Review of pathology and cost benefit analysis of hernia sacs processed over a 19-year period

Arshia Kazerouni, Klaudia M Nowak, Stefano Serra, Rajkumar Vajpeyi, Kenny Chieu, Runjan Chetty

Department of Pathology, University Health Network Laboratory Medicine Program, University of Toronto, Toronto, Ontario, Canada

Correspondence to
Professor Runjan Chetty, Department of Pathology, University Health Network Laboratory Medicine Program, University of Toronto, Toronto, M5G 2C4, Canada; runjan.chetty@gmail.com

Received 18 February 2020
Revised 13 March 2020
Accepted 18 March 2020
Published Online First 27 March 2020

Check for updates

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To cite: Kazerouni A, Nowak KM, Serra S, *et al*. *J Clin Pathol* 2020;**73**:737–740.

ABSTRACT

Aim Hernia sacs with pathological evaluation over a 19-year period were analysed with regards to pathological diagnoses, full costing and the impact on patient management.

Materials and methods The database of the Department of Pathology were searched over the study period (2001 to 2019 inclusive) for hernia sacs. The total cost of complete pathology examination was calculated on average numbers and rates of pay that existed over the study period.

Results A total of 3619 hernia sacs from the abdominal, hiatus/diaphragmatic, inguinal and femoral hernias were retrieved. Of these 3592 cases (99.25%) had sections taken for histological evaluation. A total of 3437 cases representing 95.7% of all hernia sacs did not show any pathological abnormality. If non-neoplastic clinically insignificant lesions seen in hernia sacs is included, then 3552 of 3592 (98.9%) hernia sacs underwent full pathological evaluation for no patient benefit.

On average two blocks or tissue sections per case were processed incurring a technical cost of $53 175.00. The total pathologist cost in reporting the 3592 cases was approximately $39 870.00 and rose to $40 410.00 when interpretation of ancillary tests was factored in. $95 328.90 (average $26.90 per specimen with a yearly average total cost of $5 017.31) was spent over the 19-year period in full pathological examination of 3592 hernia sacs.

Conclusion Given the low return on investment and the difficult to quantify time savings and reallocation, we do not advocate the routine sampling of hernia sacs. Gross examination will suffice in 99% of the cases. Selective cases may be sampled if clinically indicated.

Hernias are a relatively common clinical condition and often times, surgery is the best and only option for a definitive cure. As such, the excised hernia sacs are sent for pathological evaluation. Pathology departments vary in their approach to specimens of this ilk. Practice ranges from a gross only examination of the surgically removed specimens to processing random sections for microscopic evaluation. Additionally, anything that is deemed unusual or 'odd' at gross examination, is also sampled.

Stringent fiscal constraints confront many pathology departments that necessitate a critical look at resource and time allocation. Opportunities to curtail expenditure on specimens that are likely to provide a low yield of diagnostically important and/or clinically actionable information for patient management, must be sought as resources can be redirected to more clinical impactful scenarios.

The purpose of this study was to analyse the pathological findings and the cost benefit of undertaking gross and microscopic evaluation of the tissue removed at hernia surgery. Specifically, we wanted to address the question whether hernia sacs should be processed routinely for microscopic study and the generation of a pathology report.

MATERIALS AND METHODS

A retrospective search of the computer records for all hernia sacs received in the Division of Anatomical Pathology, Laboratory Medicine Program, University Health Network, Toronto, from 2001 to 2019 (inclusive) was undertaken. The pathology reports were reviewed looking specifically at: the number of sections taken in each case, the gross descriptions and the final diagnosis. Hernia sac specimens included as part of larger oncological surgical resections were excluded from the study cohort. Part of the data (2001 to 2012) collected was taken from a 2013 case series by Wang and Vajpeyi.[1]

The cost of each block sampled was based on the average time (approximately 15 to 20 min per case) for a pathologists' assistant to examine the gross specimen (including patient chart review for indication of the surgery and to exclude comorbidity, inspection, measurement, dictation of the gross report and sampling) as well as the cost of processing, cutting and staining a routine block. This was averaged out to $15 per block based on the hourly rates of pay and cost of consumables.

The average time taken by the reporting pathologist was 5 min per case. The hourly rate for pathologists is $135 per hour. An additional 2 min was factored when ancillary tests were ordered. All monetary values were in Canadian (CDN) dollars.

RESULTS

In total, 3619 cases of hernias were retrieved from the database search. The locations and distribution of the hernias are listed in table 1. Of the total cases identified, 3592 (99.25%) were submitted for microscopic examination. The vast majority of hernias were abdominal and inguinal. A total of 1819 abdominal hernias were identified: in 1753 cases (96.4%) no pathological abnormality was identified, non-neoplastic diagnoses were encountered in 41 and a diagnosis of a neoplastic condition was made in 25 cases (see table 2). Of the 1618 inguinal hernias, no pathological abnormality was seen in 1556 cases (96.1%), non-neoplastic

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Table 1 Location and number of hernia sacs with pathological evaluation

Location	Number of hernia sacs
Abdominal	1819
Inguinal	1618
Hiatal/diaphragmatic	90
Femoral	65
Total	**3592**

conditions were seen in 47 cases (see table 2). The hiatus and diaphragmatic hernia revealed no pathological abnormality in 63 of 90 cases (70%) and the remaining 27 cases were associated with non-neoplastic lesions.

Twenty-five of the 27 cases were made up of reactive lymph nodes present in these hernias. All 65 femoral hernias did not show any significant pathological abnormalities.

A total of 3437 hernia sacs were reported as having no pathological abnormality, representing 95.7% of the entire series examined.

With regards to neoplasms associated with abdominal and inguinal hernias (see tables 3 and 4), the majority of diagnoses were apparent and known clinically before the hernia surgery.

Twenty-five tumours were noted in abdominal hernias, encompassing a wide variety of malignancies (see table 3). These included eight ovarian serous carcinomas and three neuroendocrine tumours. Of note, there was only one case (a pancreatic adenocarcinoma) that was not clinically suspected and not seen grossly in the abdominal hernia sac specimen. The diagnosis was made on random sections taken of the hernia sac.

Table 4 shows the range of neoplasms encountered in inguinal hernias which totalled 15. Once again, a wide range of lesions were seen including two each of small B-cell lymphomas, neuroendocrine tumours and ovarian serous carcinomas. In one of the inguinal hernia sacs, a liposarcoma was diagnosed. The diagnosis was not known pre-surgery and the inguinal hernia sac pathology report was the first indication of a diagnosis of liposarcoma. The patient underwent further investigation and a retroperitoneal mass was discovered necessitating further surgery.

Other neoplastic, but clinically non-actionable, histological findings in inguinal hernias included acellular mucin secondary to a ruptured low-grade mucinous neoplasm (n=1), adenomatoid tumour (n=1), adenomyoma (n=1) and a benign perivascular epithelioid cell tumour.

While no pathological abnormality was encountered in the vast majority of hernia sacs, if non-neoplastic conditions are now factored in, then 3552 of 3592 (98.9%) cases with full pathological evaluation did not have any impact on clinical management of the patient post-hernia surgery.

The non-neoplastic findings that could potentially warrant a change in medical management included endometriosis (n=2) and vas deferens (n=7). These cases were not seen during gross inspection but one specimen included a vas deferens as part of a larger orchiectomy performed for a non-oncological clinical indication.

An average of two blocks per case were taken amounting to a total technical cost of approximately $53 175.00 (table 5). The total cost ancillary test amounted to $1743.90 (table 5).

The total Pathologist cost in reporting these cases was approximately $39 870.00 and rose to $40 410.00 when interpretation of ancillary tests was accounted for.

Thus, the overall cost of processing and examining hernia sacs of over a 19-year period amounted to $95 328.90 with an average of $26.90 per specimen and a yearly average total cost of $5017.31.

Table 2 Summary non-neoplastic pathological findings in all hernia sacs

Location	Histological findings	Number
Abdominal	No significant pathological abnormalities	1753
	Lymph node(s)	11
	Intestines	25
	Endosalpingiosis	2
	Endometriosis	1
	Epidermal inclusion cyst	2
	Subtotal	**1794**
Inguinal	No significant pathological abnormalities	1556
	Intestines	14
	Lymph node(s)	16
	Vas deferens	7
	Appendix	3
	Adrenal rest(s)	2
	Bladder tissue	1
	Endometriosis	1
	Haematoma	1
	Undescended testis	1
	Psammoma bodies	1
	Subtotal	**1578**
Hiatus	No significant pathological abnormalities	61
	Lung	1
	Lymph node(s)	25
	Parietal pleura	1
	Subtotal	**88**
Femoral	No significant pathological abnormalities	65
	Subtotal	**65**
Diaphragmatic	No significant pathological abnormalities	2
	Subtotal	**2**
Total non-neoplastic findings		**3527**

DISCUSSION

Careful scrutiny of operations and evaluation of return on investment are important and integral to efficient practice as operating budgets come under ever increasing pressure from cuts. Redirection of limited resources into high-yield, clinically impactful practice is an important facet of efficient resource management.

The Hospitals Act of Ontario mandates that all specimens removed at surgical procedures should have pathological assessment. This assessment is left to the discretion of the individual pathology department and ranges from gross examination only to full microscopic histopathological evaluation even for specimens thought to have a low pathology yield with little-to-no impact on patient care. Examples include nail clippings, teeth, prostheses and other implants/devices. Careful gross examination is conducted on all specimens and submission of tissue sections for microscopic evaluation, is based on grossly observed/detected abnormalities and pertinent clinical information.

Additionally, it should be remembered that so-called 'gross-only' specimens are retained within surgical pathology for a period of 30 days after the issuance of a pathologist-sanctioned

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Table 3 Summary of neoplastic histological findings in abdominal hernia sacs

Location	Neoplasm	Number	Grossly seen	Comments
Abdominal	Serous ovarian carcinoma	8	7	Seven patients with known malignancy. One case unknown clinically but a lesion was identified grossly.
	Neuroendocrine tumour	3	1	Two cases were not seen grossly; however represented cases of known neuroendocrine tumour with either positive lymph nodes or metastatic disease. Clinical history was not available for one case; however, the lesion was grossly seen.
	Undifferentiated carcinoma	2	2	Clinical suspicion of malignancy and seen grossly
	Colorectal adenocarcinoma	1	0	Clinically known malignancy
	Adenocarcinoma, not specified	1	0	Clinical suspicion of malignancy
	Pancreatic adenocarcinoma,	1	0	**Clinically unsuspected**
	Hepatocellular carcinoma	1	0	Clinically known malignancy
	Prostate adenocarcinoma,	1	0	Clinical suspicion of malignancy
	Mixed clear cell and endometrioid carcinoma	1	0	Clinical suspicion of malignancy
	Endometrial serous carcinoma	1	0	Clinically known malignancy
	Granulosa cell tumour	1	1	Clinically known and seen on gross inspection
	Primary peritoneal carcinoma	1	0	Clinical suspicion of malignancy
	Renal cell carcinoma	1	1	Clinically known and seen on gross inspection
	Pleomorphic sarcoma	1	0	Clinical suspicion of malignancy
	Small B-cell lymphoma	1	0	Clinically known malignancy
	Subtotal	**25**	**12**	**12/25 of lesion were seen at the time of gross inspection. Only one case (pancreatic adenocarcinoma) was considered a clinically unexpected malignant finding and was not seen grossly**

report. This allows clinicians the ability to contact the pathologist requesting sections to be taken because of a valid clinical indication.

From this study, non-neoplastic histological findings represented a total of 98.9% of all histopathological evaluations made in hernia sac specimens. 'No significant pathological abnormality' was the most frequent (95.7%) histological diagnosis rendered in hernia sac specimens. These findings are consistent with reports from other large series evaluating the histological findings in hernia sac specimens.[2–4]

A total of 34 malignancies (overall rate of 0.9%) of all hernia sacs, was detected in our series which is in keeping with quoted rates of malignant tumours in hernia sacs reported in the literature.[2–4] Malignant findings ranged from epithelial malignancies, with the most frequent being serous ovarian carcinomas (n=11), to two cases of sarcoma: a liposarcoma and a pleomorphic undifferentiated sarcoma.

All cases of malignancies, except for two (a pancreatic cancer and a liposarcoma), either had a clinical suspicion/known history of malignancy and/or were visualised at the time gross inspection. Consequently, the overall rate of truly unexpected malignancies, not seen at the time gross as well as not being clinically suspected, was 0.06%.

Non-neoplastic conditions that impacted on medical management or on the patient post-surgery, included endometriosis (n=2) and the presence of normal transected vas deferens in the

Table 4 Summary of neoplastic histological findings in inguinal hernia sacs

Location	Neoplasm	Number	Grossly seen	Comments
Inguinal	Small B-cell lymphoma	2	0	Clinically known malignancy
	Neuroendocrine tumour	2	0	Clinically known malignancy
	Acelluar mucin secondary to ruptured LAMN	1	1	Clinically unsuspected
	Adenomatoid tumour	1	0	Clinically unsuspected
	Adenomyoma	1	1	Clinically unsuspected
	Cholangiocarcinoma	1	1	Clinically known malignancy; however, new diagnosis of metastatic disease
	Serous ovarian carcinoma	2	2	Clinically known malignancy
	Endometrial endometrioid carcinoma	1	1	Clinically known malignancy
	PEComa	1	1	Clinically unsuspected
	Liposarcoma	1	0	No history available
	Granulosa cell tumour	1	1	Clinically known and seen on gross inspection
	Choriocarcinoma	1	0	Clinically known malignancy
	Subtotal	**15**	**8**	**One unexpected finding of liposarcoma; all other cases were known clinically**
Total of abdominal and inguinal hernias		**40**	**20**	**Two of 3567 (0.06%) diagnoses made were unexpected malignant findings**

LAMN, low-grade appendiceal mucinous neoplasm; PEComa, perivascular epithelioid cell tumour.

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Table 5 Cost analysis of full examination of hernia sacs ($ CDN)

Total technical cost*	**$53 175.00**
Total cost of ancillary testing	$1743.90
Total cost of examination by pathologist	$39 870.00
Total cost of examination of ancillary tests by pathologist	$540.00
Overall total cost of pathological examination of hernia sacs	$95 328.90
Overall total cost of pathological examination of hernia sacs per year	$5017.31
Average cost of pathological examination of hernia sac specimen	$26.90
Ancillary histochemical (5 cases) and immunohistochemical (25 cases) costs	$1743.90

*Excluding gross only specimens

hernia sac (n=7). Of note, neither of these two diagnoses were observed at the time of gross inspection and there was no clinical history suggesting endometriosis in either of the two cases. The reported rate of epididymal structures and/or vas deferens in the histological evaluation of paediatric hernia sacs, ranged from 0.06% to 0.88%.[5–7] In our series, one of the hernia sacs containing a vas deferens was part of a larger, non-oncological orchiectomy specimen. Thus, the impact of this of finding a vas deferens in the hernia sac in this particular case was negligible and not clinically relevant.

In terms of a cost benefit analysis, the total yearly cost of pathological analysis of hernia sacs reported in the literature ranged from $7100 to $26 851.00 CDN.[2 4–7] The reported costs spanned diverse healthcare systems including private,[4] and tiered healthcare[2] and public.[5–7] Overall, the total yearly cost of $5017.31 in our series was much lower than the reported range in the literature.

In conclusion, there is a broad spectrum of pathological findings found in hernia sac specimens after histological evaluation. These range from non-neoplastic to neoplastic entities that are not associated with any change in preoperative clinical management or impact on patient well-being in the vast majority of cases (98.9%). There was only an extremely small proportion of histological diagnoses that could be deemed to be of clinical significance and hence, actionable in terms of patient management. Indeed, none were life-threatening or changing as the patients did not have preoperative symptomatology of the pathology diagnosed in the hernia sac specimen. As a result of the extremely low yield of unexpected but clinically significant and actionable diagnoses from our cohort of hernia sac specimens, we therefore suggest that hernia sac specimens should fall into the category of specimens that have careful gross examination only without routine sampling of tissue. However, sections should be submitted for microscopic analysis if grossly evident lesions are present or discovered, if there is a clinical/known history of clinically significant pathology that may be related to the hernia or, there is some other valid clinical indication warranting histological examination. While the overall dollar cost savings accomplished over the 19-year study period are modest, the unquantifiable factor of time saving by pathologists' assistants, medical laboratory technologists, administrative assistants and pathologists, make a compelling case for hernia sac specimens to be triaged by gross pathological evaluation only in the first instance in the vast majority of cases. We recommend that departmental policy regarding handling of hernia sac specimens sent to pathology laboratories should be designated as 'gross examination only' specimens.

Take home messages

- In many institutions hernia sac specimens undergo full pathological evaluation.
- This study highlights the extremely low diagnostic yield of diagnostic information from hernia sacs.
- Almost 98% of diagnoses rendered histologically were clinically apparent and/or did not impact further patient management.
- We recommend gross examination only of hernia sacs unless there is a pertinent clinical indication for tissue sampling.
- While the actual financial savings of not processing tissue from hernias is modest, the time savings made, can be redirected to other specimens.

Handling editor Dhirendra Govender.

Contributors Author contributorship statement: AK and KN were responsible for data extraction, pathology report review and collating all information. KC was responsible for the financial costing. RC was responsible for the concept and execution. All authors contributed to the writing, editing and direction of the manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval Institutional research ethics board approval was obtained: CAPCR ID: 17–5578.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information. Not applicable.

ORCID iD
Runjan Chetty http://orcid.org/0000-0002-2124-515X

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