

## Evaluation of Modified Alvarado Score in the Diagnosis of Acute Appendicitis at Baghdad Teaching Hospital.

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### ABSTRACT:

#### BACKGROUND :

Acute appendicitis is one of the most common causes of abdominal surgical emergencies. It is associated with high morbidity and occasionally mortality related to failure of making an early diagnosis. Modified Alvarado Scoring System is a clinical score which aid in the diagnosis of acute appendicitis.

#### OBJECTIVE :

To evaluate the overall diagnostic value of Modified Alvarado Scoring System in patients with suspected acute appendicitis and to determine gender differences.

**Study design and Setting :** A prospective study was conducted in the surgical emergency unit of Baghdad Teaching hospital in a period of five months extending from 18<sup>th</sup> February to 18<sup>th</sup> July 2011

#### PATIENTS AND METHODS :

(100) consecutive patients above the age of (14) years old and of both genders with provisional diagnosis of acute appendicitis were subjected to interview questionnaire covering sociodemographic and clinical characteristics revealing 7 variables based on the Modified Alvarado Scoring System , summation of all scores were calculated for each patient before underwent surgery and all operated appendices were sent for histopathology.

#### RESULTS:

The total number of included sample were (100) patients , (57%) were females and (43%) were males , (60%) were in the age group of (15-24) years old , (49%) were admitted to hospital within (6-12) hours after onset of symptoms . (87%) had Modified Alvarado Score of  $\geq 7$  (57.5% females, 42.5% males) while (13%) had Modified Alvarado Score of  $< 7$  (53.9% females, 46.1% males) . Out of those (87%) patients with Modified Alvarado Score  $\geq 7$  , (92%) patients had acute appendicitis and (8%) patients had normal appendix on histopathological examination. The negative appendectomy rate for patients with score  $\geq 7$  was 8.1%. While patients with Modified Alvarado Score  $< 7$  were (13%), only (46.1%) of them had acute appendicitis on histopathological examination giving a negative appendectomy rate of 53.9%. The sensitivity , specificity , accuracy and positive predictive value in males were ( 85.4%) , (0%) ,(81.4%) and (94.6%) respectively while in females were (100%) , (58.3%) , (91.2%) and (90%) respectively .

The overall sensitivity , specificity , accuracy , negative appendectomy rate and positive predictive value were (93%) , (50%) , (87%) , (14%) and (91.9%) respectively .

#### CONCLUSION:

Modified Alvarado Scoring System is helpful in the diagnosis of acute appendicitis.

**KEY WORDS:** alvarado, appendicitis

### INTRODUCTION:

Acute appendicitis is one of the most common surgical emergencies in both developed and developing countries<sup>(1)</sup>, with a life time prevalence of approximately 1 in 7 world-wide.

Its incidence is 1.5 – 1.9 \ 1000 in male and female population <sup>(2)</sup>.

Patients with acute appendicitis may present with different symptoms and signs varying from non-specific vague abdominal pain to typical findings of right lower quadrant pain , tenderness and rebound tenderness<sup>(3)</sup>.This variability has been attributed to a series of possible causes , including patient's age , inflammation severity

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and perforation, or a combination of these factors<sup>(4)</sup>.

The diagnosis of acute appendicitis is purely based on history, clinical examination and some laboratory investigations. Imaging techniques have been shown to add very little<sup>(5)</sup>. Acute appendicitis is associated with high morbidity and occasionally mortality related to failure of making an early diagnosis<sup>(2)</sup>. Surgery for acute appendicitis is the most frequent operation performed (10%) of all emergency abdominal operations<sup>(6)</sup>. A certain diagnosis can only be obtained at surgery and after pathological examination of surgical specimen<sup>(5)</sup>.

A negative appendectomy rate of 20 – 40 % has been reported in literature and many surgeons advocate early surgical intervention for the treatment of acute appendicitis to avoid perforation<sup>(7)</sup>. Removing normal appendix is an economic burden on both patients and health resources. Misdiagnosis and delay in surgery can lead to complications like perforation and finally peritonitis<sup>(8)</sup>.

In order to reduce the negative appendectomy rate, various scoring systems have been developing to support the diagnosis of acute appendicitis. One of the scoring systems is the Alvarado Scoring System which is purely based on history, clinical examination and few laboratory tests and is very easy to apply<sup>(9)</sup>.

The Modified Alvarado Scoring System has been reported to be a cheap and quick diagnostic tool in patients with acute appendicitis<sup>(10)</sup>.

The original Alvarado score describes a possible total of 10 points, but those medical facilities that are unable to perform a differential white blood cell count, are using a Modified Alvarado Score with total score of 9 points which could be not as accurate as the original score. The high diagnostic value of the score has been confirmed

in a number of studies across the world<sup>(4,7)</sup>. The consensus is that the Alvarado Score is a non-invasive, safe, diagnostic method, which is simple, reliable repeatable, and able to guide the clinician in the management of the cases<sup>(9)</sup>.

### AIMS OF THE STUDY:

- 1) To evaluate the overall diagnostic value of Modified Alvarado Scoring System in patients with provisional diagnosis of acute appendicitis.
- 2) To determine any gender differences in the diagnostic value of Modified Alvarado Scoring System among patients with suspected acute appendicitis.

### PATIENTS AND METHODS:

A prospective study was conducted at the surgical emergency unit of Baghdad Teaching Hospital over a period of five months extending from the 18<sup>th</sup> of February to 18<sup>th</sup> of July 2011. The study sample had been selected from patients who were admitted to surgical emergency unit of Baghdad Teaching Hospital after 3:00 p.m. until 8:00 a.m. . One hundred consecutive patients above the age of fourteenth years and of both sexes presented with provisional diagnosis of acute appendicitis were included in this study. Patients presented with urological, gynecological or other surgical problems including patients with a mass in the right iliac fossa and those who had no histopathological results were excluded from the study.

A specially designed questionnaire was filled for each patient containing general information regarding sociodemographic characteristic, duration of symptoms and clinical characteristics, revealing 7 variables based on the Modified Alvarado Scoring System (three symptoms, three signs and one investigation)<sup>(7)</sup>

**Modified Alvarado Scoring System**

|             | Mnemonic (MANTREL)                      | Score |
|-------------|---|-------|
| Symptoms    | Migratory right iliac fossa pain        | 1     |
|             | Nausea \ Vomiting                       | 1     |
|             | Anorexia                                | 1     |
| Signs       | Tenderness in right iliac fossa         | 2     |
|             | Rebound tenderness in right iliac fossa | 1     |
|             | Elevated temperature $\geq 37.3$ c°     | 1     |
| Laboratory  | Leukocytosis $\geq 10 \times 10^9/L$    | 2     |
| Total Score |   | 9     |

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Summation of all scores were calculated for each patient. The score played no role in the management of patients. The diagnosis of acute appendicitis was made clinically and the decision to operate was done independently by the surgeon on call or surgical team and all patients underwent appendectomy according to the hospital protocol. All operated appendices were sent for histopathological examination. For the purpose of statistical analysis; the patients were categorized into two groups:

Group 1: consisted of patients having Modified Alvarado Scoring System of  $\geq 7$  (clinically positive appendicitis).

Group 2: consisted of patients having Modified Alvarado Scoring System of  $< 7$  (clinically

negative appendicitis). The collected data were analyzed by (SPSS) version 16. The overall sensitivity, specificity, accuracy and positive predictive value of score were calculated, and for females and males separately based on histopathological results of appendectomy.

### RESULTS:

This study included (100) patients with clinical features suggestive of acute appendicitis. Among those patients (57%) were females and (43%) were males. Female to male ratio was 1.33:1. The mean age of patients was  $24.12 \pm 7.98$  years. The age of the patients included in this study range from (15-46) years— and the highest percentage of patients (60%) were of younger age group (15-24) years as shown in figure (I).

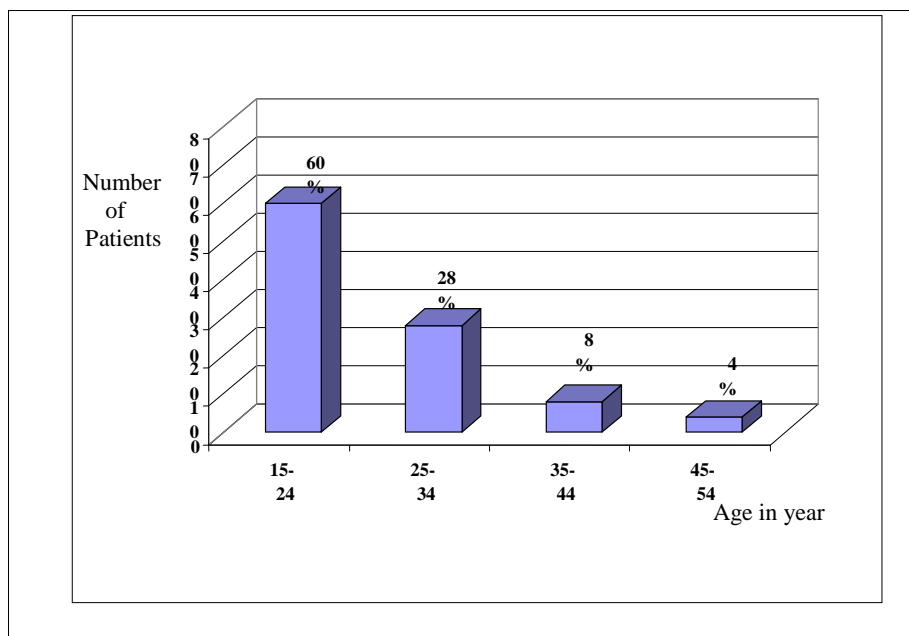


Figure I: Distribution of the studied sample regarding the age

According to the onset of the disease, the highest percentage of patients (49%) were admitted to hospital within (6-12) hours and the lowest

percentage of patients (4%) were admitted after (24) hours, as shown in table (1).

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**Table 1: Distribution of the studied sample regarding the onset of disease.**

| Time (hours) | Number of Patients | Percentage |
|--------------|--------------------|------------|
| < 6          | 35                 | 35%        |
| 6-12         | 49                 | 49%        |
| 13-24        | 12                 | 12%        |
| >24          | 4                  | 4%         |
| Total        | 100                | 100%       |

The distribution of the patients according to the results of Modified Alvarado Score demonstrate that the highest percentage of patients (87%) had Modified Alvarado Score of  $\geq 7$ , as shown in table (2).

**Table 2: Distribution of patients according to Modified Alvarado Score.**

| Score | Number of patients | Percentage |
|-------|--------------------|------------|
| 5     | 5                  | 5%         |
| 6     | 8                  | 8%         |
| 7     | 60                 | 60%        |
| 8     | 23                 | 23%        |
| 9     | 4                  | 4%         |
| Total | 100                | 100%       |

Out of these (87) patients with score  $\geq 7$ , (80) patients had histologically proven acute appendicitis, while (7) patients had histologically normal appendix. Patients with positive histopathology, (45) of them (56.25%) were females, while (35) patients (43.75%) were males. Patients having negative histopathology, (5) of them (71.5%) were females while (2) patients (28.5%) were males. Negative appendectomy rate for patients with Modified Alvarado Score  $\geq 7$  was 8.1% as shown in table (3).

**Table 3: Gender distribution of results of histopathology for patients with Modified Alvarado Score  $\geq 7$ .**

| Gender      | Positive histopathology | Percentage | Negative histopathology | Percentage | Negative appendectomy rate |
|-------------|-------------------------|------------|-------------------------|------------|----------------------------|
| Female n=50 | 45                      | 56.25%     | 5                       | 71.5%      | 10%                        |
| Male n=37   | 35                      | 43.75%     | 2                       | 28.5%      | 5.4%                       |
| Total n=87  | 80                      | 100%       | 7                       | 100%       | 8.1%                       |

Out of (13) patients with Modified Alvarado Score  $< 7$ . (6) Patients had histologically proven acute appendicitis, while (7) patients had histologically normal appendix. All (6) patients with positive histopathology were males, while in patients with normal appendix, all (7) patients were females. Negative appendectomy rate for patients with score  $< 7$  was 53.9% as shown in table (4).

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**Table 4: Gender distribution of results of histopathology for patients with Modified Alvarado Score < 7.**

| Gender        | Positive histopathology | Percentage | Negative histopathology | Percentage | Negative appendectomy rate |
|---------------|-------------------------|------------|-------------------------|------------|----------------------------|
| Female<br>n=7 | 0                       | 0%         | 7                       | 100%       | 100%                       |
| Male<br>n=6   | 6                       | 100%       | 0                       | 0%         | 0%                         |
| Total<br>n=13 | 6                       | 100%       | 7                       | 100%       | 53.9%                      |

The total number of patients who underwent appendectomy was (100) patients , among them acute appendicitis was confirmed in (86%) patients , comprised of (80) patients with score of  $\geq 7$  (true + ve) and (6) patients with score of  $< 7$  (false - ve) , while normal appendix was found in (14%) patients , comprised of (7) patients with score of  $\geq 7$  (false +ve) and (7) patients with score of  $< 7$  (true - ve) .

Out of (86) patients, regardless of their Modified Alvarado Score, with confirmed appendicitis by histopathology, (52.4%) were females, and (47.6%) were males. On the other hand, out of (14) patients with non-appendicitis , (85.7%) were females and (14.3%) were males. Accordingly the negative appendectomy rate in female patients was (21.05%) while in male patients was (4.65%) , as shown in table (5) .

**Table 5: Gender distribution of results of histopathology for all patients.**

| Gender         | Appendicitis patients(n=86) | Percentage | Non- appendicitis patients (n=14) | Percentage | Negative appendectomy rate |
|----------------|-----------------------------|------------|-----------------------------------|------------|----------------------------|
| Female<br>n=57 | 45                          | 52.4%      | 12                                | 85.7%      | 21.05%                     |
| Male n=43      | 41                          | 47.6%      | 2                                 | 14.3%      | 4.65%                      |
| Total<br>n=100 | 86                          | 100%       | 14                                | 100%       | 14%                        |

So the sensitivity , specificity , accuracy and positive predictive value in males were ( 85.4%) , (0%) , (81.4%) and (94.6%) respectively , while

in females were (100%), (58.3%) , (91.2%)and (90%) respectively, as shown in figures (2) and (3) respectively .

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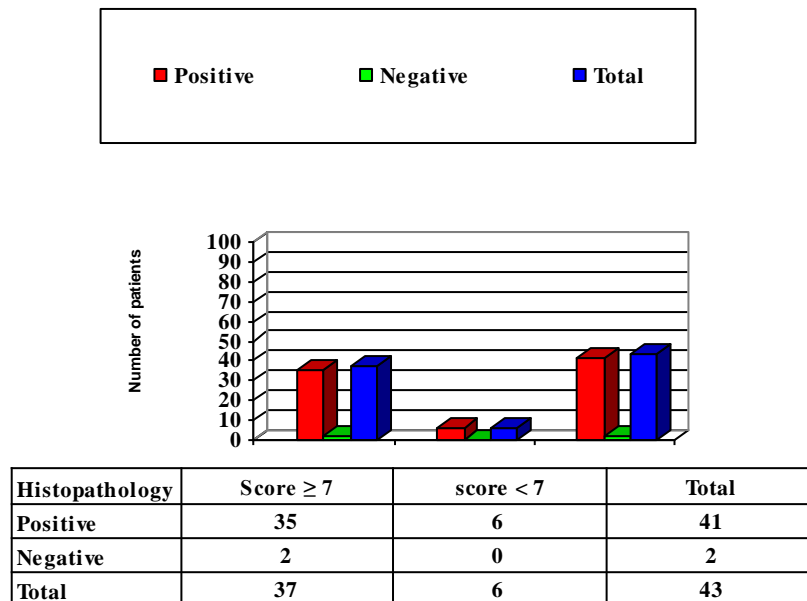


Figure 2: Validity of Modified Alvarado Score applied for male patients

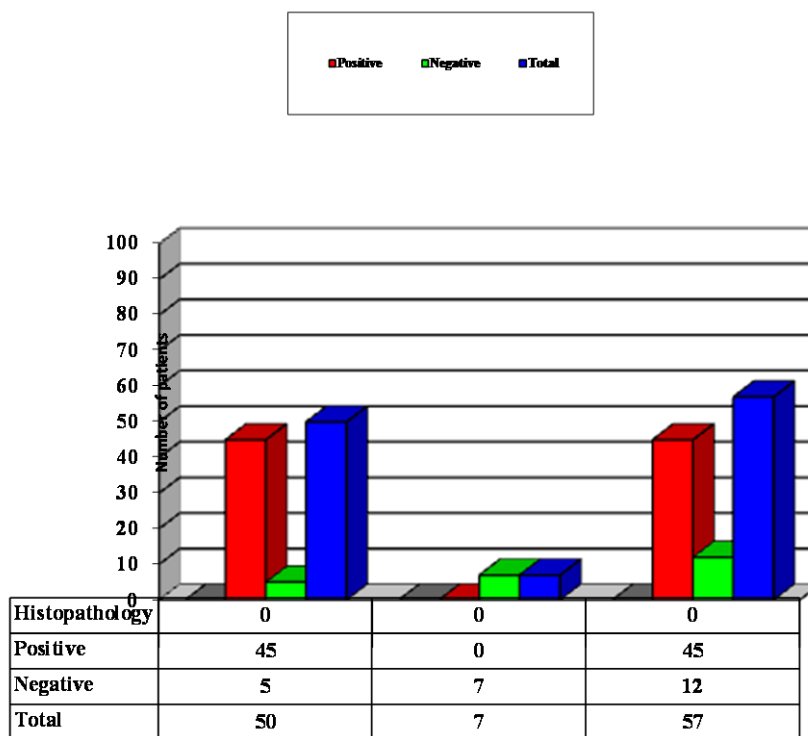


Figure 3: Validity of Modified Alvarado Score applied for female patients.

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The overall sensitivity, specificity, accuracy, positive predictive value and total negative appendectomy rate of Modified Alvarado Score were (93%), (50%), (87%), (91.9%) and (14%)

respectively. The validity of Modified Alvarado Score for the (100) patients with provisional diagnosis of acute appendicitis is shown in figure (4).

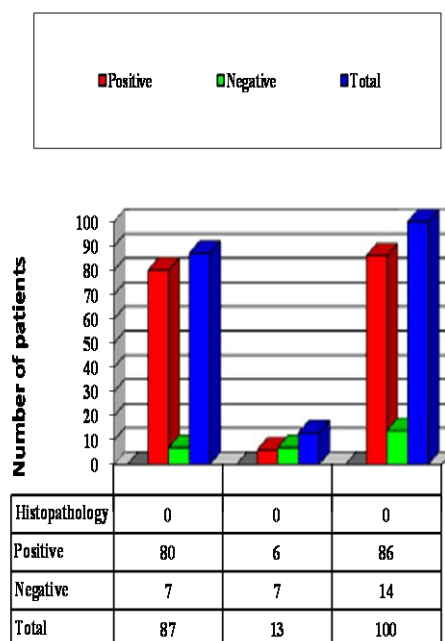


Figure 4: Validity of Modified Alvarado Score applied for all patients

### DISCUSSION:

The goal of the clinical decision process in patients who have acute abdominal pain is to make a correct diagnosis in the fastest and cheapest way. The proper diagnosis of patients with suspected acute appendicitis is based on separation of patients with high likelihood of acute appendicitis that operation is warranted for them and those who may be safely observed or discharged<sup>(7)</sup>.

The female predominance in this study is in agreement with the finding of (Khan and Rehman)<sup>(11)</sup> and contradict the findings of other studies conducted in Kenya, Nigeria and Ethiopia<sup>(12,13,14)</sup> which found male dominance. This may be attributed to the fact that female patients with right iliac fossa pain have a wide range of differential diagnosis as a result acute appendicitis may be over-diagnosed.

The majority of patients (88%) were aged between (15-34) years. This finding is

comparable with the results of (Khan and Rehman)<sup>(11)</sup> and (Alishahetal)<sup>(15)</sup>, acute appendicitis was frequently seen in patients in their second through fourth decades of life.

According to the onset of presentation to emergency department, (49%) of patients were admitted within (6-12) hours, this could be explained due to health awareness of our patients. This contradict the finding of (Kanumba et al)<sup>(16)</sup> and (Ibramallah et al)<sup>(17)</sup>, the majority of patients had been admitted more than (24) hours. This delay in seeking medical consultation were attributed to delay in referral from peripheral hospitals<sup>(16,17)</sup>.

Several studies validated the Modified Alvarado Score System using different cut-off points<sup>(18)</sup>. In this study, the cut-off points was 7 and (87%) of the patients had Modified Alvarado Score of  $\geq 7$  and only (13%) had a score of  $< 7$  (5-6). This result is nearly compatible to the finding of

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(Kalan et al) [7] that (83.6%) of the included patients were of high Modified Alvarado Score ( $\geq 7$ ) while the remaining (16.4%) with score of ( $< 7$ ). The results of (Khawaja et al) <sup>(19)</sup>, who conducted a study at Muhammed Medical College in Pakistan, and found that out of (100) patients, (62) patients (62%) had a score of  $> 7$ , among them (15) patients (24%) were females and (47) patients (76%) were males.

It seems that Modified Alvarado Score is more helpful in females than males. (Sanei et al) <sup>(20)</sup>, in their study, showed that Modified Alvarado Score is not accurate for the determination of acute appendicitis in females and (Kanumba et al) <sup>(16)</sup>, in Tanzania, found that the negative appendectomy rate was slightly higher in females (38.3%) than in males (26.8%). They attributed this to misdiagnosis that had occurred in females of reproductive age groups, where other pelvic diseases would make diagnosis difficult.

The overall negative appendectomy rate in this study was (14%), this is supported by literature <sup>(8,21)</sup>, showed that if negative appendectomy rate is less than (10-15%), then the surgeon is operating too few patients, thus increasing the risk of complications. This total negative appendectomy was nearly compatible to (Macklin et al) <sup>(22)</sup> in their prospective study (14%), lower than that of (Kanumba et al) <sup>(16)</sup> (33.1%) and higher than that of (Yegane et al) <sup>(23)</sup> in Iran (9.1%).

The overall sensitivity, specificity and accuracy rates of Modified Alvarado Score in this study were (93%), (50%) and (87%) respectively, which is higher than that revealed by (Jan H and Khan J) <sup>(24)</sup> in Pakistan (49.65%, 77.5% and 67%) respectively. (GwyhoL) <sup>(25)</sup>, in his study found that the sensitivity and specificity of Alvarado Score were (91.6%) and (84.7%) respectively. He noted that patients in extreme age groups are more likely to be falsely diagnosed for acute appendicitis, also (Alishah et al) <sup>(15)</sup> in their study, found that the overall sensitivity was (88.9%) and the negative appendectomy rate decreased with the rise in the score. The results of (Kanumba et al) <sup>(16)</sup> in Tanzania, showed that the use of Modified Alvarado Score provided high degree of diagnostic accuracy. The sensitivity, specificity and accuracy rates of their study were (94.1%, 90.4% and 92.9%) respectively, while the results of (Yegane et al) <sup>(23)</sup> in Iran, found that Modified Alvarado

Score were neither sensitive or specific (sensitivity 55%, specificity 59%). Diagnosis was based on surgeon's decision was more sensitive than Alvarado Score.

### CONCLUSION:

- Modified Alvarado Scoring System is easy, simple and cheap complementary aid for supporting the diagnosis of acute appendicitis.
- The overall Modified Alvarado Scoring System showed high sensitivity rate, low specificity rate, high accuracy rate, high positive predictive value and low negative appendectomy rate.
- The Modified Alvarado Scoring System is more helpful in female patients as compared to male patients by showing high accuracy rate for females as compared to males.

### Recommendations:

- 1) Modified Alvarado Scoring System could be used to improve the diagnostic accuracy of acute appendicitis and subsequently reduce the negative appendectomy and complication rates.
- 2) The uses of this score in the diagnosis of acute appendicitis in female patients should be supplemented by additional investigations like abdominal ultrasound or diagnostic laparoscopy.
- 3) It is very handy in primary health care centers and peripheral hospitals where follow up facilities are sparse.

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