5 years (technological life) and at 10 years (physical life) using Internal Revenue Service tables, in which the life of hospital capital equipment is based on the nature of the equipment.

For RALP and OPN the financial model incorporated total operating room time, surgical consumables, hospital room and board, and human capital loss. Variables with separate cost centers, such as office visits, and surgical pathology and laboratory testing, were excluded from analysis. Operative time was defined as the time between surgery start time and surgery end time for RALP and OPN. Total operating room time (patient in room time) was defined as the time between patient entry and patient exit from the operating room for RALP and OPN. Operating room cost for the first hour of surgery was estimated at $960 with each subsequent 15-minute block incurring an additional $240. Consumable costs were determined from a list of items on the surgical field and reflect a purchase price of $619.43 for RALP and $170.36 for OPN.[6] Hospital room and board were calculated at a rate of $735 for the first night and $620 for each additional day after 12 a.m. Hospital LOS was based on time of start of surgery to the time of hospital discharge.

The human capital approach was used to value productivity losses. It was assumed that for each day and partial day in the hospital 1 parent would miss 1 full workday. The annual median salary for a 2-parent family in California was obtained from the 2006 United States Census data, in which an average daily wage of $88.72 was calculated. Parental productivity losses were calculated as the loss of daily wages per each day or partial day of hospitalization. This method does not account for stay at home or unemployed spouses since it assumes the maximum contribution that human capital loss could affect the financial status of a typical 2-parent family.

We tested the cost hypotheses using the modified model of Link et al[6] by 1-way sensitivity analysis, in which a single factor was altered and its effect on the total cost was calculated with all other factors held constant (see Appendix). Statistical analysis of perioperative data was done with Prism® 5 using Student's t test with statistical significance considered at $p < 0.05$.

RESULTS

In terms of perioperative parameters no significant difference was found in mean ± SEM patient age in the RALP and OPN groups (10.3 ± 0.9 years, range 2 to 18.7 and 7.3 ± 2.2, range 2.4 to 19.2, respectively, $p = 0.251$). The difference in mean patient weight in the RALP and OPN groups was significant (41.5 ± 3.7 kg, range 9.8 to 80.6 vs 24.1 ± 4.8, range 13.2 to 47.0, $p = 0.012$). For RALP vs OPN there