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Evaluating The Diagnostic Performance Of The Ripasa Score In Acute Appendicitis

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ABSTRACT

Introduction: Complains of lower abdominal pain is very much common in our hospital emergencies, which in most of the cases is due to acute appendicitis. Surgeons need to be very careful and precise for the correct diagnosis, else any carelessness and negligence may lead to bad consequences. Experts must use all of their strengths and available diagnostic methods to its best to avoid any misshapes. The following study was designed to evaluate the worth of RIPASA score in diagnosis of acute appendicitis in Peshawar and nearby areas. Methodology: The study was performed in Surgical B Unit of Khyber Teaching Hospital at Peshawar, Khyber Pakhtunkhwa, Pakistan from 27th May to 1st December 2024. Sample size for the study was 472, i.e. patients complaining of lower abdominal pain Results: RIPASA score proved to be very accurate with higher accuracy, sensitivity and specificity percentages. It gave very quick diagnosis and is economical. Conclusion: RIPASA scoring method must be used with laboratory tests to cross check and ensure the diagnosis.

INTRODUCTION

Vermiform appendix is a hollow organ attached to the cecum. It is located within the digestive tract, but is not a digestive organ (Vaos et al., 2019)[1]. The etiology of appendicitis is usually an obstruction of appendiceal lumen, which may due to appendicolith. Tumors like carcinoid, intestinal parasites and hypertrophied lymphatic tissue are also the causes of appendiceal obstruction (Khan et al., 2018)[2]. Acute appendicitis is one of the most common cause of quick acute abdomen intervention in surgical emergency of tertiary care hospitals, that results in removal of appendix, which is called as appendectomy (Bhangu et al., 2015)[3], it is also the most prevalent reason for lower abdominal pain (Saverio et al., 2020)[4].

During 2021 the rate of appendicitis incidence was 214 (174-274) per 100,000 individuals with 17 million new cases. High income Asia pacific has the highest incidence rate at 364 (286-475) per 100,000, while the Western sub- Sahara Africa has the lowest at 81.4 (63.9-109) per 100,000. Mortality rate in the same year was recorded 0.358 per 100,000, ranged from 1.01 (0.895-1.13) in central latin America to 0.054 (0.0464-0.0617) in high income Asia specific per 100,000 individuals (Han et al., 2024)[5]. The incidence rate of appendicitis in USA, Europe and Africa is 9%, 8% and 2% respectively (Bhangau et al., 2015)[6]. Approximately 110,000 cases of appendicitis are reported annually in Pakistan (Shahid et al., 2021)[7].

Raja Isteri Pengiran Anak Saleha (RIPASA) scoring system was developed in Brunei during 2010 for the diagnosis of acute appendicitis in Asian population, which has proven as a very efficient method for detection of the disease. It has been tested in several regions with high successful results (Mohammad et al., 2014)[8]

Diagnosis through clinical examination alone is very difficult, physicians usually go for other diagnostic modalities also, to confirm their diagnosis and avoid unnecessary surgeries which lead wastage of time and resources. As the incidence of appendicitis is rising in many parts of the world, countries should prepare their health-care infrastructure for timely, high-quality diagnosis and treatment. Given the risk that improved diagnosis may counterintuitively drive apparent rising trends in incidence, these efforts should be coupled with improved data collection, which will also be crucial for understanding trends and developing targeted interventions (Han et al., 2024)[5].

RIPASA scoring method has never been used in Khyber Pakhtunkhwa specially in Peshawar and nearby areas so the study was designed to evaluate its efficacy in the region.

MATERIAL AND METHODS

The research was conducted in Surgical B Unit of Khyber Teaching Hospital Peshawar, Khyber Pakhtunkhwa, Peshawar, Pakistan from 27th of June to 26th of December 2022 by Cross Sectional Study Design through non probability consecutive sampling technique. Buderer[9] sampling technique was used for the calculation of sample size.

SAMPLE SIZE (N): 472

Assumptions while calculating sample size:
Sensitivity=88.46% [10] Specificity=66.67%[10] Prevalence=7%[11]
Precision level for sensitivity=11%
Precision level for specificity=11%

SAMPLE SELECTION

Inclusion Criteria: Complainers of lower abdominal tender pain migrating to right iliac fossa between age 18 to 60 years, belonging to both the genders, having fever of ≥ 101^{0}F, WBC (white blood cells) > 10000 mm^3 and ASA (American Society of Anesthiologists) score of I-II.

Exclusion Criteria: Patients with all or any of the below diagnosis or complaints were excluded:.

- Diagnosed appendicular lump on physical examination.
- Right iliac fossa mass on ultrasound.
- Pregnancy on ultrasound.
- Urolithiasis and pelvic inflammatory disease on medical record.

DATA COLLECTION PROCEDURE

After being approved from the hospital ethics committee and research department of CPSP, data was collected from all those patients fulfilling the inclusion criteria. Base line demographic information like age, gender, duration of complain, ASA score and weight was recorded. Consent, ensuring respondents secrecy and of no risk was taken.

Parameters, which are integral to determine the RIPASA score were recorded for each patient and a score > than 7.5 was considered positive appendicitis, which were operated for appendectomy: either by open method or by the laparoscopic technique. Specimens of appendix were sent to Pathology Laboratory of the hospital for histo-pathological examination. Post operative histopathology and RIPASA score were observed as per operational definition in the specially designed proforma (Annexure 1).

DATA ANALYSIS

Data was analyzed through SPSS 22.0. Mean with standard deviation was calculated for quantitative variables like: age, weight and duration of pain, while for qualitative variables such as gender and ASA score, frequency and percentage was determined. Effect modifiers like age, gender, ASA score and duration of pain were controlled by stratification. Post-stratification 2 × 2 table was used to find sensitivity, specificity, positive predictive level (PPV), negative predictive value (NPV) and diagnostic accuracy.

Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy were calculated through the following standard formulae: (Bolin and Lam, 2013[12], Parikh et al., 2008[13])

Sensitivity (%) = True Positive (TP) ÷ True Positive (TP) + False Negative (FN) X 100
Specificity (%) = True Negative (TN) ÷ True Negative (TN) + False Positive (FP) X 100
PPV (%) = True Positive (TP) ÷ True Positive (TP) + False Positive (FN) X 100
NPV (%) = True Negative (TN) ÷ False Negative (FN) + True Negative (TN) X 100
Diagnostic Accuracy (%) = TP + TN ÷ TP + FP + FN + TN X 100

RESULTS

The Table 1 below shows that mean age of the patients under study (n=472) was 30.23 years, while mean weight and duration of pain were 67.52 kg and 44.063 hours respectively. Table 2 and 3 manifests that out of 472 respondents, 306 were male and 166 were female, 456 patients have ASA score I, while the rest (16) have ASA score II. Table 4 demonstrates that out of 472 complainers, 218 were diagnosed appendicitis positive both by RIPASA score and histopathology, while 241 were proved to be appendicitis negative by both the diagnostic modules.

TABLE 1: MEAN ± SD OF PATIENTS AGE, WEIGHT AND DURATION OF PAIN
N = 472

S. No.	Demographics and baseline characteristics	MEAN ± STD. DEVIATION
1.	Patient age (years)	30.23 ± 6.20
2.	Patient weight (Kg)	67.52 ± 7.101
3.	Duration of pain (hours)	44.063 ± 15.66

TABLE 2: FREQUENCY AND PERCENTAGE ACCORDING TO GENDER
N = 472

S. No.	Gender	Frequency	Percent
1	Male	306	64.8
2	Female	166	35.2
3	**Total**	**472**	**100.0**

TABLE 3: FREQUENCY AND PERCENTAGE ACCORDING TO ASA SCORE
N = 472

S. No.	ASA Score	Frequency	Percent
1	I	456	96.6
2	II	16	3.4
3	**Total**	**472**	**100.0**

TABLE 4: OVERALL RESULTS OF RIPASA SCORE AND HISTOPATHOLOGY IN DIAGNOSIS OF ACUTE APPENDICITIS
N = 472

Acute Appendicitis	RIPASA Score	Histopathology
Yes	218 (46.2%)	229 (48.5%) 231
No	254 (53.8%)	243 (51.5%) 241
Total	472	472

Results stratification for the accuracy of RIPASA score by histopathology is shown in Table 5. Out of 472, 231 respondents were having true acute appendicitis, among whom, 201 (true positive) were also confirmed by RIPASA score, while for 30 (false negative) respondents, the RIPASA score showed negative appendicitis. The table further reveals that the rest 241 patients were having false acute appendicitis, among whom, 17 complainers were appendicitis positive, and 224 were appendicitis negative as diagnosed by RIPASA score. Sensitivity of the test, i.e. percentage of the patients who were appendicitis positive by RIPASA score as well as histopathology was 87.7%. Specificity: percent patients, who were appendicitis negative through RIPASA score and hispathology as well was 93.0%. Out of 218 complainers, who were appendicitis positive through RIPASA score, 92.2% (positive predictive value: PPV) have histopathological evidence also. Total number of complainers, who were appendicitis negative through RIPASA score was 254, but 88.9% (negative predictive value: NPV) were confirmed by histopathology also. Out of 472, 425 patients were correctly diagnosed whether diseased or not, which determined the accuracy of the RIPASA score which was 90.4%.

TABLE 5: STRATIFICATION OF DIAGNOSTIC ACCURACY OF RIPASA SCORE VERSUS HISTOPATHOLOGY

N = 472

RIPASA SCORE * HISTOPATHOLOGY					
		HISTOPATHOLOGY			
		DISEASED	NOT DISEASED	Total	
RIPASA SCORE	POSITIVE	201 (TP)	17 (FP)	218	Sensitivity = 87.7% Specificity = 93.0% PPV= 92.2% NPV= 88.9% Accuracy = 90.4%
	NEGATIVE	30 (FN)	224 (TN)	254	
Total		231	241	472	

Table 6 reveals that complainers of acute appendicitis between age of 18-35 years were 371. 180 patients have true acute appendicitis, among whom 157 were appendicitis +ive both by RIPASA score and histopathology, while the rest 23 were shown appendicitis –ive by RIPASA score. 191 respondents were having false appendicitis: 181 were confirmed both by RIPASA score and histopathology, while for only 8 the experimental test showed +ive result. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of a test for the parameter was 87.2%, 95.8%, 95.1%, 88.8% and 91.6% respectively.

The table further demonstrates that 101 patients under the study were of age between 36-60 years. 51 complainers were actually diseased (true acute appendicitis), but 7 patients were declared un diseased by RIPASA score. 50 respondents were un diseased (false acute appendicitis), among whom, 41 patients were confirmed appendicitis negative by RIPASA as well as histopathology, the rest 9 were shown positive by RIPASA only. 86.2%, 82.0%, 83.01%, 85.4% and 84.1% were sensitivity, specificity, PPV, NPV and accuracy respectively.

TABLE 6: STRATIFICATION OF DIAGNOSTIC ACCURACY OF RIPASA SCORE VERSUS AGE OF THE PATIENTS

N = 472

Patient Age	RIPASA SCORE * HISTOPATHOLOGY					
			HISTOPATHOLOGY			
			DISEASED	NOT DISEASED	Total	
18-35 years	RIPASA SCORE	POSITIVE	157 (TP)	8 (FP)	165	Sensitivity = 87.2% Specificity = 95.8% PPV= 95.1% NPV= 88.8% Accuracy = 91.6%
		NEGATIVE	23 (FN)	183 (TN)	206	
	Total		180	191	371	
36-60 years	RIPASA SCORE	POSITIVE	44 (TP)	9 (FP)	53	Sensitivity = 86.2%
		NEGATIVE	7 (FN)	41 (TN)	48	

	Total	51	50	101	**Specificity = 82.0% PPV= 83.01% NPV= 85.4 % Accuracy = 84.1%**

Diagnostic accuracy of RIPASA score, counterchecked through histopathological tests based on gender is chalked out in Table 7. Among 306 male patients, 146 were having symptoms with the disease (true acute appendicitis), in whom 18 were declared appendicitis negative by RIPASA, hence contradicting lab. results. 160 patients were having false acute appendicitis: 152 were confirmed by both the RIPASA and labs., while for the rest, RIPASA showed appendicitis +ive score. Sensitivity and specificity were recorded 87.6% and 95% respectively, while PPV, NPV and accuracy of the test were 94.1%, 89.4% and 91.5% respectively.

Table 7 further indicates that out of 166 female sample patients, 85 were diseased (true acute appendicitis): 73 were conformed both by RIPASA score and lab. results, while the rest were not confirmed by the test under the study. 81 female complainers have false acute appendicitis, among whom 72 patients were confirmed by RIPASA and lab. results both, while 9 patients were confirmed by histopathology only, i.e. they were declared for having appendicitis by RIPASA. Sensitivity, specificity, PPV, NPV and accuracy of the test for the mentioned parameter were 85.8%, 88.8%, 89.0%, 85.7% and 87.3% respectively.

TABLE 7: STRATIFICATION OF DIAGNOSTIC ACCURACY OF RIPASA SCORE VERSUS GENDER OF THE PATIENTS

N = 472

Gender	**RIPASA SCORE * HISTOPATHOLOGY**					
			HISTOPATHOLOGY			
			DISEASED	**NOT DISEASED**	**Total**	
Male	**RIPASA SCORE**	**POSITIVE**	128 (TP)	8 (FP)	136	**Sensitivity = 87.6% Specificity = 95% PPV= 94.1% NPV= 89.4% Accuracy = 91.5%**
		NEGATIVE	18 (FN)	152 (TN)	170	
	Total		146	160	306	
Female	**RIPASA SCORE**	**POSITIVE**	73 (TP)	9 (FP)	82	**Sensitivity = 85.8% Specificity = 88.8% PPV= 89.0% NPV= 85.7% Accuracy = 87.3%**
		NEGATIVE	12 (FN)	72 (TN)	84	
	Total		85	81	166	

Table 8 demonstrates that 278 patients under the study were of or less than 70 kg of weight. 128 respondents were having true appendicitis, among whom 112 sample patients were

diagnosed as appendicitis +ive by RIPASA score as well as lab. tests, while the rest of patients were declared having appendicitis only by lab. results, not by RIPASA. 150 patients have only symptom of appendicitis (false appendicitis): 140 respondents were confirmed as appendicitis –ive both by RIPASA score and histopathology, while 10 patients (false appendicitis) were +ive by RIPASA score, not by lab. results. Sensitivity, specificity, PPV, NPV and accuracy of the test for the parameter were 87.5%, 93.3%, 91.8%, 89.7% and 90.6% respectively.

Table 8 further reveals that out of under observation 472 patients, 194 were having weight of more than 70 kg. 103 were diseased (true appendicitis), among whom 89 were confirmed +ive by both the modules (true +ive) used during the research, while 14 were diagnosed –ive by RIPASA score and +ive by histopathology (false –ive). Among 91 patients, who were not diseased (false appendicitis), 84 were diagnosed with no appendicitis both by RIPASA and histopathology (true –ive), while the rest 7 were declared appendicitis –ive by histopathology only (false +ive), i.e. the RIPASA score have shown the disease in them. Sensitivity, specificity, PPV, NPV and accuracy of the test were 86.4%, 92.3%, 92.7%, 85.7% and 89.2% respectively.

TABLE 8: STRATIFICATION OF DIAGNOSTIC ACCURACY OF RIPASA SCORE VERSUS WEIGHT OF THE PATIENTS

N = 472

Patients Age	RIPASA SCORE * HISTOPATHOLOGY					
			HISTOPATHOLOGY			
			DISEASED	NOT DISEASED	Total	
≤ 70 Kg	RIPASA SCORE	POSITIVE	112 (TP)	10 (FP)	122	Sensitivity = 87.5% Specificity = 93.3% PPV= 91.8% NPV= 89.7% Accuracy = 90.6%
		NEGATIVE	16 (FN)	140 (TN)	156	
	Total		128	150	278	
>70 Kg	RIPASA SCORE	POSITIVE	89 (TP)	7 (FP)	96	Sensitivity = 86.4% Specificity = 92.3% PPV= 92.7% NPV= 85.7% Accuracy = 89.2%
		NEGATIVE	14 (FN)	84 (TN)	98	
	Total		103	91	194	

Stratification of RIPASA score to evaluate its diagnostic accuracy for appendicitis based on ASA score of the respondents, rechecked by histopathology is given in Table 9. Out of 472 patients, 456 were with ASA score I. 223 respondents were having true appendicitis, among whom 196 were confirmed by RIPASA and histopathology, while the rest were not diagnosed of having the disease by RIPASA. 233 patients were not diseased (false appendicitis), out of whom 218 were declared appendicitis –ive by both the tests, while 15, who were shown +ive by RIPASA, were declared appendicitis –ive by histopathology. Sensitivity, specificity, PPV, NPV and accuracy were 87.9%, 93.6%, 92.9%, 88.9% and 90.7% respectively.

Table 9 further indicates that 16 out of 472 sample patients have ASA score II. Among 8

respondents who were truly diseased, 5 were shown diseased by RIPASA as well lab. results, while the rest were appendicitis +ive only by lab. results. 6 out of 8 patients who were not diseased were confirmed as appendicitis –ive by both the modules, while 2 were declared appendicitis +ive by RIPASA only. 62.5%, 75%, 71.4%, 66.6% and 68.7% were the digits for sensitivity, specificity, PPV, NPV and accuracy respectively.

TABLE 9: STRATIFICATION OF DIAGNOSTIC ACCURACY OF RIPASA SCORE VERSUS ASA SCORE OF PATIENTS

N = 472

ASA Score	RIPASA SCORE * HISTOPATHOLOGY					
			HISTOPATHOLOGY DISEASED	NOT DISEASED	Total	
ASA SCORE I	RIPASA SCORE	POSITIVE	196 (TP)	15 (FP)	211	Sensitivity = 87.9% Specificity = 93.6% PPV= 92.9% NPV= 88.9% Accuracy = 90.7%
		NEGATIVE	27 (FN)	218 (TN)	245	
	Total		223	233	456	
ASA SCORE II	RIPASA SCORE	POSITIVE	5 (TP)	2 (FP)	7	Sensitivity = 62.5% Specificity = 75% PPV= 71.4% NPV= 66.6% Accuracy = 68.7%
		NEGATIVE	3 (FN)	6 (TN)	9	
	Total		8	8	16	

Table 10 chalks out that 385 patients came up with a complain duration of or less than 48 hours. 184 complainers were having true appendicitis: 165 were proved to have appendicitis +ive by RIPASA score and lab. results both, while the rest 19 were shown –ive by RIPASA but +ive by histopathology. 201 patients were not diseased, among whom 188 were proven by both the modules, while 13 were shown +ive by RIPASA but –ive by histopathology. Sensitivity, specificity, PPV, NPV and accuracy of the test in this case were 89.6%, 93.5%, 92.6%, 90.8% and 91.6% respectively.

The table further manifests that 87 patients have complain of the disease for more than 48 hours. Out of 47 patients who were finally diagnosed with appendicitis (true appendicitis), 36 were confirmed by both RIPASA and histopathology, while the rest 11 were reported only by histopathology, the RIPASA score have shown them with no appendicitis. Moreover, 40 patients were not diseased (false appendicitis), but 36 were confirmed by both modalities, while the rest were reported only by lab. results, the RIPASA have declared them appendicitis +ive. Sensitivity was 76.6%, specificity and PPV were similar with a digit of 90%. NPV and accuracy were 76.5% and 82.7% respectively (Table 10).

TABLE 10: STRATIFICATION OF DIAGNOSTIC ACCURACY OF RIPASA SCORE VERSUS DURATION OF COMPLAIN OF PATIENTS
N = 472

Duration of Complain	RIPASA SCORE * HISTOPATHOLOGY				
			HISTOPATHOLOGY DISEASED	NOT DISEASED	Total
≤ 48 hours	RIPASA SCORE	POSITIVE	165 (TP)	13 (FP)	178
		NEGATIVE	19 (FN)	188 (TN)	207
	Total		184	201	385
> 48 hours	RIPASA SCORE	POSITIVE	36 (TP)	4 (FP)	40
		NEGATIVE	11(FN)	36 (TN)	47
	Total		47	40	87

Sensitivity = 89.6%
Specificity = 93.5%
PPV= 92.6%
NPV= 90.8%
Accuracy = 91.6%

Sensitivity = 76.6%
Specificity = 90%
PPV= 90%
NPV= 76.5%
Accuracy = 82.7%

DISCUSSION

Our findings were confirmed by Butt et al. (2014)[14] who determined sensitivity, specificity and accuracy of 96.7%, 93.0% and 95.1% respectively. Nanjundaish et al. (2014)[15] stated that RIPASA scoring system proved to be significantly authentic for Asian population in detecting acute appendicitis with sensitivity and specificity of 96.2% and 85.7% respectively and thus showing concurrence to our results. Barrientos et al. (2018)[16] found a sensitivity and PPV of 93.3% and 91.8% respectively by RIPASA score in detection of the mentioned disease. Bhatnagar and Chavan in 2018[17] wrote that RIPASA score provide authentic results and must be used by surgeons for Asian patients. The above studies are in conformity with the results drawn from our research.

Oztas and Asena, 2021[18] reported no negative appendectomy among the patients with high RIPASA score, while respondents with high Alvarado score have negative appendectomy of 2.8%. They further stated that NPV is higher in RIPASA score (60%) than Alvarado score (45.3%). NPV for RIPASA score is more due to patient's history, duration of symptoms, pain in the right lower quadrant, guarding, Rosving's sign, and urine test. Karami et al., 2017[19], Wahab et al., 2020 [20] and Dezfui et al., 2020 [21] stated that NPV for the RIPASA score range between 10.1% to 97.6%. Pogorelic et al. (2020) [22] and Douglas et al. (2000) [23] reported that patients having right lower quadrant pain but with low RIPASA score must be excluded from having the acute appendicitis. The results of the above research work are in agreement with ours.

Chisti et al. (2020) [24] from their research work which was conducted on the efficacy of RIPASA score found 87.78% sensitivity, 76.47% specificity and 85.98% accuracy in India and thus comparable to our results. A study conducted by Maksoud et al., 2017 [25] in Kingdom of

Saudi Arabia reported 96% sensitivity of RIPASA score. Salahuddin and Quershi, 2022 [26] in their study at Karachi showed sensitivity, specificity, and diagnostic accuracy of 95.98%, 91.67% and 95.57% respectively, thus the above findings are at par with ours.

CONCLUSION

RIPASA scoring system showed more than 85% of sensitivity, specificity, PPV, NPV and accuracy for almost all of the studied parameters. Patients with ASA score II have accuracy and NPV less than 70%. This diagnostic method is superior in its accuracy, sensitivity and specificity and a reliable diagnosis source.

RECOMMENDATION

RIPASA grading system should be implemented as a regular diagnostic tool in our hospitals emergencies. It will lessen patient morbidity, hospital stay, financial burden on health system and general public of our lower middle income society. Moreover, it will prevent the use of imaging examination and tools, which can give birth to other health consequences.

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