Minimally Invasive Surgery for Adrenal Masses in Children: Results of a Two European Centers Survey and Literature Review

Minimally invasive surgery for adrenal masses in children: results of a bi-centric survey and Literature review.

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Research Article

Keywords: Adrenal mass, Laparoscopic adrenalectomy, Minimally invasive surgery, Children

Posted Date: January 3rd, 2024

DOI: https://doi.org/10.21203/rs.3.rs-3809669/v1

Additional Declarations: No competing interests reported.

Abstract

Background

Minimally invasive surgery for adrenal pathologies in children is still developing because of the low incidence of adrenal masses in pediatric population and the discrepancy between the size of the mass and the child's one. In Literature there are no any guidelines about the use of laparoscopic andrenalectomy in children. The aim of this study is to evaluate the outcomes of minimally invasive surgery through a bi-center data analysis in order to propose a standardized protocol.

Materials and methods

Children who underwent minimally invasive adrenalectomy between 2000 and 2020 performed by two expert Pediatric surgeons at two European departments of Pediatric Surgery were included in this study. Data were collected and analyzed using X-square, Fisher tests, multiple regression model.

Results

34 patients (38 adrenal masse)s were included. Mean age was 52 months 3–176]. Median lesion diameter was 60 mm [40-125mm]. Histological examination revealed 24 neuroblastomas, 11 pheochromocytomas, 1 teratoma, 1 adrenal cyst and 1 Myelolipoma. Laterality was 52.6% left, 36.8% right and 10.5% bilateral. Surgical access was trans-peritoneal in all patients. Mean operative time was 108 min for unilateral lesions and 270 min for bilateral ones. Mean hospital stay was 4.4 days. No major intra operative complications were observed. 21.05% neuroblastomas were preventively approached with a laparoscopic access and were converted to open surgery. Median follow-up was 88 months [24–264]. 4 patients affected by neuroblastoma reported metastatic dissemination and 3 died.

Conclusions

Pediatric minimally invasive adrenalectomy was a safe and effective procedure, it allows surgeons to reduce the size of laparotomies starting the dissection of the masses and it has low rate of complication if we consider small masses. The only absolute contraindication is persistent IDRF for neuroblastomas. It should be considered the first-line treatment for selected adrenal masses in centers with good experience in laparoscopy.

Introduction

First laparoscopic adrenalectomy was performed in children in 1996 by Yamamoto [1], but it has developed slower in pediatric population if compared to adult age not only because of the discrepancy between the large dimension of adrenal masses and the small size of patients, but also because of the low incidence of adrenal masses in children and the prevalent malignant nature of tumors [2]. Main indications for adrenal surgery in children are neoplastic masses [3] both from the medulla as neuroblastomas (NBs) and pheochromocytoma/para-ganglioma (PHE) [4, 5] and from cortex like corticosurrenaloma [6]. In children adrenalectomy is performed because of bilateral adrenal hyperplasia too [3]. Main issues for surgery are risk of

spillage for corticosurrenaloma, vessel encasement of the tumor for pheocromocytoma [7], size of the tumor for myelolipoma, pheocromocytoma and neuroblastoma [3, 8–10] and Image-De Risk Factors (IDRFs) for neuroblastoma [8, 11]. There are no guidelines about the specific use of this technique in pediatric population even if the minimally invasive approach to adrenal masses seems to be a safe and effective alternative to the traditional surgery and it is associated to different advantages such as shorter operative time, easier post operative pain control, shorter hospital stay, better cosmetic results, fewer complications and less morbidity [12].

Aim of the study

Primary aim of this study is to evaluate the epidemiology, the characteristics, the surgical indications and the outcomes of adrenal masses treated with minimal invasive surgery in pediatric age through the analysis of the cases of two European centers. Secondary aim is to identify the potential risk factors involved in the outcome of minimal invasive adrenalectomy focus the attention on conversation rate and complications.

Materials and Methods

A bi-centric study was conducted including all patients younger than 18 years old who underwent minimally invasive adrenalectomy performed by two expert pediatric surgeons (one for each center) working together between January 2000 and December 2020 at University Hospital of Strasbourg and the Departement of Pediatric Surgery of Colmar. Patients older than 18 years old, patients underwent to previous abdominal surgeries, patients followed up less than 1 year or patients with incomplete data were excluded from the study.

Demographic data (age, gender, diagnosis, etiology, comorbidities, time at diagnosis and time at surgery, laterality, and pre-operative presentation) were collected. All patients with suspected adrenal mass, either symptomatic or accidentally diagnosed by imaging underwent detailed personal and familiar history, physical examination, laboratory tests including adrenal function test and they were radiologically evaluated (ultrasound, CT scan, and sometimes magnetic resonance imaging). All cases were discussed by a multidisciplinary teams and indications for surgery and / or chemotherapy were defined according to the Oncologic guidelines. Indications for Laparoscopic adrenalectomy included low-risk adrenal masses and prenatally diagnosed tumors which were increased in size during follow-up. Intra-operative parameters including type of performed procedure, operative time and intra-operative complications were evaluated.

Institutional Review Board approval was not required for this study because of its retrospective nature. **Informed consent** has been obtained. Parents of the patients includedn in the study or their caregivers signed a writte consenit for treatment and another one for publication of patients anonimous information (including images).

Surgical technique

Trans-peritoneal andrenalectomy under general anesthesia was performed in all patients. Patients were placed in lateral decubitus with a costal block to increase the space between the last costs and the iliac crests. Patient's placement and operating room set up is described in **Figure A**. A Foley catheter was placed at the beginning of the procedure in order to be used later for bladder hydro-distention. Using open access, four laparoscopic ports were placed; the first 5 or 10 mm trocar for camera port was placed under the umbilicus. Pneumo-peritoneum was induced at 10 or 12 mmHg according to patient's age. Other 3 trocars were placed. In case of right adrenalectomy a 5 mm working trocar was placed in the midline between the xiphoid and the umbilicus, the second one along the

mid-clavicular line on the right flank and the last 3 mm one in the epigastric region to retract the liver (**Figure B**). After an abdominal exploration and the retraction of the liver, surgeons proceeded opening the retroperitoneum. After blind dissection and careful isolation of the inferior vena cava and renal vein, adrenal veins were isolated and sectioned. In case of left adrenalectomy a 5 mm working trocar was placed in the midline between the xiphoid and the umbilicus, the second one along the mid-clavicular line on the left flank and the last 3 mm one in the epigastric region. After an abdominal exploration, surgeons proceeded releasing the spleen through the dissection of the peritoneum and the spleno-diaphragmatic ties; they released the left colic angle and mobilized the spleen and the pancreas tail. After opening of the spleno-renal space, releasing of the upper pole of the left kidney and the lower pole of the spleen, the left adrenal gland was identified. The medial part of the adrenal vein and the upper part of the left renal vein were isolated and sectioned.

In both cases, adrenal gland was then dissected starting from medial side through the thermofusion effect of Ligasure® (**Figure C**). The dissected adrenal gland was placed into an Endobag® and removed through the umbelical port. Only in case of huge adrenal masses, they were removed through a mini-Pfannesteil incision. The working ports were removed and the trocar orifices were closed using separate stitches.

Postoperative management including time of abdominal drainage removal, time of ureteral catheter removal, length of hospital stay, postoperative outcomes and short and long term follow up was recorded. All patients who were operated weremonitored for at least 1 year. During the follow-up, patients underwent phisical examination, laboratory tests and US evaluation.

Statistical analysis

All statistical analyses were performed using *graph-pad* and *r*. Continuous variables are presented as mean. Categorical variables are presented as frequency and percentage. ANOVA, X-square, and Fisher tests were used for statistical analysis. A stepwise regression model has been created for independent variables. A p value < 0.05 was considered significant.

Results

A total of 38 minimally invasive adrenalectomies were included in the study, performed from January 2000 to December 2020 at two European Departments of Pediatric Surgery (University Hospital of Strasbourg and Hospital of Colmar) in 34 patients, 10 females (29.4%) and 24 males (70.6%) with a mean age of 52 months [3 months– 176 months]. 1 (2.98%) patient was affected by Von Hippel–Lindau syndrome, but no cases of Li–Fraumeni, Rubin- stein–Taybi, or Prader–Willi syndromes were identified among patients with adrenocortical masses. 9 (26,5%) patients were totally asymptomatic and in 22% of cases tumors were accidentally found out during diagnostic procedures performed for other reasons. Among the symptomatic patients, 14 (41%) had gastrointestinal symptoms. Demographic data and clinical presentation are presented in **Table 1.**

All patients were tested for hormonal profile and were evaluated by ultrasonography (US), 26 (76.4%) by Computed Tomography (CT) and 14 (41.2%) by Magnetic Resonance Imaging (MRI). In 7 patients (20.6%) both CT and MRI were performed. A PET scan was performed in 2 (5.9%) patients and only in one case of pheochromocytoma with neurological impairment a 3D reconstruction imaging was performed to understand both the patient's surgical anatomy and to plan the surgical procedures especially to determine the optimal port layout.

Laterality included 14 (36.8%) right lesions, 20 (52.6%) left lesions and 4 (10.5%) bilateral lesions. The mean diameter of lesions was of 60 mm [40mm-125mm].

Table 2 shows pre operative data (imaging evaluation, laterality and mean diameter). Surgical approach was trans-peritoneal in all 34 patients. Mean operative time was 118.5 min for all procedures, specifically 108 min for unilateral and 270 min for bilateral ones. Mean laparoscopic operative time was of 96 min.

No major intra-operative complications were reported. 8 (21.05%) laparoscopic adrenalectomies were converted to open surgery. They were all cases of neuroblastomas with vascular infiltration and 75% of them had positive IDRF. In those cases, the strategy was defined before surgery: laparoscopy was chosen as first approach in order to start the dissection and make easier the laparotomy. Among converted cases, mean age was 19.75 months, mean diameter of the mass was 64mm. Patients were discharged after a mean hospital stay of 4.4 days. The mean follow up was of months 88 months [24-264 months].

Histological analysis confirmed the following results: 24 (63.2%) of all cases were neuroblastomas (NB), 14 of them were associated to Image Defined Risk Factors (IDRF) and 3 to the amplification of N-MYC. 11 (28.9%) cases were pheochromocytomas, 1 (2.6%) teratoma, 1 (2.6%) adrenal cyst and 1 (2.6%) Myelolipoma. Post operative complications included 1 case of arterial hypertension 11 years after surgery for pheochromocitoma and elevated catecholamine with a 31 mm adrenal left mass in 1 patient affected by Von Hippel Lindau and 1 case of paraganglioma and an adrenal hyperplasia accidentally found out 7 years after surgery for pheochromocitoma in 1 patient affected by multiple endocrine neoplasia type 2A. 4 out 8 patients affected by NB grade IV with positive IDRF presented metastatic dissemination despite of complete resection of the mass during the first surgery confirmed also by the histological analysis, after a mean time of 11 months [4-24months]. Finally 3 (8.8%) patients died, 2 of them because infectious complications associated to chemotherapy and the last one because of a severe deshydratation due to acute gastroenteritis. Surgical data, post operative management, intra and post operative complications are reported in **Table 3**. **Table 4** shows all data about 24 neuroblastomas and all their characteristics in term of OT, conversion rate, recurrences and incidence of death.

Discussion

Many studies on minimally invasive surgery for adrenal masses in pediatric age have been already published [9, 13, 14]. They demonstrated an increasing use of minimally invasive surgery for adrenal masses in pediatric patients, especially for small and benign tumors [3, 8]. Advantages associated to laparoscopic adrenalectomy are different: it allows a smaller incision and better exposition with an easier and more precise dissection to reach the gland [15, 16]. Post operative hospital stay is reduced, cosmetic results are better and post operative pain control are easier if compared to open surgery [17].

Neuroblastic tumors have been the most treated adrenal masses with minimally invasive surgery at our centers, followed by pheocromocitoma; perfectly in line with data showed in Literature [18]. Median age at surgery of 34 patients involved in this study is significantly lower if compared to that reported in Literature (mean age 52 months vs. 106) [18–20], but on range if considered only the cases of neuroblastomas (36 vs. 38 months) [9]. There is still no current approved consensus about the indications of minimally invasive surgery for adrenal masses in pediatric age, but it has been demonstrated to be superior to open surgery for small size masses (< 5 cm) and benign tumors [3, 21–23]. Precisely according to the International Pediatric Endosurgery Group Guidelines (IPEG), laparoscopic adrenalectomy can be safely performed for benign tumors and for malignant

ones smaller than 60 mm [24]. Also in our series, mass volume is a significant risk factor for conversion to open surgery ($p = 0.002$), even if there is no association between mass volume and recurrence risk. IPEG confirmed that there are no absolute contraindications to laparoscopy unless radical excision is ensured [24]. In case of malignant tumors it should be considered as starting approach to allow a minimal open access and make easier the dissection with the traditional approach after conversion. Vascular infiltration is the only real absolute contraindication for laparoscopic adrenalectomy because of the high risk of intra-operative bleeding and conversion rate [25]. Moreover, Shirota et al. and Catellani et al. suggested to limit the use of laparoscopy in case of neuroblastoma with positive pre-operative IDRFs because its proximity to vital structures [26, 27]. As we can see in **Figure D**, there is a dependent relationship between preoperative pre-chemotherapy positivity of IDRF and conversion rate / recurrences without a statistically significant difference (42.85% vs 20%; $p = 0.23$ and 28.57% vs 0%; $p < 0.09$). There is no significant difference in term of operative time and length of hospital stay too. The International Neuroblastoma Risk Group proposed IDRF as risk factor resulting in subtotal tumor excision [28, 29]. Surgical approach was trans-peritoneal in 100% of patients included in the study. According to literature review it has become the standard procedure for adrenal masses because it makes abdominal lymph node sampling and cancer staging easier and it allows good exposition through a direct access to the gland and bilateral control, avoiding the need of colon mobilization with a low risk of intra-abdominal organ damages [3, 20]; it has different anatomical landmarks and it is technically easier [30]. Retroperitoneal approach can be proposed only for masses smaller than 5 cm [3]; working place is very small and its related learning curve extremely low [3]. In our cohort, we did not report any major intra-operative complications vs 7.5% of intra-operative complication rate reported in Literature ($p = 0.03$) [14]. On the other hand, total conversion rate was higher if compared to the mean conversion rate reported in Literature (21.05 vs 3.75%, $p = 0.0003$) [9, 14, 16, 31]. Conversion rate for neuroblastomas is 33.33%; specifically 42.85% for neuroblastoma with pre-operative IDRF-positive vs. 20% for those with IDRF negative ($p = 0.23$). These data are in accordance with those reported in Literature: In Tanaka et al. conversion rate is 40% for IDRF positive neuroblastomas and 0% for IDRF negative ones which means that positivity of IDRF should be considered as a risk factor for conversion in laparoscopic adrenalectomies [32]. We know that these are not real conversions due to the impossibility to complete surgery laparoscopically. It is a choice of our center to approach also big masses with positive IDRF with minimally invasive surgery in order to convert to a minimal open surgery and make the open dissection easier after conversion. Recurrence rate of laparoscopic adrenalectomy for IDRF positive - neuroblastomas is 28.57% vs 0% of laparoscopic adrenalectomy for IDRF negative – ones vs 8.33% for open adrenalectomy reported in Literature ($p < 0.0001$) [33]. Even if the results proposed by our Literature review would make us to consider the positivity for IDRF as a contraindication for laparoscopy; in our cohort we can not confirm this statistical significant difference, probably because there are other bias such as different mass volume and histological grading. We know there is a direct correlation, but we do not have enough data to get a good quality statistical analysis. IDRF-positive neuroblastomas completely treated with MIS have a risk of recurrence of 37.5%, instead for those started with MIS and then converted the risk decreases up to 16%. Moreover, if we compare the recurrence rate of our neuroblastomas with preoperative positivity of IDRF who were approached with laparoscopic surgery then converted to open one and the recurrence rate of neuroblastomas with preoperative positivity of IDRF directly treated with open surgery reported in Literature (16.67% vs 10.8%; $p = 0.22$) [34], we can see that there is no a statistically significant difference. These data allow us to conclude that the use of minimally invasive surgery is justified and is a safe approach also for this subtype of adrenal mass. In this study the mean operative times were of 108 min and 270 min respectively for unilateral and bilateral lesions, perfectly on range with operative time of other multicenter studies [9, 18, 21, 22, 35]. Operative time increases up to 91 min in case of organs or vascular infiltration with a rupture and bleeding

risk of 20%. There was not a direct correlation between age, symptoms at presentation, laterality, histology and surgical technique or operative time. Follow up outcomes were worse than those reported in Literature with a not insignificant procedure and tumors – related morbidity and mortality. Median hospital stay in our study was 4.4 days [2–6 days], perfectly on range with that reported in Literature. According to several authors laparoscopic adrenalectomy is associated to a significantly shorter hospital stay compared to that with open surgery [19, 36–38]. According to Mirallie et al. Shirota et al. laparocopic adrenalectomies also reduce laparotomy-related complications: wound infection, post operative pain control, cosmetic results [26, 39]. In our study group, complications were observed in 3 (8.8%) patients: 1 case of arterial hypertention, 1 case of paraganglioma and 1 adrenal hyperplasia accidentally found out 7 years after surgery. On the other hand, mortality and recurrence rates are higher than those reported in Literature, 8.8% vs 0% in Fascetti et al. study and Dukumcu's one [14, 40], 11.7% vs 2.9% [14]. Kelleher et al. and Shirota et al. compared the recurrence rate after open and laparoscopic adrenalectomy for adrenal neuroblastomas and they both emphasized the importance of limiting the use of laparoscopy in case of positive IDRF neuroblastomas [26, 36]. In Keller et al. there is a comparison between high and low risk neuroblastomas treated by laparoscopic or open surgery, but there is no a specific differentiation between IDRF positive and IDRF negative adrenal masses [36]; while Shirata et al. divided their sample in IDRF positive and IDRF negative neuroblastoma, but they compared the results between the laparoscopic and the open group only for the IDRF-negative patients concluding that recurrence rate was higher after the open approach than after the minimally invasive one (22% vs 0% p = 0.47) [26]. There was no study in Literature that has previously compared the recurrence rate of IDRF – positive Neuroblastomaa treated by minimally invasive surgery and open adrenalectomy. In our study, 4 children with neuroblastoma had metastatic dissemination and they were all IDRF – positive. Also in our data IDRF –negative neuroblastoma can be safety approached with MIS. It could be useful to understand if there is an association between the metastatic dissemination and the laparoscopic approach; if it were proved, it would be as a possible limitation of the minimally invasive surgery in this group of patients. Future studies will probably standardize the use of pre-operative 3D reconstruction, especially for malign and hyper vascularized tumors such as pheochromocitoma in order to better define the vascularization and to simulated the operative steps [30, 41]. Another innovation could be standardized especially in pediatric complex adrenal masses is the intra-operative use of Indocyanine green (ICG) to make easier the surgical dissection [42–44]. Finally robotic – assisted approach to pediatric adrenal masses would be proposed too. It has already been demonstrated in adult age to be associated to higher cost, similar operative time and conversion rate if compared to laparoscopic adrenalectomies, but hospital stay and intra operative bleeding is significantly reduced [3, 45].

Conclusion

Laparoscopic adrenalectomy in pediatric age has developed over the last 25 years and it is now the gold standard in the management of adrenal pathologies in children. Because of the low incidence of these diseases in the pediatric population, the present series could be considered one of the largest and heterogeneous one about the minimally invasive approach to the adrenal glands in pediatric patients. The limitations of this approach depend on the aggressiveness and loco-regional invasion of the tumor, and the surgeon's experience. The results show that Minimally invasive adrenalecomy can be safely and effective for children affected by benign and small masses (inferior to 5 cm). Probably surgeons should start improving their skills in laparoscopic adrenalectomies with unilateral, benign, small masses (no phrecromocitomas) and approach malignant masses only when sufficiently expert. Laparoscopic adrenalectomy requires advanced endoscopic skills, especially for the resection of malignant lesions. In our cohort conversion rate is not insignificant, but in 75% of cases it involves

adrenalectomies for neuroblastomas with positive IDRF: in these cases laparoscopy has been chosen as starting approach to make the open dissection easier; but it was not a definitive surgery. We can conclude that IDRF-negative neuroblastomas can be safety approached with MIS, instead IDRF-positive ones could be dissected with laparoscopy but they need to be converted. Further studies should be conducted on the role of robotic adrenalectomies with or without the use of Indocyanine.

Limits of the study

The first limit of the study is related to its retrospective nature. Our sample is relatively small, but this is explained by the extremely low incidence of adrenal masses in pediatric age. Finally it would have been useful to demonstrate the eventual association between the laparoscopic approach and the metastatic dissemination through a comparison with metastatic rate after an open adrenalectomy.

Abbreviations

NB= neuroblastomas

IDRF = Image Defined Risk Factors

PHE = pheochromocytoma/paraganglioma

US = Ultrasounds

CT = computed tomography

MRI = magnetic resonance imaging

IPEG = International Pediatric Endosurgery Group Guidelines

ICG = Indocyanine green

Declarations

Acknowledgment

All the authors who contributed to this study are acknowledged for their work.

Disclosure

The authors Dr Francesca Nascimben, Dr. Amane Lachkar, Prof. Francois Becmeur, Prof. Francesco Molinaro, Prof. Rossella Angotti, Dr. Ciro Andolfi, Dr. Stephan Geiss and Prof. Isabelle Talon declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Funding information

No funding sources have been accepted for this work.

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Tables

Table1: It shows demographic data and clinical presentation.

Number of patients, N (%)	
Tot.	34
Sex	
Female	10 (29.4%)
Male	24 (70.6%)
Age (months)	
	52 [3-176]
Clinical presentation	
Asymptomatic	9 (26.5%)
Abdominal compression	10 (29.4%)
Abdominal pain	4 (11.8%)
Hypertension	7 (20.6%)
Articular pain	3 (8%)
Thoraci pain /dyspnea	2 (6%)
Anemia	1 (2.9%)
Virilization	0
Hedache	0
Sweating	0
Obesity	0
Opsoclonus myoclonus	0
Associated morbidities	
Von Hippel Lindau sdr	1 (2.9%)
Li Fraumeni syndrome	0
Rubin-Stein- Taybi	0
Predr Willi syndrome	0

Table 2: it shows pre operative data (imaging evaluation, laterality and mean diameter).

Number of patients, N (%)	
Imaging exams	
US	34 (100%)
CT	26 (76.4%)
MRI	14 (41.2%)
PET scan	2 (5.9%)
3D- reconstruction	1 (2.9%)
Laterality	
Left	20 (51.2%)
Right	14 (36.8%)
Bilateral	4 (10.5%)
Mean diameter (mm)	60

Table 3: It reports surgical data, post operative management, intra and post operative complications.

Number of patients, N (%)	
Surgical approach	
Trans-peritoneal	34 (100%)
Retro-peritoneal	0
Operative time (minutes)	
Total	118.5
Monolateral	108
Bilateral	270
Intra-operative complications	
Blood loss	0
Mass rupture /dissemination	0
Internal organ injuries	0
Conversion	8 (21-6%)
Post operative management	
Mean hospital stay (days)	4.4
Mean follow up (months)	88 (24-264)
Histopathology of the mass	
Neuroblastoma	24 (63.2%)
Pheocromocitoma	11 (28.9%)
Teratoma	1 (2.6%)
Adrenal cyst	1 (2.6%)
Myelolipoma	1 (2.6%)
Post-operative complications	
Local recurrence	2 (5.9%)
Metastatic dissemination	4 (11.7%)
Death	3 (8.8%)

Table 4: it reports data about 24 neuroblastomas and all their characteristics in term of OT, conversion rate, recurrences and incidence of death.

Role of pre and postoperative IDRF as risk factor for conversion and recurrence

Stade INRG	Preoperative IDRF	Mass volume	OT (days)	Conversion	Postoperative IDRF	LOS (days)	Recurrence	Death
1	0	60x45x35	90	0	0	4	0	1
1	1	70x60x40	130	1	1	5	0	0
1	0	65x35x25	70	0	0	3	0	0
1	0	70x50x47	90	1	0	3	0	0
1	0	66x42x47	95	0	0	3	0	0
4	0	50x29x34	300	0	0	7	0	1
4	1	52x38x22	55	0	0	3	0	0
4	1	45x40x25	70	0	0	2	1	1
4	0	40x30x20	70	0	0	4	0	0
4	1	60x45x45	120	0	0	5	1	0
1	0	90x80x50	120	1	0	6	0	0
1	1	70x40x40	150	1	1	5	0	0
1	1	55x50x37	150	1	0	4	0	0
1	0	50x12x18	90	0	0	2	0	0
1	1	70x45x45	120	1	1	3	0	0
1	1	45x30x20	60	0	0	4	0	0
4	1	45x33x19	60	0	0	3	0	0
4	1	75x20x17	120	1	1	5	1	0
1	1	50x24x20	120	0	0	4	0	0
1	0	70x65x25	180	0	0	3	0	0
4	1	43x32x17	160	0	0	8	0	0
1	0	50x35x30	120	0	0	3	0	0
4	1	60x47x42	120	1	1	3	0	0
4	1	45x30x18	80	0	1	3	1	0

*** OT = operative time**

****LOS = length of hospital stay**

Figures

Figure 1

Patient's placement and operative room set up.

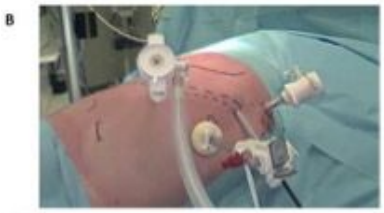

Figure 2

Laparoscopic Ports placement.

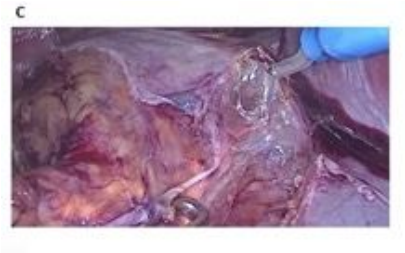

Figure 3

Laparoscopic dissection of the adrenal gland.

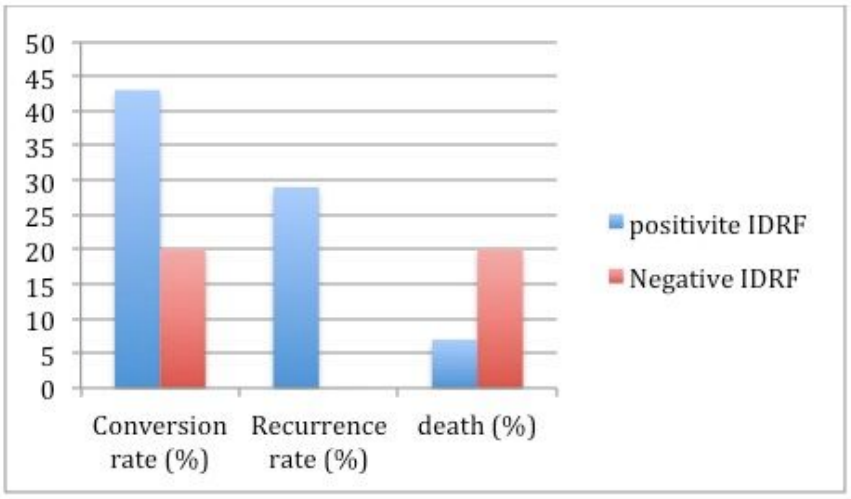

Figure 4

comparison between neuroblastome with pre-operative positive IDRF and with pre-operative negative IDRF in term of conversion rate, recurrences and death.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- ListofFiguresMIS.docx
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